Attachment 9.5 – Supporting Documents

Flood Damage Reduction Costs and Benefits

Project E – Sierra National Forest Fuels Reduction Project

Madera Region – IRWM Implementation Grant Application

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Attachment 9.5, Empirical Analysis of Historical Fire and Post-Fire Flooding and Debris Flow Data

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Empirical analysis of historical fire and post-fire flooding and debris flow data

Fire occurrence and Size Probability

169 fires are recorded in the USFS databases for the Madera IRWMG area from 1911 – 2008. !69 fires in 98 years of record gives a rough average occurrence of 1.7 fires in any given year. However, many fires are very small and cause little impact to the forest or the hydrologic functions of the forest. A better measure of probability would account for the size of the fires that have occurred. For normally distributed data, this can be estimated with the following formula:

$$T = (n+1) / m \qquad (1)$$

Where T is the recurrence interval, n is the number of fires, and m is the rank of each fire. M is assigned a value of 1 for the largest fire, 2 for the second largest fire, and so on. However, an examination of the fire history data shows that fire size is not normally distributed. In fact, using the software "EasyFit," (Mathwave 2010) it is determined that the fire size distribution is best fit by a Log Pearson III distribution (Figure 1).

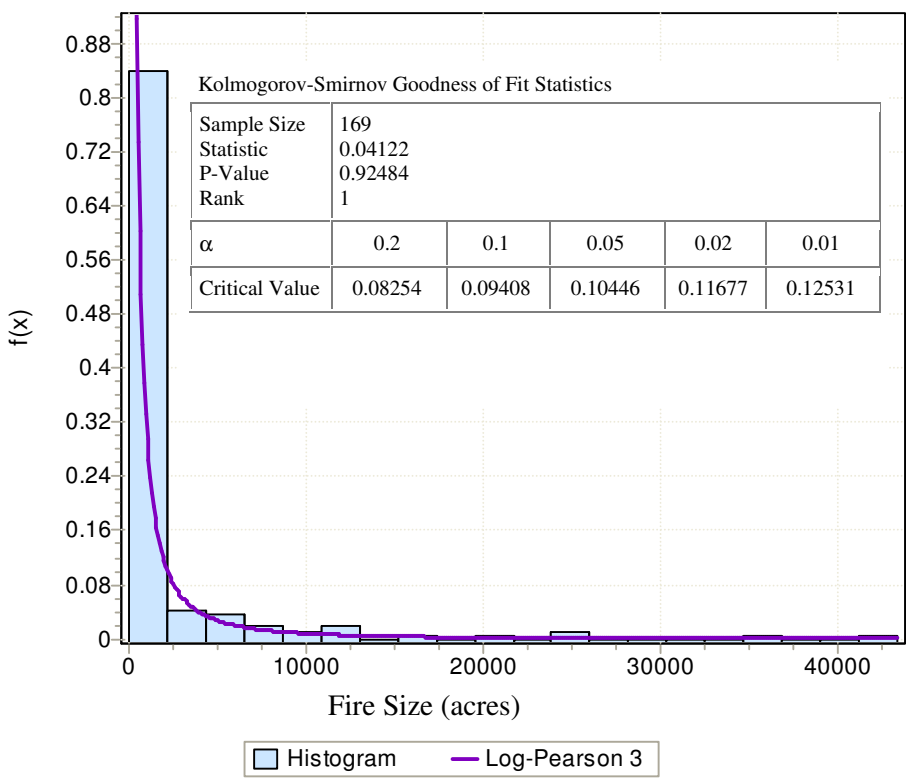

Figure 1. Fire size distribution and Log Pearson III Probability Density Function

To determine a fire size frequency, the largest fire from every year of record was used in a Log-Pearson III frequency analysis (similar to a flood frequency analysis, Table 1).

Table 1. Fire size probability analysis of the largest fires in the Madera IRWMG from USFS data.

Return period T (yr)	Annual Probability (percent)	Fire Size (acres)
1.05	95.2	18
1.11	90.1	39
1.25	80	102
2	50	657
5	20	4259
10	10	11363
25	4	32450
50	2	64021
100	1	118005
200	0.5	207167

Precipitation and Flow Frequency calculations

Precipitation frequency data used in this analysis was taken from the NOAA Atlas 2 (NOAA 1973). Methods described on page 15 of the Atlas were used when storm data was required that was not mapped.

Flow frequency data was taken from the Madera County Flood Insurance Study (FEMA 2008), when available, or was derived from the USGS regression equations for the Sierra Region (Waananen and Crippen 1977). The equations for the Sierra Region are:

$$Q2 = 0.24(A0.88)(P1.58)(H-0.80) \quad (2)$$
$$Q5 = 1.20(A0.82)(P1.37)(H-0.64) \quad (3)$$
$$Q10 = 2.63(A0.80)(P1.25)(H-0.58) \quad (4)$$
$$Q50 = 10.4(A0.78)(P1.06)(H-0.48) \quad (5)$$
$$Q100 = 15.7(A0.77)(P1.02)(H-0.43) \quad (6)$$
$$Q25 = 6.55(A0.79)(P1.12)(H-0.52) \quad (7)$$

Where A is the drainage area in square miles, P is the annual average precipitation, and H is the altitude index in thousands of feet.

Two major drainages exist within the project area: North Fork Willow Creek and the fresno River. The existing pre-burn discharges were determined using either equations (2) – (7) (Table 2). The USGS equations slightly under predict the published 100-year discharge. For consistency, and because there are no published values for other frequencies, the USGS results were used for further analysis.

Table 2. Flood Frequency for pre-burn existing conditions based on USGS regression equations and FEMA (2008).

Location	Regression Variables			Discharges (cfs)					
	A	P	H	Q2	Q5	Q10	Q25	Q50	Q100
NF Willow	16.9	44	3	474	1077	1513	2392	3075	4098
Fresno R @ 41	49.9	39	3	1044	2267	3156	5004	6399	8462
Fresno R @ 41 (FEMA 2008)				n/a	n/a	n/a	n/a	N/A	9630

Estimation of the number of acres that would burn at moderate to high severity

The size and spatial distribution of moderate to high severity burn areas is dependent on the soil moisture conditions at the time of the fire, the organic content of the top soil, amount of ground fuels, and the weather conditions. Absent the data required for this type of fire behavior modeling, an review of data provided by Burn Area Emergency Response (BAER) teams for the Stanislaus, Sierra, and Sequoia National Forest was performed. BAER reports are completed by USFS personnel once a fire is contained. Acres of burn severity are mapped in the field when possible, or by aerial reconnaissance for larger areas. BAER data for 28 fires from 2001 to 2010 were available (Table 3). Since the Stanislaus and Sequoia forests are subject to very similar weather patterns, have similar fuels types, and similar topography as the Sierra, these data are considered to be representative of project area. On average, 12 and 33 percent of burned areas are burned at high and moderate to high severity, respectively. These percentages were applied to the fire size when analyzing an event of a given return period

Runoff Response

There are numerous methods used to estimate post-fire runoff. The most frequently used are discussed here: http://forest.moscowfsl.wsu.edu/BAERTOOLS/ROADTRT/Peakflow/
Methods include geomorphic analysis combined with regional (At-a-station) hydraulic geometry curves, modeling using the Water Erosion Prediction Project (WEPP) model, TR-55 modelin

Table 2. Data from BAER reports on the Sequois, Sierra, and Stanislaus National Forests 2001-2010

Year	Forest	Fire	Acres Burned	Acres burned at moderate severity	Acres burned at high severity	Percent burned at high severity	Acres burned at moderate to high intensity	Percent burned at moderate to high severity	Design Storm Return Interval (yrs)	Design Storm Duration (hrs)	Design Storm Magnitude (in)	Pre-fire discharge (cfs/mi^2)	Post-fire discharge (cfs/mi^2)
2010	Sequoia	Canyon	9888	2606	2680	0.27	5286	0.53	n/a	n/a	n/a	n/a	n/a
2010	Sequoia	Sheep	8962	1071	157	0.02	1228	0.14	2	6	2.2	17	27
2010	Sequoia	bull	16448	9558	161	0.01	9719	0.59	2	6	1.6-2.8	4	5.66
2009	Stanislaus	knight	6133	1542	85	0.01	1627	0.27	25	6	2.4	20	25
2008	Sequoia	Piute	37026	12241	3655	0.10	15896	0.43	10	6	2.2-2.6	n/a	n/a
2008	Sequoia	Clover	15300	7001	855	0.06	7856	0.51	5	6	2.3	173	210
2008	Sierra	Oliver	2789	1453	430	0.15	1883	0.68	2	24	4	20.4	48.3
2008	Sierra	Silver	1161	254	10	0.01	264	0.23	2	6/24	2.4/5.5	23.6	24.8
2008	Stanislaus	Telegraph	34115	22404	3218	0.09	25622	0.75	n/a	n/a	n/a	n/a	n/a
2008	Stanislaus	North Mtn	2823	1048	130	0.05	1178	0.42	n/a	n/a	n/a	n/a	n/a
2007	Sequoia	Goldledge	4196	811	205	0.05	1016	0.24	2	6	n/a	51.46	56.32
2007	Sequoia	James	1350	0	0	0.00	0	0.00	n/a	n/a	n/a	n/a	n/a
2006	Stanislaus	sand flat	177	30	0	0.00	30	0.17	n/a	n/a	n/a	n/a	n/a
2005	Sequoia	KOA	68	0	0	0.00	0	0.00	2	2	1.5	15	55
2004	Sequoia	Deep	3143	87	2747	0.87	2834	0.90	1.5-2	6	2.1	11.4	102
2004	Sequoia	Crag	871	0	250	0.29	250	0.29	1.5-2	2	1	10	36
2004	Sierra	Source	385	18	22	0.06	40	0.10	n/a	n/a	n/a	n/a	n/a
2004	Sierra	Nehouse	204	0	0	0.00	0	0.00	n/a	n/a	n/a	n/a	n/a
2004	Stanislaus	Tuolmne	722	240	365	0.51	605	0.84	25	6	2.4	20	25
2004	Stanislaus	Early	1670	154	308	0.18	462	0.28	n/a	n/a	n/a	n/a	n/a
2003	Sequoia	China	819	4	0	0.00	4	0.00	n/a	n/a	n/a	n/a	n/a

2003	Stanislaus	Woodlot	481	66	67	0.14	133	0.28	5	6	2.3	67	198
2003	Stanislaus	Kibbie	772	147	46	0.06	193	0.25	25	6	2.8	60	66
2002	Sequoia	McNally	150670	60973	12518	0.08	73491	0.49	5	6	2.3	8.7	53.3
2002	Sequoia	Borel	3416	0	0	0.00	0	0.00	2	2	1.5	15	57
2002	Stanislaus	Sourgrass	799	199	0	0.00	199	0.25	n/a	n/a	n/a	n/a	n/a
2001	Sierra	North Fork	4132	299	1116	0.27	1415	0.34	2	24	4	93	140
2001	Stanislaus	Darby	14288	2660	2142	0.15	4802	0.34	25	6	2.8	60	65
Average			11528.86	4459.5	1113.107	0.12	5572.607	0.33	8.8125	2269.111	2.4	39.38588	70.25765

using pre- and post- fire curve numbers, and "rules of thumb," based on experience and local knowledge of the burned areas. No single method has proven to be better than another. Although the WEPP model is a physically based model that includes a stochastic weather generator and is used extensively by USDA personnel, the model does not provide peak flows and so is not useful for these purposes. The TR-55 methodology is a well accepted and proven method for calculating peak flows and provides the ability to determine peak flows from several rainfall frequencies. A review of the literature did not reveal any specific Curve Number (CN) for burned areas. Cerrelli (2005) provided a guideline to select post-fire CN based on burn severity and hydrologic soil grouping specific to the Bitterrot National Forest wildfires. He did not find appropriate CNs in his initial search of the literature for CN values for burned areas in southwestern Montana. Consequently, Montana NRCS engineers created a guideline based on the existing NRCS CN/land use table. However, no gaging or calibrating took place to verify or improve this guideline. New protection practices (e.g. road treatments) were implemented using these newer NRCS guidelines. In the spring and summer following the fires, the region experienced its 2- and 5-year, 24-hour storm events and the new protection practices were not adversely affected. Cerrelli (2005) provided the following CN numbers

Burn Severity	**Hydrologic Soil Group**	**CN**
High	A	64
	B	78
	C	85
	D	88
Moderate		Use cover type in Fair condition
Low and unburned	North and East facing slopes	Use cover type in Good condition

Story (2003) a BAER team member with the USFS suggested CNs 93-98 high burn severity with water repellent soils, and 90-95 for high burn severity without water repellent soils. Stuart (2000) suggested CN values of 80 for moderate burn and between 70-72 for low burn areas. Kuyumjian, a research hydrologist for the USDA Rocky Mountain Research station suggested the following values:

Soil burn condition	**CN**
High burn with water repellant soils	95
High burn without water repellent soils	90-91
Moderate burn with water repellent soils	90
Moderate burn without water repellent soils	85
Low burn	Pre-fire CN + 5

As further guidance to determining post-fire runoff response, the BAER data in table 2 was examined for a relationship between acres burned at a given intensity and the post-fire change in discharge. Because of the dependency in design storm selection, only those reports that used a 2-

yr. 6-hour storm were used in the analysis. Regression analysis yielded a fair relation between Log of the percent increase in discharge (Q_p) versus the Log of acres burned at high severity (A_h) (Table 4):

Table 4. Linear regression results based on BAER reports

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.602839	0.359333	1.677661	0.127725	-0.21003	1.415707	-0.21003	1.415707
Severe acres	0.486356	0.145292	3.347433	0.008558	0.157682	0.81503	0.157682	0.81503

This results in the following predictive equation for post-burn changes in discharge ($r^2 = 0.5546$)

$$\text{Log}\ (Q_p) = (0.486 * \text{Log}(A_h)) + 0.603 \qquad (8)$$

Because of the uncertainty involved in the CN numbers for different burn severities and the lack of data to verify their use, equation (8) was used to estimate the increase in discharge associated with a wildfire.

References

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Attachment 9.5, Results of FRAM Analysis

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DWR Levee Mitigation Prioritization Tool

To Read Instructions:	Read Instructions
To Enter Project Information:	Enter Project Information
To Enter Special Cases:	Enter Special Cases
View Cost-Benefit Analysis:	Cost-Benefit Analysis
View Stage Damage Graph:	Stage v Damage Curve
View AAD Graph (Actual):	Loss Probability Curve

Model Map

Sheet Name	Description
Menu:	Front page of model, with links to key sheets
Instructions:	Description of how this model should be used
Inputs:	Project information to be entered by user
BCA Summary:	Summary data resulting from Cost-Benefit Analysis
Assumptions:	Master page containing unit damage assumptions
Depth Damage Curves	Data describing stage damage relationships
Residential:	Direct residential building and contents costs
Commercial & Industrial:	Direct commercial and industrial building and contents costs
Agricultural:	Direct losses to agricultural production
Roads	Direct Losses to roads and infrastructure
Special Cases:	Table for entering information about special case buildings
Without Project EAD	Calculation of Estimated Annual Damages (EAD) without-project
Graph Data	Data used to develop graphical outputs
With Project EAD	Calculation of Estimated Annual Damages (EAD) with-project
Stage v Damage Curve	Graph of flood stage v flood damages
Loss Probability Curve	Graph of flood exceedance probability v flood damages

Inputs

Return to Menu

Project Name:

Cost of Project:

Description:

Number of Events Modeled: 3

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Average Return Interval (ARI)	4	25	100				4	25	100			
Annual Probability of Exceedance	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!
Probability of Levee Failure	1.00	1.00	1.00				1.00	1.00	1.00			
Water Surface Elevation - channel (f)												
Flood Warning Time (hours)	0	0	0	0	0		0	0	0	0	0	
Flood Experience	N	N	N	N	N		N	N	N	N	N	
Period of Inundation (days)												
HEC-FIA DATA INPUTS	N											
Residential Structural Damages ($)												
Residential Contents Damages ($)												
Residential Debris & Cleanup ($)												
Commercial Structural Damages ($)												
Commercial Contents Damages ($)												
Commercial Debris & Cleanup ($)												
Industrial Structural Damages ($)												
Industrial Contents Damages ($)												
Industrial Debris & Cleanup ($)												
Agricultural Structural Damages ($)												
Agricultural Contents Damages ($)												
Agricultural Debris & Cleanup ($)												
Residential Properties												
Ratio Depreciated Value to Replacement Value	80%	80%	80%				80%	80%	80%			
Average Flood depth above ground level (f)												
Rural - Res: Homesteads	18	18	18				18	18	18			
Rural - Other: Barns, sheds	18	18	18				18	18	18			
Urban Res: Single story (no base)												
Urban Res: Single story (basement)	2	2	2				2	2	2			
Urban Res: Two plus story (no base)												
Urban Res: Two plus story (basement)												
Mobile home	7	7	7				7	7	7			
Commercial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)												
high value — building area inundated (sq.f.)												
Industrial Properties												
Ratio Depreciated Value to Replacement Value												
Average Flood depth above ground level (f)												
low value — building area inundated (sq.f.)												
medium value — building area inundated (sq.f.)												
high value — building area inundated (sq.f.)												
Agricultural Production												
Corn — ac.												
Rice — ac.												
Walnuts — ac.												
Almonds — ac.												
Cotton — ac.												
Tomatoes — ac.												
Wine Grapes — ac.												
Alfalfa — ac.												
Pasture — ac.												
Safflower — ac.												
Sugar Beets — ac.												
Beans — ac.												
Other — ac.												
Roads												
length of arterial roads inundated (miles)												
length of major roads inundated (miles)												
length of minor roads inundated (miles)												
length of unsealed roads inundated (miles)												

Extrapolate Y-intercept: N

Summary of Cost-Benefit Analysis

Return to Menu

Project Name: **0**

Description: 0

Proposed project capital cost:	$ -	[Note: construction costs which are assumed to occur in one year.]
Change in annual O&M costs:	$ -	[Note: the change in annual O&M costs compared to without project conc
PV of future O&M costs:	$ -	(at 6% discount rate over 50 years)
PV of future costs	$ -	[Note: the sum of capital costs plus the PV of O&M costs.]

Benefits

	Actual	Potential	
EAD without project	$ 477,460	$ 487,552	[Note: for stormwater projects use "Potential" damage which ignores s
EAD with project	$ 310,183	$ 311,219	
Annual Benefit:	$ 167,277	$ 176,333	
PV of Future Benefits:	$ 2,636,593	$ 2,779,341	(at 6% discount rate over 50 years)

Cost-Benefit Analysis

	Actual	Potential	
Net Present Value (NPV)	$ 2,636,593	$ 2,779,341	(at 6% discount rate over 50 years)
Benefit:Cost Ratio	0.000	0.000	

NPV Sensitivity to Discount Rate:

	Actual	Potential
4%	$ 3,593,470	$ 3,788,025
5%	$ 3,053,792	$ 3,219,128
6%	$ 2,636,593	$ 2,779,341
7%	$ 2,308,544	$ 2,433,532
8%	$ 2,046,377	$ 2,157,171

Model Assumptions

Residential

Foundation heights

Structure Category	Foundation Height (ft)
Rural - Res: Homesteads	1.5
Rural - Other: Barns, sheds	0
Urban Res: Single story (no base)	1.1
Urban Res: Two plus story (no base)	1.1
Mobile home	2.0
Commercial: Low	1
Commercial: Medium	1
Commercial: High	1
Industrial: Low	0.5
Industrial: Medium	0.5
Industrial: High	0.5

Estimate Replacement Value (assumed proxy for depreciated value)

Structure Category	Unit Cost $/ft^2 (2)	Average Size ft^2 (1)	Constructio n Cost
Rural - Res: Homesteads	159	1900	302100
Rural - Other: Barns, sheds	98	4000	392000
Urban Res: Single story (no base)	159	1900	302100
Urban Res: Two plus story (no base)	155	2200	341000
Mobile home (3)	98	1180	115640
Commercial: Low	120		0
Commercial: Medium	142		0
Commercial: High	207		0
Industrial: Low	120		0
Industrial: Medium	142		0
Industrial: High	207		0

1. Residential Square Footage Source: Sacramento County Tax Assessor Unit Cost and Commercial/Industrial/Public Square Footage Assumptions Source: Saylor Publications, Inc, 2007 Current Construction Costs

2. Replacement unit cost per square foot reflects average costs in the San Fran

3. According to FEMA guidance, replacement costs per square foot for mobile homes and barns and outbuildings are similar.

Other

External damages garden/outdoor areas $/building	$	5,000
Cleanup $/building	$	4,000
Number of residents per residential property		2.6

Commercial / Industrial Buildings

Clean-up costs as a percentage of direct structural damages	30%

Calculation of Other Direct Damages

Percentage of residential direct damages applied as indirect:	25%
Percentage of comm/ind. direct damages applied as indirect:	25%
HEC-FIA only: Percentage all building direct damages applied as indirect	25%
Percentage of roads direct damages applied as indirect:	25%

NPV Calculation

Discount Rate	6%
Time Horizon	50 years

Roads

Cost per mile of highway road inundated	$	250,000
Cost per mile of major road inundated	$	100,000
Cost per mile of minor road inundated	$	30,000
Cost per mile of unsealed road inundated	$	10,000

Agricultural Damages

	Weighted, Average Annual Damages ($/acre)	Establishment Costs ($/acre)	Land Cleanup & rehabilitation ($/acre)	Total <5 d) ($/acre)	Total (>=5 d) ($/acre)
Corn	$48	$0	$246	$293	$293
Rice	$227	$0	$243	$471	$471
Walnuts	$585	$5,284	$243	$828	$6,112
Almonds	$1,618	$3,514	$243	$1,862	$5,376
Cotton	$301	$0	$246	$547	$547
Tomatoes	$1,015	$0	$235	$1,250	$1,250
Wine Grapes	$3,241	$3,240	$235	$3,476	$6,716
Alfalfa	$250	$246	$243	$493	$739
Pasture	($15)	$82	$272	$257	$339
Safflower	$164	$0	$241	$405	$405
Sugar Beets	$313	$0	$262	$575	$575
Beans	$111	$0	$246	$356	$356
Other	$0	0	$246	$246	$246

Source: Comp Study

Establishment Costs are 50% costs of total establishment costs

Calculation of Actual to Potential Damages Ratio

		Without Project						With Project					
		Event 1	Event 2	Event 3	Event 4	Event	Event 6	Event	Event 2	Event 3	Event 4	Event 5	Event 6
Warning Time:	hours	0	0	0	0	0	0	0	0	0	0	0	0
Recent Flood Expe	Y / N	N	N	N	N	N	0	N	N	N	N	N	0
Actual : Potential Ratio		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Warning Time	Experienced Community	Inexperienced Community
< 2 hours	0.8	0.9
2-12 hours	Linear reduction from 0.8 at 2 hours to 0.4 at 12 hours	0.8
>12 hours	0.4	0.7

Occ_Name	Cat_Name	Occ_Description	Parameter	Depth (ft) above First Finished Floor (FFE)																		
1ST-NB	RES	one story, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1ST-NB	RES		S	0	2.5	13.4	23.3	32.1	40.1	47.1	53.2	58.6	63.2	67.2	70.5	73.2	75.4	77.2	78.5	79.5	80.2	80.7
1ST-NB	RES		C	0	2.4	8.1	13.3	17.9	22	25.7	28.8	31.5	33.8	35.7	37.2	38.4	39.2	39.7	40	40	40	40
2ST-NB	RES	two or more stories, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2ST-NB	RES		S	0	3	9.3	15.2	20.9	26.3	31.4	36.2	40.7	44.9	48.8	52.4	55.7	58.7	61.4	63.8	65.9	67.7	69.2
2ST-NB	RES		C	0	1	5	8.7	12.2	15.5	18.5	21.3	23.9	26.3	28.4	30.3	32	33.4	34.7	35.6	36.4	36.9	37.2
FARM	FAR	Farm Homesteads	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25
FARM	FAR		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49
FARM	FAR		C	0	0	0	0	0	6	30	54	69	75	78	80	80	80	100	100	100	100	100
MOBILE	MOB	Mobile homes	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25
MOBILE	MOB		S	0	0	0	0	8	44	63	73	78	80	81	82	82	82	82	82	82	82	82
MOBILE	MOB		C	0	0	0	0	0	27	49	64	70	76	78	79	81	83	83	83	83	83	83
PUBLIC	PUB	Public buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25
PUBLIC	PUB		S	0	0	0	0	8	22	30	35	39	41	44	46	48	49	49	49	49	49	49
PUBLIC	PUB		C	0	0	0	0	0	17.5	25	30	34	37	39	40.5	41.5	42	42	42	42	42	42
INDUSTRY	IND	Industrial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25
INDUSTRY	IND		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49
INDUSTRY	IND		C	0	0	0	0	0	72	75	76.5	78	81	84	87	90	96	102	108	114	120	120
COMMERC	COM	Commercial Buildings	Stage	-10	-3	-2	-1	0	1	2	3	4	5	6	7	8	10	13	15	19	21	25
COMMERC	COM		S	0	0	0	0	4	9	13	18	22	27	31	35	38	49	49	49	49	49	49
COMMERC	COM		C	0	0	0	0	0	11	30	54	69	75	78	80	80	80	100	100	100	100	100

NOT USED

SL-NB	RES	split level, no basement	Stage	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16						
SL-NB	RES		S	0	6.4	7.2	9.4	12.9	17.4	22.8	28.9	35.5	42.3	49.2	56.1	62.6	68.6	73.9	78.4	81.7	83.8	84.4						
SL-NB	RES		SN	0	2.9	2.1	1.9	1.9	2	2.2	2.4	2.7	3.2	3.8	4.5	5.3	6	6.7	7.4	7.9	8.3	8.7						
SL-NB	RES		C	0	2.2	2.9	4.7	7.5	11.1	15.3	20.1	25.2	30.5	35.7	40.9	45.8	50.2	54.1	57.2	59.4	60.5	60.5						
SL-NB	RES		CN	0	2.2	1.5	1.2	1.3	1.4	1.5	1.6	1.8	2.1	2.5	3	3.5	4.1	4.6	5	5.4	5.7	6						
SL-NB	RES		Struct	N		0.8																						
1ST-B	RES	one story, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1ST-B	RES		S	0	0	0.7	0.8	2.4	5.2	9	13.8	19.4	25.5	32	38.7	45.5	52.2	58.6	64.5	69.8	74.2	77.7	80.1	81.1	81.1	81.1	81.1	81.1	81.1
1ST-B	RES		SN	0	0	1.34	1.06	0.94	0.91	0.88	0.85	0.83	0.85	0.96	1.14	1.37	1.63	1.89	2.14	2.35	2.52	2.66	2.77	2.88	2.88	2.88	2.88	2.88	2.88
1ST-B	RES		C	0	0.1	0.8	2.1	3.7	5.7	8	10.5	13.2	16	18.9	21.8	24.7	27.4	30	32.4	34.5	36.3	37.7	38.6	39.1	39.1	39.1	39.1	39.1	39.1
1ST-B	RES		CN	0	1.6	1.16	0.92	0.81	0.78	0.76	0.74	0.72	0.74	0.83	0.98	1.17	1.39	1.6	1.81	1.99	2.13	2.25	2.35	2.45	2.45	2.45	2.45	2.45	2.45
1ST-B	RES		Struct	N		0.8																						
2ST-B	RES	two or more stories, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2ST-B	RES		S	0	1.7	1.7	1.9	2.9	4.7	7.2	10.2	13.9	17.9	22.3	27	31.9	36.9	41.9	46.9	51.8	56.4	60.8	64.8	68.4	71.4	73.7	75.4	76.4	76.4
2ST-B	RES		SN	0	2.7	2.7	2.11	1.8	1.66	1.56	1.47	1.37	1.32	1.35	1.5	1.75	2.04	2.34	2.63	2.89	3.13	3.38	3.71	4.22	5.02	6.19	7.79	9.84	12.36
2ST-B	RES		C	0	0	1	2.3	3.7	5.2	6.8	8.4	10.1	11.9	13.8	15.7	17.7	19.8	22	24.3	26.7	29.1	31.7	34.4	37.2	40	43	46.1	49.3	52.6
2ST-B	RES		CN	0	0	2.27	1.76	1.49	1.37	1.29	1.21	1.13	1.09	1.11	1.23	1.43	1.67	1.92	2.15	2.36	2.56	2.76	3.04	3.46	4.12	5.08	6.39	8.08	10.15
2ST-B	RES		Struct	N		0.8																						
SL-B	RES	split level, with basement	Stage	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SL-B	RES		S	0	0	0	2.5	3.1	4.7	7.2	10.4	14.2	18.5	23.2	28.2	33.4	38.6	43.8	48.8	53.5	57.8	61.6	64.8	67.2	68.8	69.3	69.3	69.3	69.3
SL-B	RES		SN	0	0	0	1.8	1.6	1.5	1.6	1.6	1.6	1.6	1.7	1.9	2.1	2.4	2.6	2.9	3.2	3.4	3.6	3.9	4.2	4.8	5.7	5.7	5.7	5.7
SL-B	RES		C	0	0.6	0.7	1.4	2.4	3.8	5.4	7.3	9.4	11.6	13.8	16.1	18.2	20.2	22.1	23.6	24.9	25.8	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3
SL-B	RES		CN	0	2.09	1.49	1.14	1.01	1	1.02	1.03	1.04	1.06	1.12	1.23	1.38	1.57	1.76	1.95	2.13	2.28	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44
SL-B	RES		Struct	N		0.8																						

Residential Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	4	25	100	0	0	0	4	25	100	0	0	0
Probability of Levee Failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Flood depth above ground level (ft)	0.00	1.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
Buildings Inundated (no.)												
Rural - Res: Homesteads	17	17	17	0	0	0	17	17	18	0	0	0
Rural - Other: Barns, sheds	17	17	17	0	0	0	17	17	17	0	0	0
Urban Res: Single story (no base)	2	2	2	0	0	0	2	2	2	0	0	0
Urban Res: Two plus story (no base)	0	0	0	0	0	0	0	0	0	0	0	0
Mobile home	7	7	7	0	0	0	7	7	7	0	0	0
Structural Damages												
Rural - Res: Homesteads	$ -	$ -	$ 164,342	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ 213,248	$ 479,808	$ 693,056	$ -	$ -	$ -	$ 213,248	$ 213,248	$ 479,808	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 12,084	$ 64,770	$ -	$ -	$ -	$ -	$ -	$ 12,084	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ 51,807	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Structual Damages HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ 213,248	$ 491,892	$ 973,975	$ -	$ -	$ -	$ 213,248	$ 213,248	$ 491,892	$ -	$ -	$ -
Content Damages												
Rural - Res: Homesteads	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rural - Other: Barns, sheds	$ -	$ 319,872	$ 1,599,360	$ -	$ -	$ -	$ -	$ -	$ 319,872	$ -	$ -	$ -
Urban Res: Single story (no base)	$ -	$ 11,601	$ 39,152	$ -	$ -	$ -	$ -	$ -	$ 11,601	$ -	$ -	$ -
Urban Res: Two plus story (no base)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Mobile home	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damage HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ 298,325	$ 1,474,661	$ -	$ -	$ -	$ -	$ -	$ 298,325	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ 331,473	$ 1,638,512	$ -	$ -	$ -	$ -	$ -	$ 331,473	$ -	$ -	$ -
Clean-Up/ Other Costs												
External	$ 215,000	$ 215,000	$ 215,000	$ -	$ -	$ -	$ 215,000	$ 215,000	$ 220,000	$ -	$ -	$ -
Cleanup	$ 172,000	$ 172,000	$ 172,000	$ -	$ -	$ -	$ 172,000	$ 172,000	$ 176,000	$ -	$ -	$ -
Other Costs HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Other Costs: Potential	$ 387,000	$ 387,000	$ 387,000	$ -	$ -	$ -	$ 387,000	$ 387,000	$ 396,000	$ -	$ -	$ -
Sum Actual Damages	**$ 600,248**	**$ 1,177,217**	**$ 2,835,636**	**$ -**	**$ -**	**$ -**	**$ 600,248**	**$ 600,248**	**$ 1,186,217**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ 600,248**	**$ 1,210,365**	**$ 2,999,488**	**$ -**	**$ -**	**$ -**	**$ 600,248**	**$ 600,248**	**$ 1,219,365**	**$ -**	**$ -**	**$ -**
Total Actual Damage with levee failure ($):	**$ 600,248**	**$ 1,177,217**	**$ 2,835,636**	**$ -**	**$ -**	**$ -**	**$ 600,248**	**$ 600,248**	**$ 1,186,217**	**$ -**	**$ -**	**$ -**
Total Potential Damage with levee failure ($):	**$ 600,248**	**$ 1,210,365**	**$ 2,999,488**	**$ -**	**$ -**	**$ -**	**$ 600,248**	**$ 600,248**	**$ 1,219,365**	**$ -**	**$ -**	**$ -**
Indirect Actual Damage	$ 150,062	$ 294,304	$ 708,909	$ -	$ -	$ -	$ 150,062	$ 150,062	$ 296,554	$ -	$ -	$ -
Indirect Potential Damage	$ 150,062	$ 302,591	$ 749,872	$ -	$ -	$ -	$ 150,062	$ 150,062	$ 304,841	$ -	$ -	$ -

Commercial & Industrial Buildings

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	4	25	100	0	0	0	4	25	100	0	0	0
Probability of Levee Failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Commercial												
'Flood depth above ground level (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	0	0	0	0	0	0	0	0	0	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Industrial												
'Flood depth above ground level (ft)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
low building size	0	0	0	0	0	0	0	0	0	0	0	0
medium building size	0	0	0	0	0	0	0	0	0	0	0	0
high building size	0	0	0	0	0	0	0	0	0	0	0	0
Structural Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Structural Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contents Damages												
Commercial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Commercial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial												
low	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
medium	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
high	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Industrial HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Actual:Potential Ratio	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Total Contents Damages: Actual	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Contents Damages: Potential	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-up/ Other Costs	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Clean-Up/ Other Costs: HEC-FIA	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sum Actual Damages	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Sum Potential Damages	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Total Damage with levee failure ($):	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Indirect Actual Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirect Potentail Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Agricultural Damages

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI:	4	25	100	0	0	0	4	25	100	0	0	0
Probability of Levee Failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Length of Inundation <5d Y/N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Agricultural Land Inundated												
Corn ac.	0	0	0	0	0	0	0	0	0	0	0	0
Rice ac.	0	0	0	0	0	0	0	0	0	0	0	0
Walnuts ac.	0	0	0	0	0	0	0	0	0	0	0	0
Almonds ac.	0	0	0	0	0	0	0	0	0	0	0	0
Cotton ac.	0	0	0	0	0	0	0	0	0	0	0	0
Tomatoes ac.	0	0	0	0	0	0	0	0	0	0	0	0
Wine Grape ac.	0	0	0	0	0	0	0	0	0	0	0	0
Alfalfa ac.	0	0	0	0	0	0	0	0	0	0	0	0
Pasture ac.	0	0	0	0	0	0	0	0	0	0	0	0
Safflower ac.	0	0	0	0	0	0	0	0	0	0	0	0
Sugar Beets ac.	0	0	0	0	0	0	0	0	0	0	0	0
Beans ac.	0	0	0	0	0	0	0	0	0	0	0	0
Other ac.	0	0	0	0	0	0	0	0	0	0	0	0
Potential Damages												
Corn	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rice	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Walnuts	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Almonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cotton	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tomatoes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Wine Grapes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Alfalfa	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pasture	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Safflower	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sugar Beets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Beans	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Potential Damages	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damage with levee failure ($):	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Roads

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	4	25	100	0	0	0	4	25	100	0	0	0
Probability of Levee failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Roads Inundated												
length of arterial roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of major roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of minor roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
length of unsealed roads inundated (miles)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential Damages												
length of arterial roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of major roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of minor roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
length of unsealed roads inundated (miles)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Damages:	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*
Total Damage with levee failure ($):	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Special Cases - Dollar Damages Incurred

Return to Menu

	Without Project						With Project					
	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
ARI	4	25	100	0	0	0	4	25	100	0	0	0
Probability of Levee failure	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	0.00	0.00	0.00
Description / Site ID												
	$ 215,722	$ 672,272	$ 1,206,295				$ 189,197	$ 522,758	$ 867,889			
Total Damages:	$ 215,722	$ 672,272	$ 1,206,295	$ -	$ -	$ -	$ 189,197	$ 522,758	$ 867,889	$ -	$ -	$ -
Total Damage with levee failure ($):	215722.399	672272.2256	1206294.926	0	0	0	189196.882	522758.2681	867889.3207	0	0	0

Calculation of Without Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Y Intercept
Average Recurrence Interval (ARI)	2	25	100	0	0	0	
AEP	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ 600,248	$ 1,177,217	$ 2,835,636	$ -	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ 600,248	$ 1,210,365	$ 2,999,488	$ -	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Actual Indirect Costs	$ 150,062	$ 294,304	$ 708,909	$ -	$ -	$ -	
Potential Indirect Costs	$ 150,062	$ 302,591	$ 749,872	$ -	$ -	$ -	
Special Cases	$ 215,722	$ 672,272	$ 1,206,295	$ -	$ -	$ -	
Total Actual Damages	$ 966,032	$ 2,143,794	$ 4,750,840	$ -	$ -	$ -	$ 4,750,840
Total Potential Damages	$ 966,032	$ 2,185,228	$ 4,955,654	$ -	$ -	$ -	$ 4,955,654
EAD (Actual)	$ 477,460						
EAD (Potential)	$ 487,552						

Potential Damages Without Project

Water Surface Elevation - channel (f)	0	0	0	0	0	0	
ARI	4	25	100	0	0	0	
Probability of Exceedence (AEP)	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!	
Damages incurred	$ 966,032	$ 2,185,228	$ 4,955,654	$ -	$ -	$ -	$ 4,955,654

Actual Damages Without Project

Water Surface Elevation - channel (f)	0	0	0	0	0	0	
ARI	4	25	100	0	0	0	
Probability of Exceedence (AEP)	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!	
Damages incurred	$ 966,032	$ 2,143,794	$ 4,750,840	$ -	$ -	$ -	$ 4,750,840

Without Project

Water Surface Elevation - channel (f)	4	25	100	0	0	0
Probability of Exceedence (AEP)	0.250	0.040	0.010	0.010	0.010	0.010
Potential	$ 966,032	$ 2,185,228	$ 4,955,654	$ 4,955,654	$ 4,955,654	$ 4,955,654
Actual	$ 966,032	$ 2,143,794	$ 4,750,840	$ 4,750,840	$ 4,750,840	$ 4,750,840

With Project

Water Surface Elevation - channel (f)	4	25	100	0	0	0
Probability of Exceedence (AEP)	0.250	0.040	0.010	0.010	0.010	0.010
Potential	$ 939,507	$ 1,273,068	$ 2,392,095	$ 2,392,095	$ 2,392,095	$ 2,392,095
Actual	$ 939,507	$ 1,273,068	$ 2,350,661	$ 2,350,661	$ 2,350,661	$ 2,350,661

Calculation of With Project EAD

	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	
Average Recurrence Interval (ARI)	4	25	100	0	0	0	
AEP	0.250	0.040	0.010	#DIV/0!	#DIV/0!	#DIV/0!	0
Actual Damage to Residential Buildings ($)	$ 600,248	$ 600,248	$ 1,186,217	$ -	$ -	$ -	
Potential Damage to Residential Buildings ($)	$ 600,248	$ 600,248	$ 1,219,365	$ -	$ -	$ -	
Actual Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Potential Damage to Commercial/Industrial Buildings ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Agriculture ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Damage to Roads ($)	$ -	$ -	$ -	$ -	$ -	$ -	
Actual Indirect Costs	$ 150,062	$ 150,062	$ 296,554	$ -	$ -	$ -	
Potential Indirect Costs	$ 150,062	$ 150,062	$ 304,841	$ -	$ -	$ -	
Special Cases	$ 189,197	$ 522,758	$ 867,889	$ -	$ -	$ -	
Total Actual Damages	$ 939,507	$ 1,273,068	$ 2,350,661	$ -	$ -	$ -	$ 2,350,661
Total Potential Damages	$ 939,507	$ 1,273,068	$ 2,392,095	$ -	$ -	$ -	$ 2,392,095

EAD (Actual)	$ 310,183
EAD (Potential)	$ 311,219

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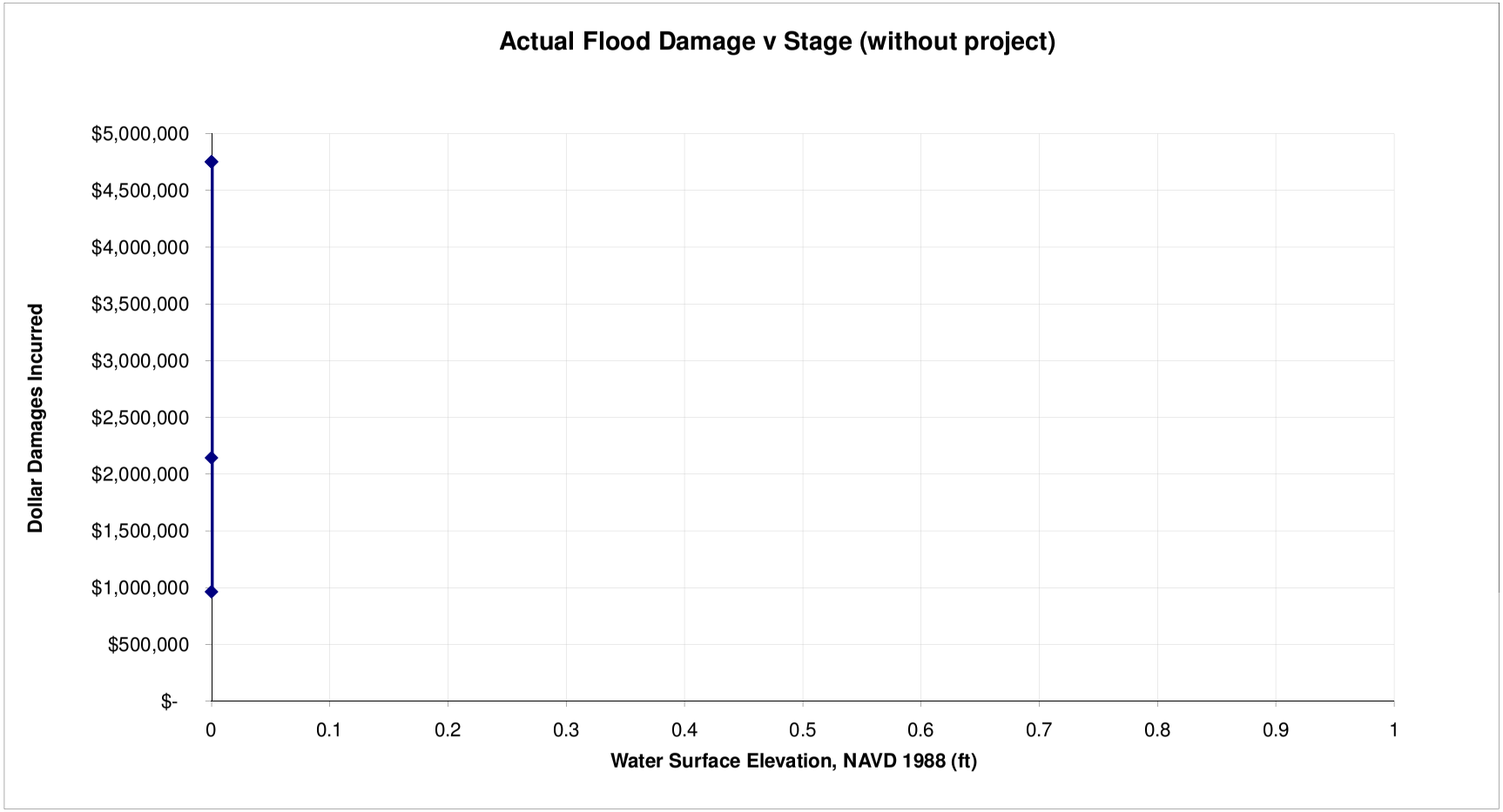
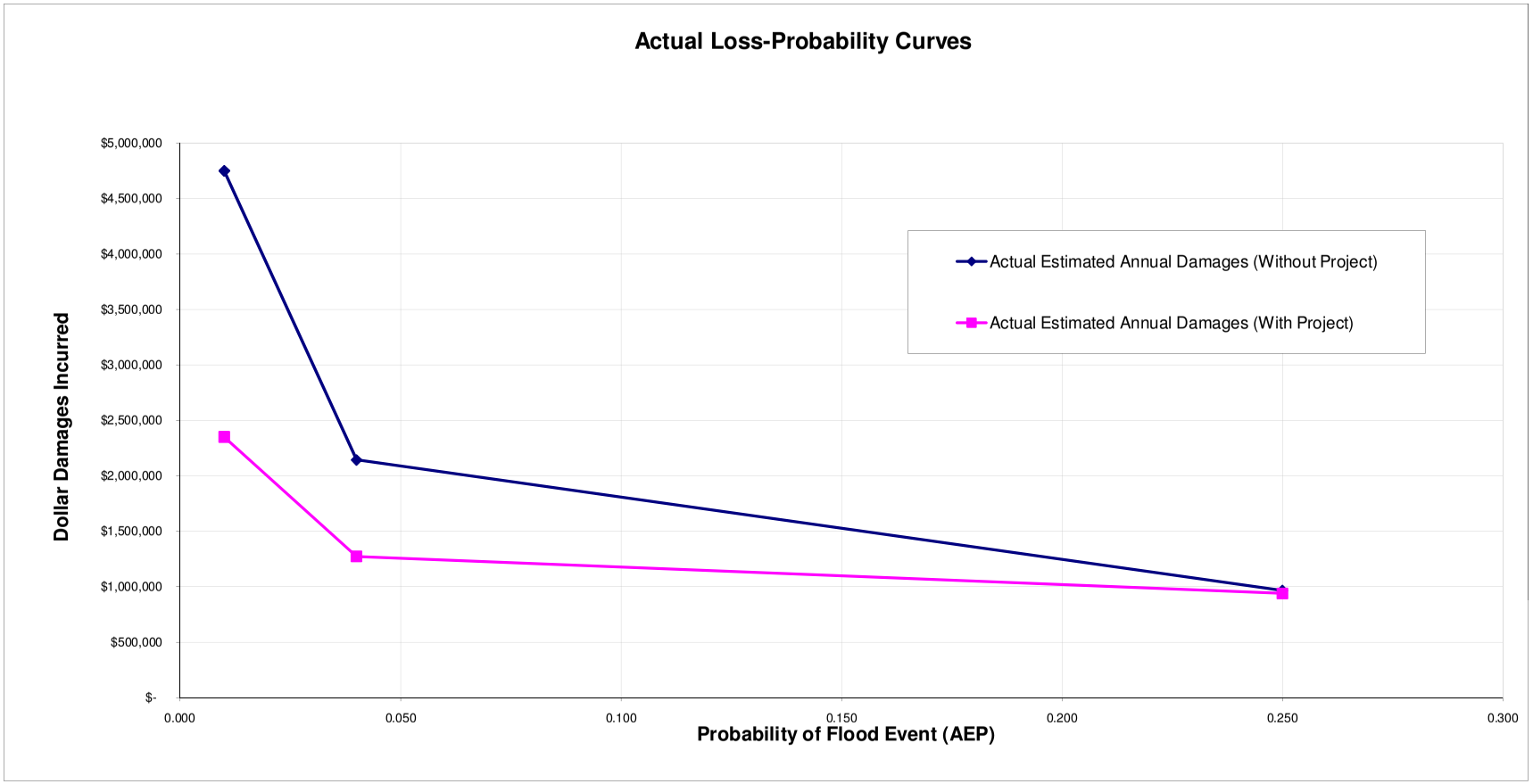
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