



Memo

Date: Tuesday, August 31, 2021

Project: GEI Sacramento County Small Communities Expected Annual Damage (EAD) Analysis
Task 5: Compute incremental EAD for various levee improvements within the Small
Community Flood Risk Reduction Program (SCFRRP)

To: Jeff Twitchell, PE

From: Jaime Lubeck, PE (CA Lic. #88118) and Joanna Leu, PE

Subject: SCFRRP Sacramento County and City of Isleton EAD Analysis and Results, Final

Situation

The California Department of Water Resources (DWR) created the Small Community Flood Risk Reduction Program (SCFRRP) as a result of the first Central Valley Flood Protection Plan (CVFPP) published in 2012. The SCFRRP is a local assistance program and its objective is to reduce flood risk for small communities protected by the State Plan of Flood Control (SPFC) facilities. In the CVFPP, small communities are defined as developed areas with a population between 200 and 10,000 residents. The program is funded over multiple phases. The first phase provides funding to complete feasibility studies of structural and nonstructural flood risk reduction projects. Within Sacramento County and the City of Isleton, the following small communities received funding from Phase 1:

- Courtland
- Hood
- Locke
- East Walnut Grove
- West Walnut Grove and Ryde
- Isleton

Task

GEI Consultants Inc. (GEI) is supporting Sacramento County and the City of Isleton with completing the DWR SCFRRP feasibility studies for the small communities that received Phase 1 funding as listed in the previous section. As part of the DWR SCFRRP feasibility studies, GEI requested that HDR conduct pre- and post-project expected annual damage (EAD) analysis using the Flood Damage Reduction Analysis (HEC-FDA) computer program v1.4.2 developed by the U.S. Army Corps of Engineers' (USACE) for five communities within the unincorporated area of Sacramento County and one community within the City of Isleton as shown in Figure 1. This analysis utilizes input data developed for DWR's 2017 and 2022 CVFPP Updates as well as from GEI.

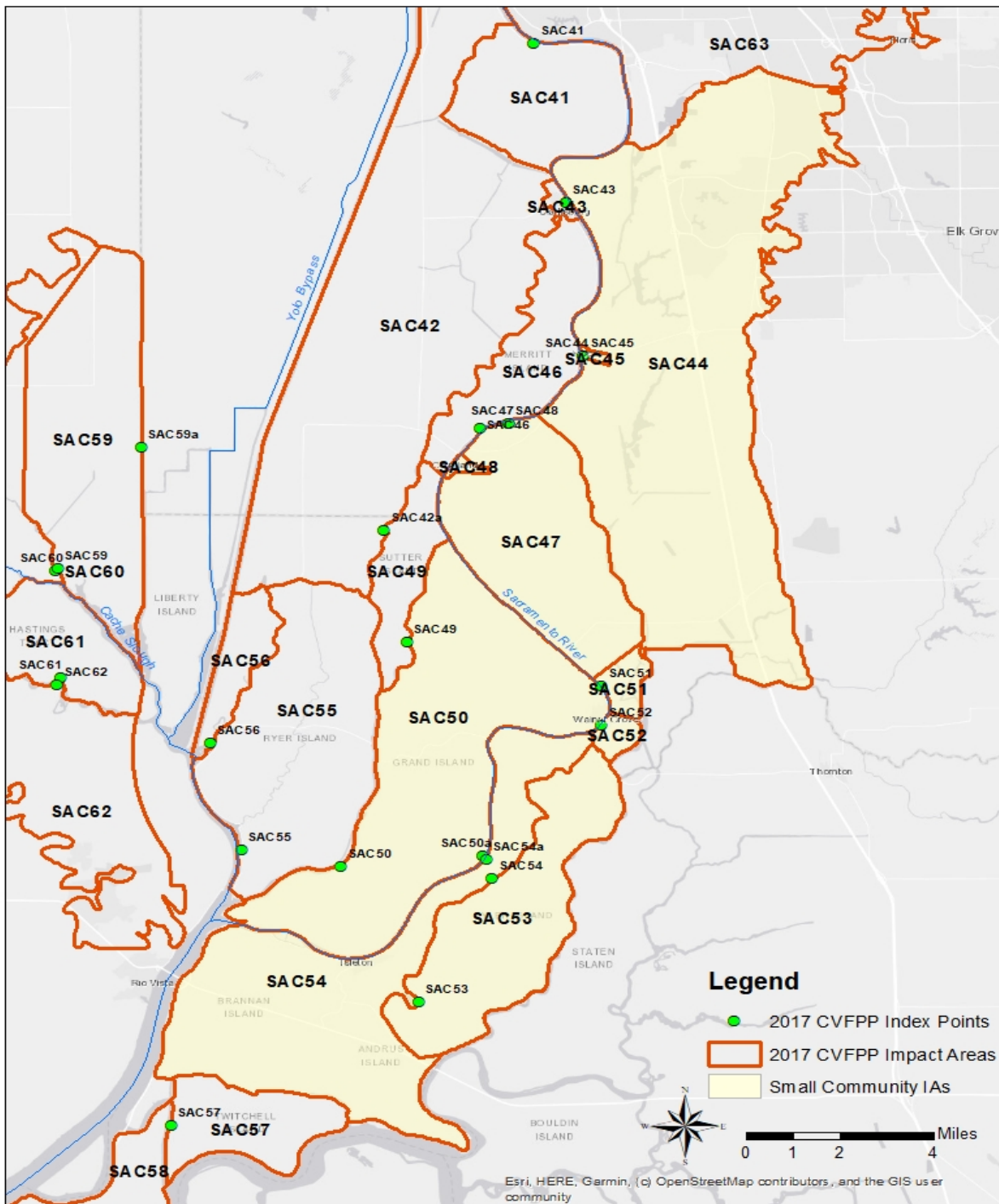


Figure 1. SCFRRP study areas (highlighted in yellow) – 2017 CVFPP impact areas and associated index points

HDR completed the following tasks:

1. Developed HEC-FDA models using impact areas and index points developed for the 2022 CVFPP Update.
2. Coordinated and developed additional HEC-FDA models using new impact areas and existing CVFPP index points developed for this analysis. New impact area delineations were developed by GEI to isolate EAD results for designated areas. The new impact areas are defined later in this memorandum.
3. Incorporated hazard input data developed for the 2017 and 2022 CVFPP Updates. Flow- and stage-frequency functions were developed for an existing condition and a future condition. The future condition includes a projection of future flood hazard based on precipitation, temperature, and sea-level trends consistent with results presented in the 2017 CVFPP Update.
4. Integrated updated levee fragility curves developed for the 2022 CVFPP Update and this analysis which represent the performance of the levees.
5. Computed EAD and annual exceedance probability (AEP) for the existing and future conditions for each evaluation scenario.

This memorandum summarizes the flood damage results and documents the work completed.

To complete this work, a DWR data sharing agreement was required to use existing 2017 and 2022 CVFPP Updates modeling tools and data. Sacramento County and its consultants (HDR and GEI) coordinated with DWR to use existing 2017 and 2022 CVFPP Updates modeling tools and data. Data sharing agreements were signed by Sacramento County, City of Isleton, and DWR.

Evaluation scenarios

For this analysis, a total of eight scenarios were evaluated, four scenarios for the current flood hazard condition and four scenarios for the future flood hazard condition. The eight evaluation scenarios analyzed are described below and summarized in Table 1.

Current condition

Scenarios 1 through 4 as listed in Table 1 include the existing conditions of the flood management systems in the Central Valley and includes projects that have been authorized and have funding, or that have started construction or implementation under the 2022 CVFPP Update. The scenarios for the current condition vary based on applying levee improvements ranging from current (or existing) to fractional, partial, or full.

The current (or existing) and partial-improvement levee fragility curves are based on the 2022 CVFPP Update without- and with-project conditions developed by DWR and its consultants (AECOM, 2021). The fractional- and full-improvement scenarios are based on levee fragility curves developed by GEI (GEI, 2021a, 2021b). Here, a full-improvement curve is representative of levees improved to at least a 100-year protection level for the Federal Emergency Management Agency (FEMA) certification.

Future condition

Scenarios 5 through 8 as listed in Table 1 have the same features as the current condition scenarios, with the addition of the effects of inland climate change projections and sea level rise. The inland climate change effects applied include a median estimate consistent with methods and results of the 2017 CVFPP Update.

Table 1. SCFRRP Sacramento County and City of Isleton evaluation scenarios

ID (1)	Scenario name (2)	Levee condition (3)	Climate condition (4)	Project description (5)
1	2022_WoP	Current	Current	Existing state of the system
2	Fraction-Improvement	Fractional	Current	Existing state of the system + fractional levee improvements
3	Partial-Improvement	Partial	Current	Existing state of the system + partial levee improvements
4	Full-Improvement	Full	Current	Existing state of the system + full levee improvements
5*	Future_WoP	Current	Future median climate change projection	Existing state of the system + effects of climate change
6*	Future_Fraction-Improvement	Fractional	Future median climate change projection	Existing state of the system + fractional levee improvements + effects of climate change
7*	Future_Partial-Improvement	Partial	Future median climate change projection	Existing state of the system + partial levee improvements + effects of climate change
8*	Future_Full-Improvement	Full	Future median climate change projection	Existing state of the system + full levee improvements + effects of climate change

*2017 CVFPP future climate condition (with climate change projection)

The levee fragility curves used for this analysis are included as Attachment A.

Model configuration

HDR developed HEC-FDA models for each index point/impact area pair and configured them with existing (developed for the 2022 CVFPP Update) and updated input information as appropriate for each scenario. The impact areas and index points form the basic framework for the flood risk analysis. Flood risk is computed at an index point, which is a location that represents the interface between an impact area and the channel.

For the 2022 CVFPP Update, the index points and impact areas were not changed from those used in the 2017 CVFPP Update. In addition to the CVFPP impact areas, GEI requested that HDR compute EAD for new impact areas within SAC50, SAC53, and SAC54 as shown in Figure 2 and Figure 3. The existing CVFPP impacts were divided into two or three new impact areas to separate the rural area (designated with “_N1” or “_N2”) from the more developed area (designated with “_URB”). The index points and impact areas used in this analysis are presented in Table 2.

To represent each combination of the levee and climate conditions, a plan was configured in HEC-FDA. HEC-FDA model plans were configured for each index point for each levee condition and climate condition as described in the previous section. The HEC-FDA plans were configured in two HEC-FDA models for each index point to accommodate the eight evaluation

scenarios; one HEC-FDA model for current conditions and one HEC-FDA model for future conditions.

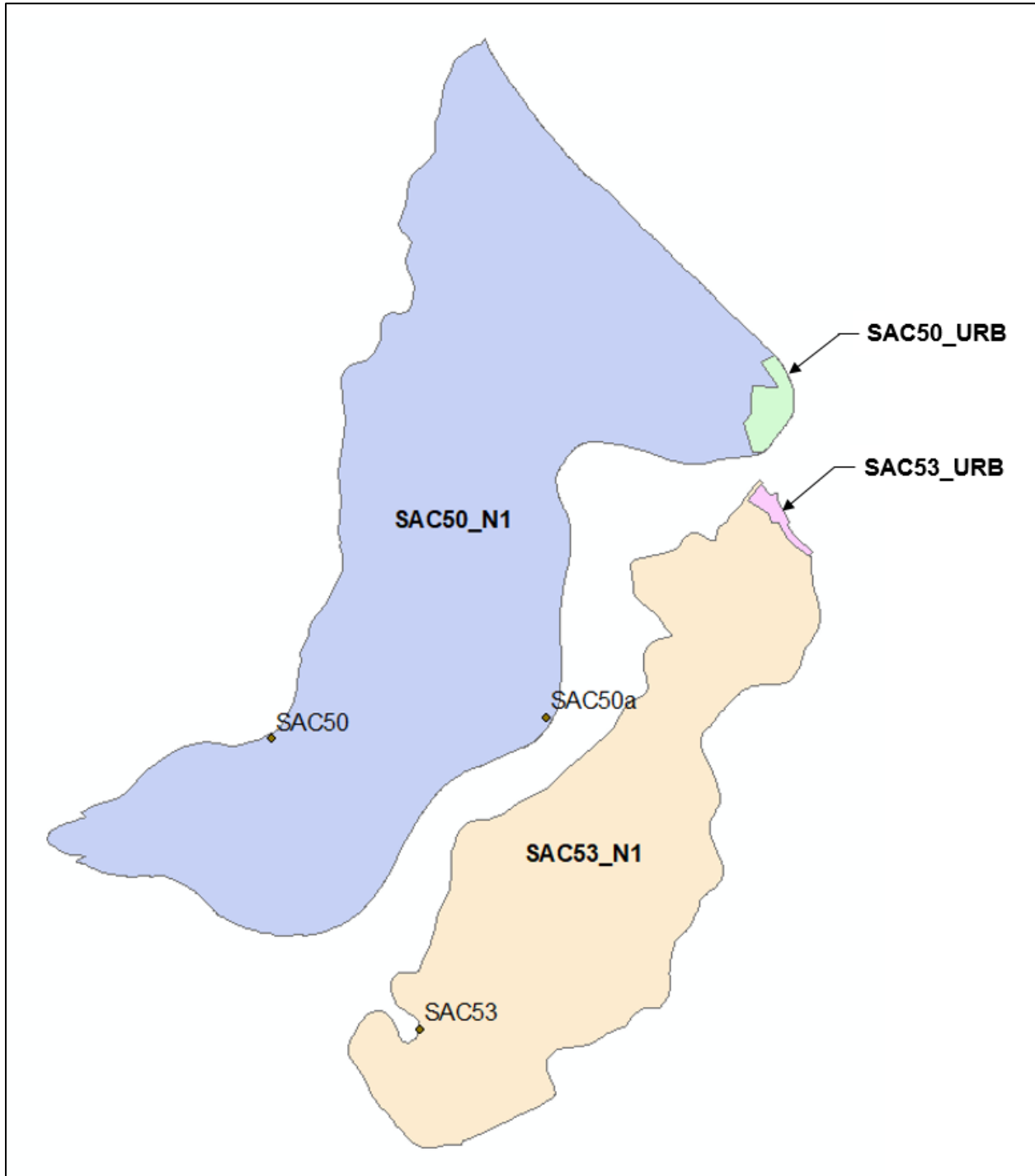


Figure 2. SCFRRP new impact areas within CVFPP impact areas SAC50 and SAC53 – West and East Walnut Grove

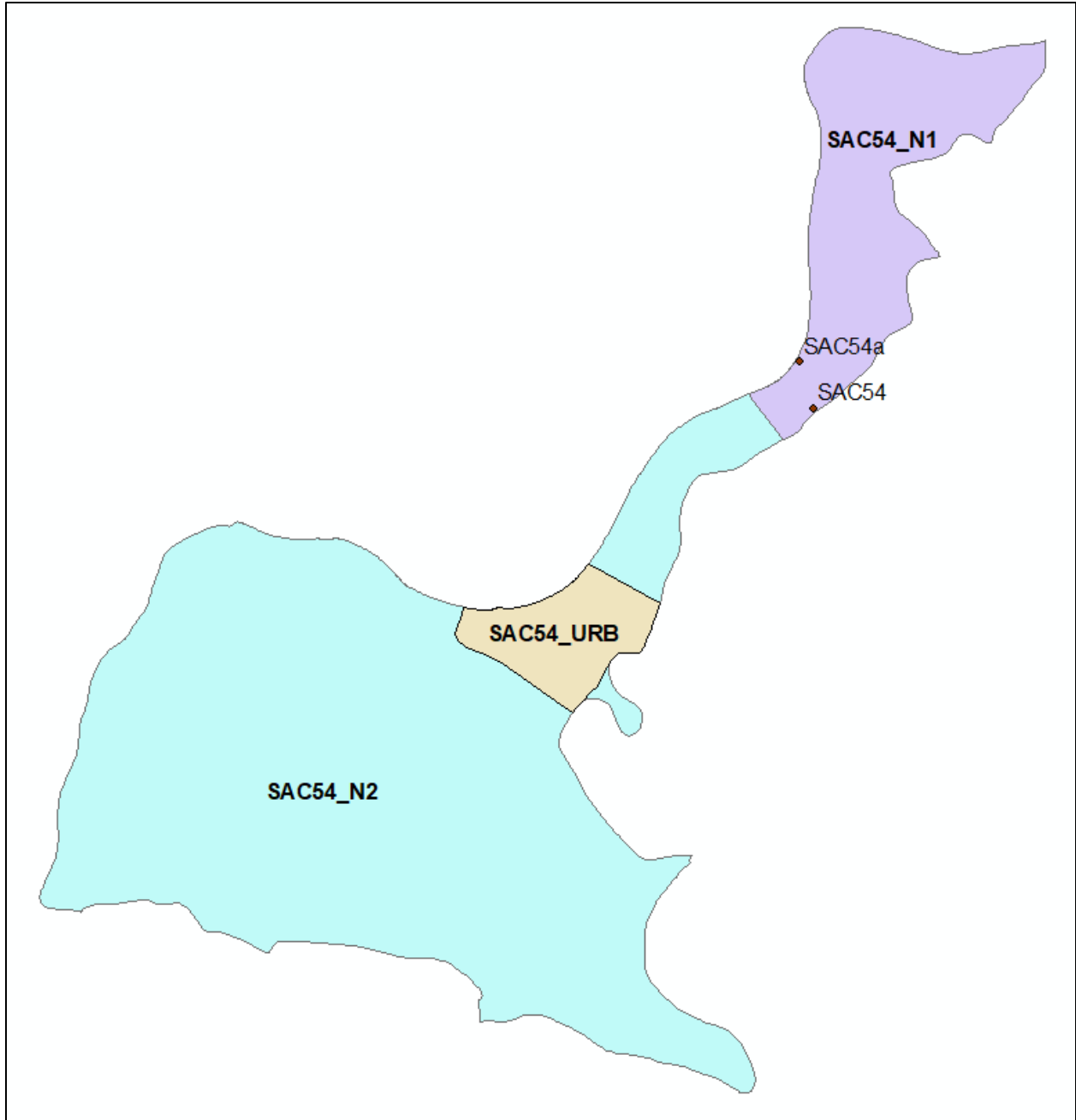


Figure 3. SCFRRP new impact areas within CVFPP impact area SAC54 – City of Isleton

Table 2. SCFRRP study areas based on the 2017 and 2022 CVFPP impact areas and associated index points

Impact area (1)	Associated index point(s) (2)	Small community study area (3)	Existing CVFPP impact area? (4)
Sacramento County			
SAC44	SAC44	Hood	Yes
SAC45	SAC45	Hood	Yes
SAC47	SAC47	Courtland	Yes
SAC48	SAC48	Courtland	Yes
SAC50	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	Yes
SAC50_N1	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	No
SAC50_URB	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	No
SAC51	SAC51	Locke	Yes
SAC52	SAC52	East Walnut Grove	Yes
SAC53	SAC53	East Walnut Grove	Yes
SAC53_N1	SAC53	East Walnut Grove	No
SAC53_URB	SAC53	East Walnut Grove	No
City of Isleton			
SAC54	SAC54, SAC54a	City of Isleton	Yes
SAC54_N1	SAC54, SAC54a	City of Isleton	No
SAC54_N2	SAC54, SAC54a	City of Isleton	No
SAC54_URB	SAC54, SAC54a	City of Isleton	No

The analysis inputs for the existing and future conditions scenarios as well as the source data are summarized in Table 3 and Table 4. HEC-FDA models are mostly based on existing information used for the 2022 CVFPP Update. The flow-stage relationships include the sea level rise assumption at the Golden Gate used for the 2022 CVFPP Update. However, the analysis inputs do not include the 2022 CVFPP Update inland climate change analysis. Since the 2022 CVFPP climate change results have not been published or peer reviewed by DWR, the future in-channel flow-frequency curves that include inland climate change used in this analysis are consistent with those used in the 2017 CVFPP Update. The hydrologic and hydraulic analysis inputs are provided in the enclosed spreadsheet file “20210831_GEI_SacCounty_SCFRRP_EAD_Analysis_Results.xlsx” dated August 31, 2021.

Table 3. Current condition analysis inputs and data sources

Analysis input (1)	Data sources			
	2022_WoP (2)	Fraction-Improvement (3)	Partial-Improvement (4)	Full-Improvement (5)
In-channel frequency curves	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update
Channel flow to stage (flow-stage) relationships	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update
Channel water surface elevation to floodplain water surface elevation relationships	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update
Levee fragility curves	2022 CVFPP Update without-project	GEI	2022 CVFPP Update with-project	GEI
Structure inventory	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update

Table 4. Future condition analysis inputs and data sources

Analysis input (1)	Data sources			
	Future_WoP (2)	Future_Fraction-Improvement (3)	Future_Partial-Improvement (4)	Future_Full-Improvement (5)
In-channel frequency curves	2017 CVFPP Update with-climate change	2017 CVFPP Update with-climate change	2017 CVFPP Update with-climate change	2017 CVFPP Update with-climate change
Channel flow to stage relationships	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update
Channel water surface elevation to floodplain water surface elevation relationships	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update
Levee fragility curves	2022 CVFPP Update without-project	GEI	2022 CVFPP Update with-project	GEI
Structure inventory	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update	2022 CVFPP Update

Changed from the current condition to account for the future climate condition

Results

EAD was computed for each index point using HEC-FDA. For impact areas with more than one index point, the index-point specific results for each impact area were evaluated. Then, the maximum flood risk (maximum EAD) was adopted and reported for that specific impact area. This adopted value is shown in Table 5 and Table 6. All damages and costs are reported in quarter 1 2020 dollars.

More detailed information including EAD by index point and damage category is provided in the enclosed spreadsheet file “20210831_GEI_SacCounty_SCFRRP_EAD_Analysis_Results.xlsx” dated August 31, 2021. Additional results including AEP by current and future conditions are included in Attachment B. These values are shown by impact area. Details of the inventory are included in Attachment C. Inventory information includes structures, vehicle and roadway, and crop details.

Table 5. Current condition EAD

Impact area (1)	Small community study area (2)	EAD, \$1,000 2020 USD			
		2022_WoP (3)	Fraction-Improvement (4)	Partial-Improvement (5)	Full-Improvement (6)
SAC44	Hood	6,253.4	3,935.6	242.0	93.7
SAC45	Hood	2,331.4	1,355.1	76.2	20.3
SAC47	Courtland	38,544.1	27,557.0	1,601.8	318.1
SAC48	Courtland	6,365.6	4,553.9	265.0	53.9
SAC50_N1	West Walnut Grove-Ryde on Grand Island	7,345.9	N/A	252.5	50.7
SAC50_URB	West Walnut Grove-Ryde on Grand Island	1,377.1	N/A	49.8	12.1
SAC51	Locke	362.8	N/A	36.3	10.2
SAC52	East Walnut Grove	3,546.1	N/A	157.2	71.7
SAC53_N1	East Walnut Grove	5,824.4	N/A	310.4	145.5
SAC53_URB	East Walnut Grove	3,948.6	N/A	224.6	110.7

Impact area (1)	Small community study area (2)	EAD, \$1,000 2020 USD			
		2022_WoP (3)	Fraction- Improvement (4)	Partial- Improvement (5)	Full- Improvement (6)
SAC54_N1	City of Isleton	2,162.3	N/A	231.2	126.5
SAC54_N2	City of Isleton	13,791.2	N/A	1,334.2	676.4
SAC54_URB	City of Isleton	6,439.2	N/A	677.4	366.6

Table 6. Future condition EAD

Impact area (1)	Small community study area (2)	EAD, \$1,000 2020 USD			
		Future_WoP (3)	Future_Fraction- Improvement (4)	Future_Partial- Improvement (5)	Future_Full- Improvement (6)
SAC44	Hood	65,687.7	54,377.0	2,472.3	961.8
SAC45	Hood	5,829.6	3,727.5	192.0	51.8
SAC47	Courtland	81,118.1	62,286.6	3,232.5	775.3
SAC48	Courtland	14,125.8	10,861.3	562.6	135.6
SAC50_N1	West Walnut Grove-Ryde on Grand Island	35,571.5	N/A	1,538.4	527.5
SAC50_URB	West Walnut Grove-Ryde on Grand Island	8,743.7	N/A	396.4	146.0
SAC51	Locke	1,533.4	N/A	132.0	39.8
SAC52	East Walnut Grove	17,088.4	N/A	776.8	237.3
SAC53_N1	East Walnut Grove	23,623.0	N/A	8,710.5	7,334.6
SAC53_URB	East Walnut Grove	18,404.5	N/A	6,816.1	5,741.8
SAC54_N1	City of Isleton	14,271.1	N/A	3,000.9	2,326.2
SAC54_N2	City of Isleton	53,783.1	N/A	15,549.3	12,035.0
SAC54_URB	City of Isleton	35,572.4	N/A	8,655.3	6,705.5

References

AECOM. 2021. Technical Memorandum, CVFPP Update – Levee Fragility Curves. Prepared for California Department of Water Resources (DWR). March 5.

DWR. 2017. Draft 2017 CVFPP Update – Technical Analyses Summary Expanded Report. July.

GEI. 2021a. Sac County Fragility Curves_Part Impv_Tool.xlsx. Provided to HDR on January 26. [MS Excel Tool prepared by GEI describing the levee fragility curve information for partial improvements by segment].

GEI. 2021b. Urban Project_With-Improvement Tool HDR 2-23-21 JET 3-2-21 Top 9 SPFC Only.xlsx. Provided to HDR on March X. [MS Excel spreadsheet prepared by GEI describing the levee fragility curve information for full improvements by index point].

URS. 2015. 2014 Performance Curve Development, Non-Urban Levee Evaluations Project Task Orders U119, Technical Memorandum. Prepared for DWR. January 28.

Attachment A. Levee fragility curves

The levee fragility curves for this analysis are summarized in Table A-1. The WoP (or current) and partial-improvement levee fragility curves are based on the 2022 CVFPP Update without- and with-project conditions developed by DWR and its consultants (AECOM, 2021). The fractional- and full-improvement levee fragility curves were developed by GEI (GEI, 2021a, 2021b).

Table A-1. Levee fragility curves for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area(s) (1)	Index point (2)	Levee condition (3)	Probability of failure (4)																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
SAC44	SAC44	Elevation, ft	13.00	14.07	15.14	16.21	17.28	18.35	19.42	20.49	21.56	22.63	23.70	24.26	24.82	25.38	25.94	26.50	27.06	27.62	28.18	28.74	29.30	N/A	
		WoP	0.00%	0.34%	0.88%	1.72%	3.08%	5.27%	8.79%	14.41%	23.22%	36.58%	55.59%	83.84%	94.13%	97.88%	99.24%	99.74%	99.91%	99.97%	99.99%	100.00%	100.00%	100.00%	N/A
		Fractional	0.00%	0.18%	0.46%	0.91%	1.64%	2.81%	4.71%	7.77%	12.68%	20.41%	32.23%	75.34%	91.05%	96.77%	98.85%	99.60%	99.87%	99.96%	99.99%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.40%	2.80%	3.21%	3.62%	4.02%	4.43%	4.83%	5.23%	5.63%	100.00%	100.00%	N/A
		Elevation, ft	13.00	13.81	14.62	15.43	16.24	17.05	17.86	18.67	19.48	20.29	21.10	21.91	22.72	23.53	24.34	25.15	25.96	26.77	27.58	28.39	29.30	29.31	29.31
		Full	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%	0.09%	0.14%	0.20%	0.31%	0.46%	0.71%	0.98%	1.51%	2.05%	2.59%	3.13%	3.67%	100.00%	100.00%
SAC45	SAC45	Elevation, ft	13.00	14.07	15.14	16.21	17.28	18.35	19.42	20.49	21.56	22.63	23.70	24.26	24.82	25.38	25.94	26.50	27.06	27.62	28.18	28.74	29.30	N/A	
		WoP	0.00%	0.34%	0.88%	1.72%	3.08%	5.27%	8.79%	14.41%	23.22%	36.58%	55.59%	83.84%	94.13%	97.88%	99.24%	99.74%	99.91%	99.97%	99.99%	100.00%	100.00%	100.00%	N/A
		Fractional	0.00%	0.18%	0.46%	0.91%	1.64%	2.81%	4.71%	7.77%	12.68%	20.41%	32.23%	75.34%	91.05%	96.77%	98.85%	99.60%	99.87%	99.96%	99.99%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.40%	2.80%	3.21%	3.62%	4.02%	4.43%	4.83%	5.23%	5.63%	100.00%	100.00%	N/A
		Elevation, ft	13.00	13.81	14.62	15.43	16.24	17.05	17.86	18.67	19.48	20.29	21.10	21.91	22.72	23.53	24.34	25.15	25.96	26.77	27.58	28.39	29.30	29.31	29.31
		Full	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.04%	0.06%	0.09%	0.14%	0.20%	0.31%	0.46%	0.71%	0.98%	1.51%	2.05%	2.59%	3.13%	3.67%	100.00%	100.00%
SAC47	SAC47	Elevation, ft	8.20	9.60	11.00	12.40	13.80	15.20	16.60	18.00	19.40	20.80	22.20	22.87	23.54	24.21	24.88	25.55	26.22	26.89	27.56	28.23	28.90	N/A	
		WoP	0.00%	0.25%	0.65%	1.28%	2.30%	3.94%	6.59%	10.86%	17.67%	28.30%	44.30%	79.65%	92.59%	97.32%	99.04%	99.66%	99.89%	99.97%	99.99%	100.00%	100.00%	100.00%	N/A
		Fractional	0.00%	0.17%	0.45%	0.88%	1.57%	2.69%	4.52%	7.46%	12.20%	19.68%	31.20%	74.87%	90.85%	96.69%	98.81%	99.58%	99.86%	99.96%	99.99%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.35%	2.72%	3.09%	3.45%	3.82%	4.18%	4.54%	4.91%	5.27%	100.00%	100.00%	N/A
		Elevation, ft	8.20	9.24	10.27	11.31	12.34	13.38	14.41	15.45	16.48	17.52	18.55	19.59	20.62	21.66	22.69	23.73	24.76	25.80	26.83	27.87	28.90	28.91	28.91
		Full	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.14%	0.23%	0.38%	0.65%	0.96%	1.58%	2.20%	2.81%	3.43%	4.05%	100.00%	100.00%
SAC48	SAC48	Elevation, ft	8.20	9.60	11.00	12.40	13.80	15.20	16.60	18.00	19.40	20.80	22.20	22.87	23.54	24.21	24.88	25.55	26.22	26.89	27.56	28.23	28.90	N/A	
		WoP	0.00%	0.25%	0.65%	1.28%	2.30%	3.94%	6.59%	10.86%	17.67%	28.30%	44.30%	79.65%	92.59%	97.32%	99.04%	99.66%	99.89%	99.97%	99.99%	100.00%	100.00%	100.00%	N/A
		Fractional	0.00%	0.17%	0.45%	0.88%	1.57%	2.69%	4.52%	7.46%	12.20%	19.68%	31.20%	74.87%	90.85%	96.69%	98.81%	99.58%	99.86%	99.96%	99.99%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.35%	2.72%	3.09%	3.45%	3.82%	4.18%	4.54%	4.91%	5.27%	100.00%	100.00%	N/A
		Elevation, ft	8.20	9.24	10.27	11.31	12.34	13.38	14.41	15.45	16.48	17.52	18.55	19.59	20.62	21.66	22.69	23.73	24.76	25.80	26.83	27.87	28.90	28.91	28.91
		Full	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.14%	0.23%	0.38%	0.65%	0.96%	1.58%	2.20%	2.81%	3.43%	4.05%	100.00%	100.00%
SAC50_N1 SAC50_URB	SAC50	Elevation, ft	2.50	3.88	5.26	6.64	8.02	9.40	10.78	12.16	13.54	14.92	16.30	16.59	16.88	17.17	17.46	17.75	18.04	18.33	18.62	18.91	19.20	N/A	
		WoP	0.00%	0.33%	0.85%	1.67%	2.99%	5.11%	8.51%	13.92%	22.35%	35.06%	52.98%	89.56%	97.69%	99.49%	99.89%	99.98%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.15%	2.31%	2.47%	2.64%	2.80%	2.96%	3.12%	3.28%	3.45%	100.00%	100.00%	N/A
		Elevation, ft	2.50	3.34	4.17	5.01	5.84	6.68	7.51	8.35	9.18	10.02	10.85	11.69	12.52	13.36	14.19	15.03	15.86	16.70	17.53	18.37	19.20	19.21	
		Full	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.05%	0.08%	0.11%	0.17%	0.26%	0.40%	0.63%	0.91%	1.37%	1.92%	100.00%	100.00%
	SAC50a	Elevation, ft	8.60	9.40	10.20	11.00	11.80	12.60	13.40	14.20	15.00	15.80	16.60	17.27	17.94	18.61	19.28	19.95	20.62	21.29	21.96	22.63	23.30	N/A	
		WoP	0.00%	0.26%	0.67%	1.32%	2.36%	4.05%	6.77%	11.15%	18.12%	28.96%	45.14%	80.13%	92.83%	97.43%	99.09%	99.68%	99.89%	99.97%	99.99%	100.00%	100.00%	100.00%	N/A
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.63%	3.28%	3.92%	4.56%	5.20%	5.83%	6.46%	7.09%	7.71%	100.00%	100.00%	N/A
		Elevation, ft	8.60	9.34	10.07	10.81	11.54	12.28	13.01	13.75	14.48	15.22	15.95	16.69	17.42	18.16	18.89	19.63	20.36	21.10	21.83	22.57	23.30	23.21	
		Full	0.00%	0.01%	0.02%	0.03%	0.04%	0.06%	0.08%	0.12%	0.17%	0.25%	0.36%	0.53%	0.78%	1.06%	1.57%	2.08%	2.58%	3.09%	3.60%	4.11%	4.62%	100.00%	100.00%

Impact area(s) (1)	Index point (2)	Levee condition (3)	Probability of failure (4)																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
SAC51	SAC51	Elevation, ft	8.70	9.72	10.74	11.76	12.78	13.80	14.82	15.84	16.86	17.88	18.90	19.23	19.56	19.89	20.22	20.55	20.88	21.21	21.54	21.87	22.20	N/A	
		WoP	0.00%	0.10%	0.25%	0.48%	0.87%	1.49%	2.51%	4.18%	6.90%	11.33%	18.50%	50.81%	70.36%	82.19%	89.36%	93.71%	96.36%	97.98%	98.98%	99.60%	100.00%	N/A	
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.24%	2.49%	2.74%	2.99%	3.24%	3.49%	3.74%	3.99%	4.23%	100.00%	N/A	
		Elevation, ft	8.70	9.38	10.05	10.73	11.40	12.08	12.75	13.43	14.10	14.78	15.45	16.13	16.80	17.48	18.15	18.83	19.50	20.18	20.85	21.53	22.20	22.21	
		Full	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%	0.03%	0.05%	0.06%	0.09%	0.12%	0.17%	0.25%	0.34%	0.48%	0.71%	0.95%	1.36%	1.84%	2.32%	100.00%	
SAC52	SAC52	Elevation, ft	11.70	12.22	12.74	13.26	13.78	14.30	14.82	15.34	15.86	16.38	16.90	17.72	18.54	19.36	20.18	21.00	21.82	22.64	23.46	24.28	25.10	N/A	
		WoP	0.00%	0.25%	0.65%	1.28%	2.30%	3.94%	6.59%	10.86%	17.67%	28.30%	44.30%	79.88%	92.75%	97.41%	99.08%	99.68%	99.89%	99.97%	99.99%	100.00%	100.00%	N/A	
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	3.20%	4.41%	5.61%	6.79%	7.96%	9.13%	10.28%	11.42%	12.55%	100.00%	N/A	
		Elevation, ft	11.70	12.37	13.04	13.71	14.38	15.05	15.72	16.39	17.06	17.73	18.40	19.07	19.74	20.41	21.08	21.75	22.42	23.09	23.76	24.43	25.10	25.11	
		Full	0.00%	0.05%	0.07%	0.10%	0.14%	0.20%	0.28%	0.39%	0.56%	0.80%	1.04%	1.52%	2.00%	2.47%	2.95%	3.43%	3.91%	4.39%	4.87%	5.35%	5.83%	100.00%	
SAC53_N1 SAC53_URB	SAC53	Elevation, ft	-1.10	0.21	1.52	2.83	4.14	5.45	6.76	8.07	9.38	10.69	12.00	12.11	12.22	12.33	12.44	12.55	12.66	12.77	12.88	12.99	13.10	N/A	
		WoP	0.00%	0.34%	0.88%	1.72%	3.08%	5.27%	8.79%	14.41%	23.22%	36.58%	55.59%	83.72%	94.05%	97.84%	99.22%	99.73%	99.91%	99.97%	99.99%	100.00%	100.00%	N/A	
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.09%	2.20%	2.31%	2.41%	2.52%	2.63%	2.73%	2.84%	2.95%	100.00%	N/A	
		Elevation, ft	-1.10	-0.39	0.32	1.03	1.74	2.45	3.16	3.87	4.58	5.29	6.00	6.71	7.42	8.13	8.84	9.55	10.26	10.97	11.68	12.39	13.10	13.11	
		Full	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%	0.04%	0.05%	0.07%	0.10%	0.15%	0.21%	0.30%	0.43%	0.64%	0.89%	100.00%	
SAC54_N1 SAC54_N2 SAC54_URB	SAC54	Elevation, ft	0.00	1.40	2.80	4.20	5.60	7.00	8.40	9.80	11.20	12.60	14.00	14.15	14.30	14.45	14.60	14.75	14.90	15.05	15.20	15.35	15.50	N/A	
		WoP	0.00%	0.19%	0.49%	0.97%	1.73%	2.98%	5.00%	8.30%	13.66%	22.28%	36.00%	61.32%	76.66%	85.96%	91.60%	95.03%	97.12%	98.40%	99.19%	99.68%	100.00%	N/A	
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	2.07%	2.15%	2.23%	2.32%	2.40%	2.48%	2.57%	2.65%	2.73%	100.00%	N/A	
		Elevation, ft	0.00	0.78	1.55	2.33	3.10	3.88	4.65	5.43	6.20	6.98	7.75	8.53	9.30	10.08	10.85	11.63	12.40	13.18	13.95	14.73	15.50	15.51	
		Full	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.05%	0.07%	0.10%	0.15%	0.22%	0.33%	0.49%	0.75%	1.01%	100.00%	
	SAC54a	Elevation, ft	8.60	9.22	9.83	10.45	11.06	11.68	12.29	12.91	13.52	14.14	14.75	15.36	15.97	16.58	17.19	17.80	18.41	19.02	19.63	20.24	20.85	21.46	N/A
		WoP	0.00%	0.25%	0.65%	1.28%	2.30%	3.94%	6.59%	10.86%	17.67%	28.30%	44.30%	79.83%	92.72%	97.39%	99.07%	99.68%	99.89%	99.97%	99.99%	100.00%	100.00%	N/A	
		Partial	0.00%	0.01%	0.03%	0.05%	0.09%	0.16%	0.27%	0.44%	0.73%	1.21%	1.99%	3.03%	4.06%	5.08%	6.10%	7.11%	8.11%	9.10%	10.08%	11.06%	100.00%	N/A	
		Elevation, ft	8.60	9.33	10.05	10.78	11.50	12.23	12.95	13.68	14.40	15.13	15.85	16.58	17.30	18.03	18.75	19.48	20.20	20.93	21.65	22.38	23.10	23.11	
		Full	0.00%	0.03%	0.05%	0.07%	0.10%	0.14%	0.20%	0.28%	0.41%	0.61%	0.87%	1.21%	1.72%	2.22%	2.73%	3.23%	3.74%	4.24%	4.75%	5.25%	5.75%	100.00%	

Attachment B. Results – AEP and 1/AEP

Current condition

AEP and 1/AEP for the current condition is summarized in Table B-1.

Table B-1. Current condition AEP for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area (1)	Index point(s) (2)	Small community study area (3)	AEP				1/AEP			
			2022_WoP (4)	Fraction-Improvement (5)	Partial-Improvement (6)	Full-Improvement (7)	2022_WoP (8)	Fraction-Improvement (9)	Partial-Improvement (10)	Full-Improvement (11)
SAC44	SAC44	Hood	0.1135	0.0651	0.0037	0.0010	8.8	15.4	273.2	1,052.6
SAC45	SAC45	Hood	0.1135	0.0651	0.0037	0.0010	8.8	15.4	273.2	1,052.6
SAC47	SAC47	Courtland	0.1441	0.1028	0.0060	0.0012	6.9	9.7	167.2	862.1
SAC48	SAC48	Courtland	0.1449	0.1032	0.0060	0.0012	6.9	9.7	166.4	854.7
SAC50_N1	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	0.0507	N/A	0.0017	0.0003	19.7	N/A	588.2	3,333.3
SAC50_URB	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	0.0506	N/A	0.0017	0.0003	19.8	N/A	588.2	3,333.3
SAC51	SAC51	Locke	0.0334	N/A	0.0034	0.0009	29.9	N/A	296.7	1,087.0
SAC52	SAC52	East Walnut Grove	0.0762	N/A	0.0034	0.0016	13.1	N/A	298.5	613.5
SAC53_N1	SAC53	East Walnut Grove	0.2308	N/A	0.0115	0.0051	4.3	N/A	86.8	197.2
SAC53_URB	SAC53	East Walnut Grove	0.2303	N/A	0.0115	0.0051	4.3	N/A	86.7	197.2
SAC54_N1	SAC54, SAC54a	City of Isleton	0.1660	N/A	0.0158	0.0079	6.0	N/A	63.3	126.7
SAC54_N2	SAC54, SAC54a	City of Isleton	0.1663	N/A	0.0158	0.0079	6.0	N/A	63.3	126.9
SAC54_URB	SAC54, SAC54a	City of Isleton	0.1660	N/A	0.0158	0.0079	6.0	N/A	63.3	126.7

Future condition

AEP and 1/AEP for the future condition is summarized in Table B-2.

Table B-2. Future condition AEP for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area (1)	Index point(s) (2)	Small community study area (3)	AEP				1/AEP			
			Future_WoP (4)	Future_Fraction-Improvement (5)	Future_Partial-Improvement (6)	Future_Full-Improvement (7)	Future_WoP (8)	Future_Fraction-Improvement (9)	Future_Partial-Improvement (10)	Future_Full-Improvement (11)
SAC44	SAC44	Hood	0.2568	0.1624	0.0084	0.0022	3.9	6.2	118.8	446.4
SAC45	SAC45	Hood	0.2577	0.1626	0.0084	0.0022	3.9	6.2	118.8	446.4
SAC47	SAC47	Courtland	0.2898	0.2223	0.0116	0.0028	3.5	4.5	86.6	362.3
SAC48	SAC48	Courtland	0.2898	0.2223	0.0116	0.0028	3.5	4.5	86.6	362.3
SAC50_N1	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	0.2071	N/A	0.0087	0.0028	4.8	N/A	115.1	352.1
SAC50_URB	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	0.2071	N/A	0.0087	0.0028	4.8	N/A	115.1	352.1
SAC51	SAC51	Locke	0.1255	N/A	0.0108	0.0032	8.0	N/A	92.3	313.5
SAC52	SAC52	East Walnut Grove	0.3471	N/A	0.0157	0.0048	2.9	N/A	63.7	206.6
SAC53_N1	SAC53	East Walnut Grove	0.8067	N/A	0.2914	0.2446	1.2	N/A	3.4	4.1
SAC53_URB	SAC53	East Walnut Grove	0.8067	N/A	0.2914	0.2446	1.2	N/A	3.4	4.1
SAC54_N1	SAC54, SAC54a	City of Isleton	0.6228	N/A	0.1798	0.1391	1.6	N/A	5.6	7.2
SAC54_N2	SAC54, SAC54a	City of Isleton	0.6228	N/A	0.1798	0.1391	1.6	N/A	5.6	7.2
SAC54_URB	SAC54, SAC54a	City of Isleton	0.6228	N/A	0.1798	0.1391	1.6	N/A	5.6	7.2

Attachment C. Inventory summary

Structure inventory information including structure count and value is summarized by impact area in Table C-1. Columns 9 through 13 are reported in thousands of quarter 1 2020 dollars.

Table C-1. Structure inventory summary for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area (1)	Index point(s) (2)	Small community study area (3)	Structure count					Structure and contents value, \$1,000 2020 USD				
			Residential (4)	Commercial (5)	Industrial (6)	Public (7)	Total (8)	Residential (9)	Commercial (10)	Industrial (11)	Public (12)	Total (13)
SAC44	SAC44	Hood	16,357	144	286	254	17,041	7,402,855	328,378	642,891	484,029	8,858,153
SAC45	SAC45	Hood	104	4	7	2	117	25,107	2,317	14,141	1,090	42,655
SAC47	SAC47	Courtland	164	-	156	-	320	65,419	-	233,571	-	298,989
SAC48	SAC48	Courtland	98	10	25	15	148	29,471	5,078	21,036	11,649	67,234
SAC50_N1	SAC50, SAC50a	West Walnut Grove- Ryde on Grand Island	294	4	148	-	446	118,032	4,155	102,811	-	224,998
SAC50_URB	SAC50, SAC50a	West Walnut Grove- Ryde on Grand Island	219	6	4	5	234	94,812	3,936	6,651	3,232	108,633
SAC51	SAC51	Locke	41	23	4	3	71	13,170	7,151	1,252	960	22,532
SAC52	SAC52	East Walnut Grove	141	45	21	15	222	43,859	18,209	21,195	17,542	100,806
SAC53_N1	SAC53	East Walnut Grove	16	-	33	-	49	7,013	-	20,763	-	27,775
SAC53_URB	SAC53	East Walnut Grove	5	-	22	-	27	1,868	-	29,759	-	31,627
SAC54_N1	SAC54, SAC54a	City of Isleton	67	1	26	-	94	21,149	371	25,779	-	47,299
SAC54_N2	SAC54, SAC54a	City of Isleton	389	2	51	34	476	87,714	2,721	59,070	5,926	155,431
SAC54_URB	SAC54, SAC54a	City of Isleton	350	70	18	21	459	97,503	32,303	20,635	14,117	164,557

Vehicle and roadway inventory including vehicle count and value; highway miles and value; and street miles and value is summarized by impact area in Table C-2. Columns 5, 7, and 9 are reported in thousands of quarter 1 2020 dollars.

Table C-2. Vehicle and roadway inventory summary for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area (1)	Index point(s) (2)	Small community study area (3)	Vehicle count (4)	Vehicle value (5)	Highways miles (6)	Highways value (7)	Streets miles (8)	Streets value (9)
SAC44	SAC44	Hood	55,463	499,167	41.3	23,184	198.4	35,856
SAC45	SAC45	Hood	338	3,042	0.3	188	1.8	321
SAC47	SAC47	Courtland	956	8,604	2.7	1,501	24.5	4,433
SAC48	SAC48	Courtland	386	3,474	0.6	350	1.3	228
SAC50	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	2,124	19,116	17.0	9,549	29.4	5,311
SAC50 N1	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	1,438	12,942	15.8	8,858	27.3	4,937
SAC50_URB	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	686	6,174	1.2	692	2.1	374
SAC51	SAC51	Locke	154	1,386	-	-	2.6	463
SAC52	SAC52	East Walnut Grove	750	6,750	-	-	5.1	916
SAC53	SAC53	East Walnut Grove	87	783	-	-	19.3	3,489
SAC53 N1	SAC53	East Walnut Grove	63	567	-	-	17.5	3,170
SAC53_URB	SAC53	East Walnut Grove	24	216	-	-	1.8	319
SAC54	SAC54, SAC54a	City of Isleton	4,634	41,706	13.0	7,301	48.7	8,810
SAC54 N1	SAC54, SAC54a	City of Isleton	400	3,600	-	-	10.8	1,956
SAC54 N2	SAC54, SAC54a	City of Isleton	2,983	26,847	11.6	6,490	30.0	5,423
SAC54_URB	SAC54, SAC54a	City of Isleton	1,251	11,259	1.5	811	7.9	1,432

Crop inventory information including total crop value, total crop acreage, and crop class acreage by impact area is summarized by impact area in Table C-3. Column 4 is reported in thousands of quarter 1 2020 dollars. For more detailed crop information (i.e., crops by type), refer to enclosed spreadsheet.

Table C-3. Crop inventory summary by impact area for the SCFRRP Sacramento County and City of Isleton EAD analysis

Impact area (1)	Index point(s) (2)	Small community study area (3)	Total crop value (4)	Total crop acres (5)	Crop class, acres								
					Citrus (6)	Rice (7)	Vineyard (8)	Deciduous Fruits and Nuts (9)	Field (10)	Grain and Hay (11)	Pasture (12)	Truck, Nursery, and Berry (13)	Young Perennials (14)
SAC44	SAC44	Hood	36,230	12,601	16	-	4,121	667	1,355	1,047	4,560	754	81
SAC45	SAC45	Hood	1	2	-	-	-	-	2	-	0	-	-
SAC47	SAC47	Courtland	25,089	7,952	-	-	1,818	1,588	2,657	615	550	715	9
SAC48	SAC48	Courtland	11	5	-	-	-	1	1	4	-	-	-
SAC50_N1	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	34,415	13,649	-	-	1,824	1,958	5,015	1,132	3,416	188	117
SAC50_URB	SAC50, SAC50a	West Walnut Grove-Ryde on Grand Island	55	40	-	-	4	-	28	-	8	-	-
SAC51	SAC51	Locke	536	130	-	-	-	80	-	-	50	-	-
SAC52	SAC52	East Walnut Grove	891	248	-	-	35	92	-	106	-	-	15
SAC53_N1	SAC53	East Walnut Grove	8,698	6,162	-	-	374	130	2,280	2,139	263	977	-
SAC53_URB	SAC53	East Walnut Grove	8	9	-	-	-	-	4	-	-	5	-
SAC54_N1	SAC54, SAC54a	City of Isleton	8,668	1,883	-	-	649	573	210	-	381	70	-
SAC54_N2	SAC54, SAC54a	City of Isleton	14,871	9,682	-	-	941	143	5,295	174	2,856	272	-
SAC54_URB	SAC54, SAC54a	City of Isleton	267	460	-	-	1	-	441	-	5	13	-

Crop inventory information including crop value and crop acreage by crop class is summarized by impact area in Table C-4. Values are reported in thousands of quarter 1 2020 dollars. For more detailed crop information (i.e., crops by type), refer to enclosed spreadsheet.

Table C-4. Crop inventory summary by crop class for the SCFRRP Sacramento County and City of Isleton EAD analysis

Parameter (1)	Total (2)	Citrus (3)	Rice (4)	Vineyard (5)	Deciduous Fruits and Nuts (6)	Field (7)	Grain and Hay (8)	Pasture (9)	Truck, Nursery, and Berry (10)	Young Perennials (11)
Acres	52,826	16	-	9,767	5,233	17,287	5,218	12,089	2,993	223
Values	129,723	97	-	57,154	37,842	9,500	4,404	15,990	4,329	407