This section presents the risk analysis results considering levee failures in the Delta and Suisun Marsh study area initiated by the several hazards addressed by DRMS for the 2005 base year and under business-as-usual (BAU) conditions.

13.1 INTRODUCTION

The previous sections described the risk modules (seismic, flood, levee vulnerability, etc.), their characterization of the physical process, the approach used to develop the numerical model, and the module products for use in the risk analysis. Section 4 describes the risk analysis approach used to integrate the various module outcomes. The results presented in this section represent the sequences of events, system response to the events, and the resulting consequences as described below:

- Hazards – Seismic, floods, wind and wave, and high tide / normal day / sunny day occurrences.
- Levee Vulnerability and Potential Failure – Liquefaction, instability, seepage, overtopping.
- Emergency Response and Repair – Particularly the order and rate of progress for repairs, including rate of erosion of flooded islands.
- Salinity Impacts – The intrusion of bay salinity in response to the event and progress in returning toward normal conditions over the repair period.
- Consequences – Public safety, environmental and economic impacts.

Each of these topics was addressed in its respective technical memorandum. Summaries of the model concepts, analytical approaches and module outputs that enter into the risk model were provided in the previous sections.

The purpose of this section is to present the results of the analyses in terms of risks inherent from the various hazards – a) the potential for island flooding, both combined and individually and b) the consequences of that flooding. To do so, the section begins with flooding potential due to risks from:

- Sunny day failures
- Seismic events
- Floods
- The combined risk of inundation from all hazards.

After the likelihood of flooding is presented, the results from analyzing the consequences of flooding from various causes are discussed. For each type of hazard event (sunny day, seismic, and flood) and for all hazards combined, the following are addressed:

- Economic Consequences
- Ecosystem Consequences
- Public Health and Safety Consequences.

13.2 ISLAND FLOODING POTENTIAL

The potential for island inundation is presented for each causative event – sunny day, seismic and hydrologic (floods). Within each, two perspectives are adopted, one considering possible outcomes from single events, including the prospect of multiple failures from the event, and the other looking at flooding potential on an island-by-island basis, not considering what may be occurring on other islands.

13.2.1 Sunny-Day Risk

As described in Section 9, the risk of sunny day failures, usually associated with high tides, is developed principally from historic observations. By definition, sunny day failures occur only in the late spring, summer and early fall (i.e., during the low-flow season). The expected frequencies of island failures, during sunny-day conditions, are summarized in Table 13-1. The results were compiled for the islands and tracts within the MHHW boundary. There are about 911 miles of Delta Levees and approximately 75 miles of exterior levees in Suisun Marsh within the MHHW boundary. The expected annual frequency of historical breaches is about $1.18x10^{-4}$ /year/levee mile or 0.107 failures/year in the Delta and $4.76 x10^{-4}$ /year/levee mile or 0.036 failures/year for Suisun Marsh. These rates are applied uniformly to all levees within the MHHW boundary in the respective areas.

In other terms, it is expected that on average there will be about 5.4 sunny-day breaches with 50 years of exposure or 10.7 breaches with 100 years of exposure in the Delta, and 1.8 sunny-day breaches with 50 years or 3.6 breaches with100 years of exposure in Suisun Marsh.

Sunny day failures are assumed to occur one island at a time. Thus, for 2005 base case conditions, the frequency of two or more sunny day failures occurring during the same sunny-day, high-tide event is assumed to be insignificant. Further, it is judged that the likelihood of increased seepage on adjacent islands leading to a levee breach resulting in additional island flooding is small.

13.2.2 Seismic Risk

When an earthquake occurs, all Delta/Suisun levees may be subject to dynamic loading and potential failure within several minutes – essentially simultaneously. If an earthquake is strong enough to cause the failure of one island, it is likely that other islands with the same or higher vulnerability would also fail. Thus, a strong earthquake impacting the study area could cause levee failures on several islands and there is a real prospect of multiple islands flooding at the same time. Figure 13-1 shows the frequency distribution on the number of islands that may fail simultaneously due to a seismic event in or in the vicinity of the Delta and Suisun Marsh. The figure shows the mean frequency of exceedance and the estimate of uncertainty calculated from the uncertainty in the ground motion hazard and the levee fragility uncertainties (which were discussed in more detail in Section 6). The figure shows the results summarized below in Table 13-2.

Table 13-2 Frequencies of Exceedance for Seismic Multiple Island Failures

Number of Islands	Annual Frequency of Exceedance	Probability of Exceedance in 25 Years	Probability of Exceedance in 50 Years	Probability of Exceedance in 100 Years
1	0.092	0.900	0.990	1.000
3	0.060	0.777	0.950	0.998
10	0.029	0.517	0.767	0.946
20	0.017	0.352	0.580	0.823
30	0.011	0.243	0.426	0.671

Figure 13-2 shows the contribution of different seismic sources to the frequency distribution on flooded islands.

The 2005 base case results can be used to estimate the probability of island flooding events due to a seismic event during various exposure periods. These estimates assume existing (2005) conditions prevail; they do not take into consideration the increasing hazard potential (as described in Section 6) or the changes in levee vulnerability that may exist in the future. (The changing risk picture over time is discussed in Section 14.) Figure 13-3 shows the probability distribution on flooded islands for exposure periods of 25, 50, and 100 years, including the uncertainty.

Each island was also analyzed individually to estimate its frequency of failure due to seismic events. This answers the question "How likely is it that a given island will flood due to an earthquake?" It doesn't consider whether other islands are or are not flooded at the same time.

Table 13-3 presents the estimated annual frequency of failure for each island in the study area. The islands were then grouped into five seismic risk categories for different ranges of frequency of failure. The ranges included: less than 0.01/year, 0.01 to 0.03/year, 0.03 to 0.05/year, 0.05 to 0.07/year, and greater than 0.07/year as shown in Table 13-3. The results indicate that the island levees are highly vulnerable to seismic shaking. The study area has been grouped into three regions: Delta, Suisun Marsh, and Cache Haas and the results from the seismic risk analysis were considered separately to assess the seismic performance of levees in these regions. Out of 93 Delta islands/tracts analyzed, 48 have less than 0.01 frequency of failure per year, and 10 islands have more than 0.03 frequency of failure per year. All islands/tracts analyzed in the Suisun Marsh area, have less than 0.01 frequency of failure per year. All islands/tracts within the Cache Haas region have less than 0.03 frequency of failure per year. Figure 13-4 illustrates the number of islands within each range of mean failure rates.

Table 13-4 summarizes the contributions of all sources to all islands. Figure 13-5 presents the percent contribution from the major seismic sources to the island failures. Figure 13-6 shows a color-coded map of the range of the annual failure frequency of individual islands due to seismic events. The contribution from different seismic sources for the three identified study regions are summarized as follows:

- **Delta**: Hayward fault 17%, southern Midland fault 10%, San Andreas 10%, Calaveras fault 9.5% and the remaining sources 52.5%.
- **Suisun Marsh**: Concord-Greenville fault 49%, Pittsburg-Kirby Hills fault 22%, and the remaining sources 29%.

- **Cache Haas**: Northern Midland fault 17%, Hayward fault 16%, Concord-Greenville fault 10%, and the remaining sources 57%.

It is interesting note that the highest contribution for the Delta region is from the Hayward fault whereas the Concord-Greenville fault dominates the seismic contribution for the Suisun Marsh area. The reason for the strong contribution from Hayward fault for the Delta region is its maximum capable magnitudes (**M**>7) and the corresponding levee fragility responses. The reason for the strong contribution from the Concord-Greenville fault for the Suisun Marsh area is its close proximity to the site.

13.2.3 Hydrologic (Flood) Risks

Similar to earthquakes, hydrologic events (floods) are major occurrences that may result in several islands flooding as a result of one event. Figure 13-7 presents the frequencies of exceedance for various numbers of islands being inundated in the same flood. The figure presents both the mean frequency of exceedance and the uncertainties calculated from hazard and fragility uncertainties (which were discussed in more detail in Section 7). The figure shows the results summarized below in Table 13-5.

Table 13-5 Frequencies of Exceedance for Flood-Caused Multiple Island Failures

Number of Islands	Annual Frequency of Exceedance	Probability of Exceedance in 25 Years	Probability of Exceedance in 50 Years	Probability of Exceedance in 100 Years
1	0.605	1.000	1.000	1.000
3	0.281	0.999	1.000	1.000
10	0.034	0.567	0.812	0.965
20	0.009	0.208	0.371	0.607
30	0.004	0.091	0.174	0.298

The 2005 base case results can be used to estimate the probability of island flooding events due to hydrologic events during various exposure periods. These estimates assume existing (2005) conditions prevail; they do not take into consideration the increasing hazard potential (as described in Section 7) or the changes in levee vulnerability that may exist in the future. (The changing risk picture over time is discussed in Section 14.) Figure 13-8 shows the probability distribution on flooded islands for periods of 25, 50, and 100 years, including the uncertainty.

The islands were again analyzed individually to obtain the annual frequencies of failure due to flood events for each island. The flood hazard and fragility models described previously in Section 7 were used. For some islands for which sufficient historical flooding data was available, the model-estimated failure frequency was adjusted based on the observed failure frequency. Because of irregularities in the levee crest elevations (singular dips and spikes) the probability of flooding by overtopping were modified to correct for these artificial conditions. Overtopping was allowed to initiate only between the two points bounding the 100-year flood event. Table 13-6 presents the results in terms of the annual frequency of failure of each island and also the probability of at least one failure on the island in 50 years and 100 years. The islands were then grouped into five flood risk categories for different ranges of the annual frequency of failure. The ranges included: less than 0.01/year, 0.01 to 0.03/year, 0.03 to 0.05/year, 0.05 to 0.07/year, and greater than 0.07/year as shown in Table 13-6. Figure 13-9 shows the number of islands within each range of the annual failure frequency. Similar to the seismic case, the study area has been grouped into three regions: Delta, Suisun Marsh, and Cache Haas and the results from the flood risk analysis were considered separately to assess the performance of levees during and after flooding in these regions. Out of 92 Delta islands/tracts analyzed, 48 have less than 0.01 frequency of failure per year, and 14 islands have more than 0.05 frequency of failure per year. Note that only one island, Venice Island, has greater than 0.07 frequency of failure per year. In general, islands/tracts analyzed both in the Suisun Marsh and Cache Haas areas, have greater than 0.07 frequency of failure per year. The levees in these two study regions are relatively short in height and therefore overtop at low return period of flooding. All islands/tracts within the Cache Haas region have less than 0.03 frequency of failure per year. Figure 13-10a shows a color-coded map of the range of the annual failure frequency of individual islands due to hydrologic (flood) events. Figure 13-10b shows a comparable map of historical flooding failures.

13.2.4 Combined Risk of Island Inundation

Figure 13-11 shows the comparison of the mean frequency distributions on the number of flooded islands due to the three causative factors. Only the seismic and flood distributions show up on the figure; the sunny day failures are always one island, so that curve is a line on the vertical axis.

Figure 13-12 presents the probability of exceedance for various numbers of islands flooding simultaneously due to all causes. The figure presents both the mean frequency of exceedance and the uncertainties derived from hazard and fragility uncertainties previously described. The figure shows the results summarized below in Table 13-7.

Table 13-7 Frequencies of Exceedance for Multiple Island Failures Due to All Hazards

Number of Islands	Annual Frequency of Exceedance	Probability of Exceedance in 25 Years	Probability of Exceedance in 50 Years	Probability of Exceedance in 100 Years
1	0.839	1.000	1.000	1.000
3	0.341	1.000	1.000	1.000
10	0.063	0.791	0.956	0.998
20	0.027	0.487	0.737	0.931
30	0.015	0.312	0.526	0.758

We also combined the contributions of all hazards to calculate the overall risk of individual islands flooding. Table 13-8 shows the aggregated risk for each island. Figure 13-13 depicts the island risks in the five different color codes for the same ranges of annual frequency of flooding used in earlier figures.

13.3 CONSEQUENCES

Any Delta levee failure has consequences – for public safety, economics, and the ecosystem. Potential consequences are discussed in detail in Section 12. Various island-oriented economic costs are summarized by island. However, a single stressing event that could cause the simultaneous failure of levees on multiple islands and subsequent flooding of these islands may have much larger consequences than the simple sum for the flooding of individual islands. This section considers the range of potential consequences and, especially, the escalation of consequences in multi-island events.

13.3.1 Seismic Consequences

Six representative failure scenarios were defined ranging from 1 to 30 islands that would be flooded simultaneously during the same seismic event. The scenarios cover a broad range of Delta-Suisun wide consequences under different seismic events. Table 13-9 summarizes the key characteristics of the six scenarios in terms of the number of islands flooded and the number of islands damaged, but not-flooded, and Figure 13-14 through 13-19 show the location of the selected islands. Each of these scenarios was analyzed under three different water year types – wet, average, and dry – to assess the variation in the resulting risk due to different hydrological conditions. The examples were chosen from the hydrological record of past 82 years. Different starting months were chosen for each water year type to provide a sense of how consequences may vary for different timings of the seismic event. Table 13-9 shows the event month and the historical hydrological year for each failure scenario.

Emergency Levee Response and Repair

The duration and cost of levee repairs rise as the number of islands flooded in a seismic event increase, as indicated in Table 13-10a. Emergency repairs are estimated to take five years or more for 20 flooded islands and more than 6.5 years for 30 flooded islands. Repairs can cost billions of dollars.

Table 13-10a Duration and Cost of Repair for Seismic Cases

Seismic Case	Number of Flooded Islands	Duration of Repairs (months)	Cost of Repairs ($billion)
1	1	Up to 20	Up to 0.6
2	3	19	0.9
3	3	23	2.1
4	10	45	4.0
5	20	62	6.2
6	30	81	8.4

Export Disruption

When a levee breach occurs during the late spring, summer or early fall, saline water from Suisun Bay will usually be drawn into the Delta and the flooded islands. Water might not be of adequate quality use by the State and Federal water projects, Contra Costa Water District and in-Delta users. As shown in Table 13-10b, pumping could be stopped for several months, depending on the number of flooded islands, the timing of the earthquake and the wetness or dryness of hydrologic conditions. The disruptions shown in Table 13-10b are due only to salinity.

Table 13-10b Duration of No Export Pumping for Seismic Cases

Seismic Case	Number of Flooded Islands	Duration of No Pumping (months)[1]	Water Not Exported (maf[2])
1	1	Up to 2	Up to 0.7
2	3	1 to 3	0.1 to 1.0
3	3	1 to 4	0.1 to 1.3
4	10	2 to 10	0.7 to 2.5
5	20	11 to 21	6.3 to 6.5
6	30	16 to 23	6.5 to 9.3

[1] Export disruptions will continue for an additional period, depending on the severity of the scenario, while only partial pumping is possible.
[2] million acre-feet

After pumping resumes, water may need additional treatment to make it safe for drinking. The primary contaminant of concern is organic carbon, which may react with disinfectants to form byproducts that are carcinogenic. Preliminary analyses performed as part of the DRMS project indicate that some water may not be treatable by municipal agencies for many months, thereby extending the period that urban users may have their Delta supplies unavailable. Costs of additional treatment, when feasible, could be as much as $70 million. More careful management of island dewatering to avoid high organic carbon, and more detailed modeling are needed in a subsequent phase of technical work in order to better calculate whether treatability issues will extend the period of disruption for urban users.

13.3.1.1 Economic Consequences from Earthquakes

As described in Section 12, economic consequences were quantified in terms of *economic costs* and *economic impacts*. The economic costs are the net costs to the state economy without any consideration of who bears the cost. All economic costs are generally additive. Economic impacts include a variety of other economic measures. For this study, four measures of economic impacts were evaluated. These were value of lost output, lost jobs, lost labor income, and lost value added. Value added is the sum of wages and salaries, proprietor's incomes, other property income, and indirect business taxes. These measures are not additive with each other, and they should not be added to economic costs.

Seismic Economic Case Study Results

Tables 13-11a and 13-11b summarize the economic costs and economic impacts, respectively of the six scenarios under the three combinations of event month and hydrological years. For simplicity, economic costs are summarized in terms of two broad categories, namely, in-Delta cost and statewide cost as shown in Figure 13-20. The main elements of in-Delta costs are emergency response and repair cost, infrastructure repair cost, lost use of structures and services, agricultural losses, and lost recreation. About 90% of in-Delta costs are from the emergency response and repair cost, and infrastructure repair cost, and 5% are from lost recreation. The main elements of statewide costs are agricultural loss and urban user loss due to water supply disruption, and lost use of major infrastructure. The economic impacts are mostly controlled by the value of lost output, followed by lost value added, then lost labor income as shown in Figure 13-21 for the 30 flooded islands scenario. The lost jobs are shown digitally on the figure for each water year.

For case studies involving significant water supply disruption, about 80% of the total statewide costs is from urban user loss due to water supply disruption and about 15% from lost use of major infrastructure.

Seismic Economic Risk Results

The results of the economic case studies presented above can be combined with the risk results presented on the mean frequency of failure for various numbers of islands. The results are shown in Figures 13-22 through 13-28. Figure 13-22 shows the mean annual frequency distribution of economic costs due to seismic events for total costs and the in-Delta and statewide components of total costs. Figure 13-23 presents the frequency distribution including uncertainty on the total economic costs including uncertainty.

13.3.1.2 Ecosystem Consequences From Earthquakes

The conceptual model developed for the effects of levee failure on aquatic species, vegetation and terrestrial wildlife sensitive species provides framework for qualitative risk analysis, displaying both beneficial and adverse effects associated with levee failure. The impacts to focal aquatic species, vegetation and terrestrial wildlife are presented in Tables 13-12 through 13-26. The ecological impacts of five different seismic levee-failure scenarios were assessed. Scenarios included levee failures on as few as two islands and as many as 30 islands. Each scenario was analyzed for three different water years consisting of a spring wet year (represented by 1927 conditions), summer average water year (1930) and fall dry water year (1972).

Aquatic Species

The results below should be interpreted with an understanding of the limitations of the aquatic species analyses, which include: differences in the ability of survey data to predict density and distribution of different species in separate regions of the delta; tremendous inter-annual variation in species' abundance and distribution; and high uncertainty in population dynamics subsequent to levee failure. In addition, the results only account for factors included in the model which may not include the most important population drivers after a catastrophic levee failure.

Interpreting the aquatic results requires understanding the factors and calculations involved in creating the risk index. The risk index (see Table 13-26a) incorporates both immediate mortality as well as the long-term impacts of levee failure, which can be beneficial or adverse.

The magnitude of the immediate mortality (the percent of the population that is entrained PEL) influences the increase in risk of population extirpation following the levee breach event. Table 13-26b provides the percent of each species' total population that is found east of the Carquinez Straits (i.e., the percentage of the population that is potentially at risk from levee failure) in July and October. For example, the vast majority of the delta smelt population resides in the Delta in July and October; therefore any levee failure may impact a large percentage of the entire population. In contrast, a small percentage of the total population of silverside juveniles is found east of the Carquinez Straits in either month, reducing the potential for a levee failure to extirpate the population.

While these numbers provide a context for the potential impact of a flood, they do not reflect the whole story encapsulated in the risk index, which includes long-term impacts of levee failure which can be beneficial or adverse. Whether the benefit is beneficial or adverse depends on the state of the Delta and flooded islands after a levee breach (i.e., the number of breaches on an

Table 13-26a Aquatic Species Risk Factors and Weights Used in the Risk Calculator

<table>
<tr><th rowspan="2">RISK FACTORS VARIABLE</th><th colspan="8">FORMULAS AND SPECIES-SPECIFIC WEIGHTINGS</th></tr>
<tr><th>Delta smelt</th><th>Longfin smelt</th><th>Striped bass</th><th>Chinook salmon</th><th>Steelhead</th><th>Green sturgeon</th><th>Threadfin Shad</th><th>Inland Silverside</th></tr>
<tr><td>Breach Duration (BD) (months) until last breach is closed:</td><td colspan="8">BD < 12 = 0
12 < BD < 24 = 1
24 < BD <48 = 2
48 < BD < 60 = 3
BD => 60 = 4
Breach open longer is assumed to be a benefit because there is more chance for habitat to develop.</td></tr>
<tr><td>Weighting Factor</td><td>1</td><td>1</td><td>1</td><td>0.75</td><td>0.75</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Number of Breaches (NB)</td><td colspan="8">NB < 5 = 0
5 < NB < 10 = -1
NB > 10 = -2
Number of breaches is assumed to correlate positively with predation/ambush opportunity. Thus, number of breaches correlates negatively with fish habitat value.</td></tr>
<tr><td>Weighting Factor</td><td>1</td><td>1</td><td>1</td><td>0.5</td><td>0.5</td><td>0.25</td><td>1</td><td>1</td></tr>
<tr><td>X_2 Location
(Feb-May):
X_2 Location = distance in km from the Golden Gate of the 2ppt halocline.</td><td colspan="8">X_2 < 74km (i.e.downstream of Chipps Island) = 0
74 km > X_2 < 83 km (i.e. between Chipps Island & river confluence) = -1
X_2 > 83 km (i.e. upstream of confluence) = -2
X_2 is expected to correlate negatively with habitat value for fish species considered in this report. When modeling scenarios, the value of X_2 used represented the largest (worst) X_2 value in the time series (from levee-failure event to breach closure).</td></tr>
<tr><td>Weighting Factor</td><td>1</td><td>1</td><td>1</td><td>0.5</td><td>0.5</td><td>0.5</td><td>1</td><td>1</td></tr>
<tr><td>Coldwater Pool (CP)
(May-Oct)
Coldwater pool reflects the amount of water stored in three reservoirs (Shasta, Oroville, and Folsom).</td><td colspan="8">CP > 60% = 0
40 < CP < 60% = -1
CP < 40% = -2
For each reservoir (Shasta, Oroville, or Folsom), end of month storage between May-Oct > 60% of baseline = 0. Storage <60% of baseline = -1. Score calculated once per year based on worst end of month result for each reservoir.</td></tr>
<tr><td>Weighting Factor</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Instream flow minimum for salmonid incubation (IF_m) on Sacramento, American, and Feather Rivers</td><td colspan="8">Flow > IF_m = 0
Flow < IF_m = -2
Assess a penalty when flow drops below IF_m on any of the three rivers.</td></tr>
<tr><td>Weighting Factor</td><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
</table>

Table 13-26a Aquatic Species Risk Factors and Weights Use in the Risk Calculator (concluded)

Entrainment on Islands (*EL*) that occurs when Island floods	*EL* < 10K = 0 10 < *EL* < 100K = -1 *EL* > 100K = -2 *EL* = volume of water entrained * species-specific regional density of fish (calculated for each month). If island volume > regional volume in channels, add to the above (volume of water needed to fill island * species-specific regional density in adjacent regions).							
Weighting Factor	1	0.75	0.3	0.3	0.3	0.3	0.75	0.75
Percentage Island Entrainment Loss (*PEL*)	*PEL* < 10% = 0 10 > *PEL* < 20% = -1 *PEL* > 20% = -2 [(*EL* ÷ standing stock in regions A2 through A13) * 100].							
Weighting Factor	1	1	0.2	0.2	0.2	0.1	1	1
Pump Entrainment Reduction Benefit (*Pump)* Based on number of months in which Delta exports are suspended.	*Pump* < 3 months = 0 3 > *Pump* > 6 months = 1 6 > *Pump* > 12 months = 2 12 > Pump > 18 = 3 *Pump* > 18 = 4							
Weighting Factor	1	1	1	1	1	1	1	1
Risk of jeopardy to the species population	R_j = SUM OF ALL RISK FACTORS FOR EACH SPECIES AFTER MULTIPLYING BY WEIGHTS $R_j > 0$ = not a risk to the species population (a higher value indicates a lesser risk) $R_j < 0$ = risk to the species population (a lower value indicates a greater risk)							
Worst-case scenario	-8.0	-7.5	-5.0	-7.0	-6.5	-2.3	-7.5	-7.5

Table 13-26b Juvenile Population Potentially Exposed to Entrainment on Flooded Islands

Fish Species	Instantaneous Average Population in the Delta[a] (1995-2005) July	Percent of Total Juvenile Population Represented by Population in Delta[a] July	Instantaneous Average Population in the Delta[a] (1995-2005) October	Percent of Total Juvenile Population Represented by Population in Delta[a] October
Chinook salmon [b]	3,900	<1%	21,000	<5%
Delta smelt	6,492,000	100%	440,000	100%
Green Sturgeon[c]	0	20%	0	20%
Inland Silverside[d]	223,000	30%	21,000	30%
Longfin smelt[e]	4,904,000	5-40%	1,075,00	10-50%
Steelhead[c]	0	<5%	0	<15%
Striped Bass	19,755,000	75%	211,000	65%
Threadfin shad[d]	7,492,000	85%	3,300,000	85%

[a] The Delta includes aquatic habitats east of the Carquinez Straits
[b] Percentages of Chinook salmon juveniles in the Delta reflect estimated total number of juveniles in a given year class (all runs combined), including those that migrated to the ocean earlier in that year.
[c] Surveys used to obtain Instantaneous Average Population (Bay survey, 20 mm survey, Summer Townet Survey and Fall Midwater Trawl) are very poor at sampling steelhead and green sturgeon because steelhead can outswim the nets and the sampling gear does not target the epibenthic habitat of green sturgeon. Professional experience was used to estimate the percent of the total population in the Delta for these fish.
[d] Threadfin shad and inland silversides live along the edge in shallower water; sampling is done in center of the channel, but represents the populations fairly well
[e] Longfin smelt appear to use nearshore marine environments during summer months; the magnitude of these migrations is unknown. Percentages of longfin smelt in the Delta reflect the estimated total number of juveniles in a year class including those that have migrated to the ocean.

island, NB; and Breach Duration; BD; location of X2), and human response to levee failure (i.e., changes in river flow upstream, IFm; changes in the pool of coldwater stored in reservoirs, CP; duration of curtailed in-Delta and CVP-SWP water diversions; PUMP) relative to species' requirements (incorporated as weighting factors). For aquatic species, the worst-case scenarios for each species were calculated by using the most adverse value of each variable in the risk index equation (Table 13-26a). The risk index scores reported for each levee failure scenario are the risk expressed as a percentage of a "worst-case" score for each species. This risk index score is a dimensionless number which essentially integrates the immediate and long-term beneficial and adverse impacts of each levee-failure scenario and expresses those impacts relative to the worst-case scenario.

Results from all modeled seismic scenarios indicate that sturgeon would benefit from levee-failure events. This reflects the fact that sturgeon forage in benthic aquatic environments that would be created by levee-failures. In addition, sturgeon are not very susceptible to the negative impacts of levee-failure because their average larval and juvenile population densities in the Delta are low (low EL) and most of their population is not in the Delta at any given moment (low PEL). The actual benefit of levee-failures to sturgeon must be interpreted with caution as impact factors are expressed as a percentage of the absolute value of the impact of the worst-case scenario; for sturgeon, the worst-case scenario represented a relatively small impact on sturgeon populations.

Most of the seismically-induced levee-failure events (involving 3, 5, 10, 20, or 30 islands) resulted in beneficial population-level effects. All seismically-induced levee-failure events that resulted in flooding of 20 or 30 islands produced beneficial effects for all species; scenarios involving fewer flooded islands had adverse population consequences for some species. Threadfin shad and inland silverside suffered adverse impacts in more seismically-induced levee-failure scenarios than other species. Threadfin shad displayed the greatest adverse impact to any species in seismically-related levee-failure event (~47% of the worst-case scenario) when 10 islands flooded during a wet year.

This small sample of levee-failure scenarios revealed that:

- Adverse impacts to fish species were nearly universal in flood-related levee-failure scenarios (except for green sturgeon which benefited from all levee-failure scenarios), whereas seismically-induced levee-failure events produced a range of beneficial and adverse impacts that varied with the magnitude and timing of the event and the species involved; and
- None of the scenarios modeled here produced adverse impacts equal to the worst-case scenario for any of the species we studied.

The impacts to aquatic species of levee-failures on individual islands cannot be conclusively generalized from seismic failure scenarios here. Modeling results from the seismic induced levee-failure scenarios indicate that impacts to individual species do not scale with the magnitude of the levee-failure event; flooding of relatively few islands produced relatively large population-level effects in some cases. The impact of any single-island flood event on a particular species will be related to the nature of the failure (e.g., number of breaches), the location and size of the island involved, and the timing of the event (which impacts the density of fish in the vicinity of the breach).

The calculations of risk for terrestrial vegetation and wildlife depend entirely on area flooded, therefore, risk to terrestrial vegetation and wildlife as calculated here would be smaller than large breach scenarios. Due to the spatially heterogeneous distribution of vegetation types and wildlife habitat, the particular island flooded in a sunny day failure would influence the magnitude of the impact.

Table 13-26a, Calculation of impact factor for levee-failure scenarios: Risk factors are multiplied by species-specific weighting factors that reflect the relevance of each risk factor to each species. For a given levee-failure scenario, weighted risk factors are summed for each species to determine the impact (positive or negative) on the population of that species. The impact factor of the worst-case scenario (bottom row) reflects the maximum negative weighted risk score attributable to a levee-failure event.

Vegetation

The impact to vegetation types and terrestrial species are shown as percentage of vegetation or habitat area impacted. As discussed here, vegetation types do not include agricultural land, but agricultural land is incorporated into impacts on terrestrial species.

In all seismic levee failure scenarios, impacted habitat increased with area flooded, but the magnitude depended on the vegetation type, with loss of up to 39% of herbaceous wetland seasonal ruderal, 29% of non-native trees and 24% of shrub wetland in the Delta and Suisun Marsh. Of critical vegetation types which harbor native vegetation and rare species of vegetation, native herbaceous upland (which comprises a small total area of the Delta < 500 acres), was not impacted by flooding in any of the cases. Less than 12% of critical intertidal and aquatic habitat was impacted in any scenario; however, shrub wetland lost 24% of its total habitat in the Delta and Marsh in the worst case. Overall, these results, while not incorporating the impacts of levee breaches on sensitive species, suggest that primary impacts of flooding are on vegetation types of non-native species. However, a considerable amount of critical habitat including alkali high marsh, shrub wetland and riparian trees are reduced by 10 - 24%.

For breach scenarios involving less than 10 breaches, very small percentages (0 - 8%, average 1%) of total area of vegetation types in the Delta and Suisun are impacted, with the greatest impact on non-native upland trees (7%). In the 10-breach scenario, impacts >10% of the total area are seen in herbaceous ruderal upland (17%) and herbaceous wetland seasonal ruderal (23%), shrub wetland (10%), and non-native upland trees (14%). In the 20-breach scenario, greater losses in area are seen for each vegetation type impacted in the 10-breach scenario (herbaceous ruderal upland (23%), herbaceous wetland seasonal ruderal (33%), shrub wetland (18%), and non-native upland trees (15%), and riparian trees (12%)), with the addition of the loss of > 10% of riparian trees. In the 30-breach scenario, the vegetation type alkali marsh lost more than 10% of area (11%), in addition to loss of at least a quarter of area of vegetation types impacted in the 20-breach scenario (herbaceous ruderal upland (30%) and herbaceous wetland seasonal ruderal (39%), shrub wetland (24%), and non-native upland trees (29%)), with the exception of riparian trees (17%).

Terrestrial Wildlife

Breaching of Delta levees resulted in no impacts on several terrestrial wildlife species of concern whose habitats are restricted to Suisun Marsh, including the federally endangered Saltmarsh harvest mouse, Saltmarsh common yellowthroat, California clapper rail, and Suisun ornate shrew. In contrast, large numbers of levee breaches modeled impact 32% of available habitat for sandhill cranes and 42% of available habitat for waterfowl. These estimates could over or underestimate impact on these birds, because the assumption was made that all agriculture land was habitat, and that loss of agricultural land resulted in a proportional loss of habitat, however, these birds utilize only a fraction of agricultural land (grains, pasture alfalfa, corn and rice), and a crop map was not made available for the analysis. Nevertheless, the results here suggest large scale levee breaches cause substantial loses of available habitat, and depending on whether food is limited or plentiful in available habitat, these habitat losses could cause food shortages and displace birds.

13.3.1.3 Public Health and Safety Consequences From Earthquakes

The primary public safety concern is for the population on flooded islands who are endangered by flooding that results from the earthquake. Table 13-27 presents the populations at risk from each scenario and Figure 13-29 indicates the trend of increasing population as the number of flooded islands increases.

Table 13-27 Population at Risk for Seismic Scenarios

Seismic Scenario	Population of Flooded Islands
Case 1, 1 island flooded	1,837
Case 2, 3 islands flooded	2,241
Case 3, 3 islands flooded	2,241
Case 4, 10 islands flooded	5,359
Case 5, 20 islands flooded	5,978
Case 6, 30 islands flooded	9,554

13.3.2 Flood Consequences

Two representative cases of severe flood events were developed to analyze consequences from floods (assuming 2005 conditions) so they could be compared with consequences from earthquakes. Case 7 was developed as a “20 islands flooded” case and Case 8 as a “30 islands flooded case.” For reference, the following peak Delta inflows can be considered:

- 1986, February – highest of record, 661,000 cfs
- 1997, January – second highest of record, 562,000 cfs
- 100-year flood (2005 conditions) – 900,000 cfs (per the Flood Hazard TM)

These inflows indicate a potential for substantially higher inflows than have been experienced to date and, based on preliminary flood vulnerability results, inflows larger than the 100-year flood can be expected to cause a significant number of failures.

In Cases 7 and 8, specific flood inflows were not used to specify levee failures. Instead levee failures were assumed for various islands/tracts near the inflow points of major Delta tributaries. The objective was to assume relatively large number of failures and assess the scale of impacts. The islands assumed flooded in Case 7 are indicated in Figure 13-30 and for Case 8 are indicated in Figure 13-31. No damaged but not flooded islands were assumed and only one breach was assumed per island. No non-breach damage was assumed on the flooded islands

To assess potential salinity impacts, the flooded islands for each case were input to WAM for various flood months of record. Little impact on Delta salinity or water exports was found.

A more detailed evaluation was performed for the specific WAM outputs that occurred in conjunction with the January 1997 flood, assuming January 2005 development conditions.

Emergency Levee Response and Repair

The duration and cost of levee repairs rise as the number of islands flooded in a hydrologic event increase, as indicated in Table 13-28. Emergency repairs are estimated to take a little less than 13 months for 20 flooded islands and more than 13 months for 30 flooded islands. Repairs are estimated to increase from 4.8 to 6.8 billion dollars.

Table 13-28 Duration and Cost of Repair for Hydrologic Cases

Hydrologic (Flood) Case	Number of Flooded Islands	Duration of Repairs (months)	Cost of Repairs ($billion)
7	20	13-	4.8
8	30	13+	6.8

Export Disruption

When a levee breach occurs during a flood, the water from Suisun Bay that is drawn into the Delta and the flooded islands is less than in summer (because of high flows in the rivers) and the Bay waters may also be relatively fresh. There may be essentially no impact on water quality at the export pumps and no impact on reduction of water pumped. As shown in the Table 13-29, for a large flood like January 1997, pumping would not be stopped at all. Depending on the number of flooded islands, the timing and size of the flood and whether high flows have already freshened the Delta and Suisun Bay this may be the most common occurrence. There were a couple of large floods in the historic record that did not have such negligible impacts, but those floods disrupted pumping for only one month and the maximum amount of water not pumped was 0.7 million acre-feet.

Table 13-29 Duration of No Export Pumping for Hydrologic Cases

Hydrologic (Flood) Case	Number of Flooded Islands	Duration of No Pumping (months)[1]	Water Not Exported (maf[2])
7	20	0	0
8	30	0	0

[1] Export disruptions could continue for an additional period after pumping restarts. Depending on the severity of the scenario, only partial pumping may possible for some time.
[2] million acre-feet

13.3.2.1 Economic Consequences from Floods

Flood Economic Case Studies

Tables 13-30 and 13-31 summarize the economic costs and economic impacts, respectively of the two scenarios addressing hydrologic (flood) events. Again, economic costs are summarized in terms of two broad categories, namely, in-Delta cost and statewide cost as shown in Figure 13-32. About 98% of the total cost is in-Delta cost and the other 2% is due to lost use of infrastructure that is of statewide importance. The main elements of in-Delta costs are emergency response and repair cost, infrastructure repair cost, lost use of structures and services, agricultural losses, and lost recreation. About 80% of in-Delta costs are from the emergency response and repair cost and infrastructure repair cost, and 15% are from loss of use of structures and services. Other significant in-Delta costs were to agriculture. Neither of the flood case studies showed any water supply disruption. The main statewide infrastructure disruption was to Delta area highways. The economic impacts are again mostly controlled by the value of lost output, followed by lost value added, then lost labor income, as shown in Figure 13-33 for Case 7, the 20 island flood scenario, and Case 8, the 30 island flood scenario. The lost jobs are shown digitally on the figure.

13.3.2.2 Ecosystem Consequences from Floods

Aquatic Species

Outcomes of the two flood-related levee-failure scenarios, revealed adverse impacts to every species studied except for green sturgeon and steelhead (Tables 13-32 and 13-33). As indicated above, green sturgeon benefited from every levee-failure scenario. Steelhead displayed a relatively small net benefit (~4% of the magnitude of the worst-case scenario) from both 20-island and 30-island flood scenarios when they occurred in December and April and adverse effects when these flood-scenarios occurred in other months. Adverse impacts to other species occurred without regard to the month, water year type, or magnitude of the levee-failure scenario. Delta smelt and longfin smelt displayed the greatest adverse impacts to any species in flood-related levee-failure events (~63% of the worst-case scenario).

Vegetation

In the flood scenarios, the islands breached were primarily those in the northern Delta, in contrast with seismic levee breach scenarios in which breached islands were primarily in the center of the Delta. This shift in geography results in vastly different impacts of flood induced breach scenarios from seismic induced breach scenarios. The primary difference is the much greater loss of all tree vegetation types in flood scenarios (vegetation type [20-breach, 30-breach]: native trees [34%; 45%], non-native trees [22%; 35%], tree wetlands [19%, 21%]). Flood scenarios result in a extremely large losses of total critical native tree habitat, which, in contrast, were diminished less than 10% of total area in any seismic failure. Herbaceous upland, which comprised the largest percent of impacted areas in the seismic scenarios with large numbers of breaches, lost only 9 and 13% of total area in 20 and 30 breach scenarios, respectively. Smaller losses of percent of total habitat (<10%) in the Delta and Suisun Marsh were seen for all other vegetation types which lost large areas (>10%) in seismic events.

Terrestrial Wildlife

Flood: In contrast with terrestrial vegetation, there was little difference in the impact of seismic- and flood-induced levee breach scenarios. Neither flood nor seismic breach scenarios impact Suisun Marsh, resulting in no impacts on several terrestrial wildlife species of concern whose habitats are restricted to Suisun Marsh, including the federally endangered Saltmarsh harvest mouse, Saltmarsh common yellowthroat, California clapper rail, and Suisun ornate shrew. As in the seismic levee breaches, the impacts of flood levee breaches included large losses of total habitat for sandhill cranes (20-breach: 34%; 30-breach: 57%) and waterfowl (20-breach: 22%; 30-breach: 36%). However, a flood-induced 30-levee breach event almost doubles the loss of sandhill crane foraging habitat (57%) compared with a seismic-induced levee failure of the same magnitude (32%).

13.3.2.3 Public Health and Safety Consequences from Floods

The primary public safety concern is for the population on flooded islands who are endangered by flooding that results from the hydrologic event. Table 13-34 presents the populations at risk from each scenario and Figure 13-34 indicates the trend of increasing population as the number of flooded islands increases.

Table 13-34 Population at Risk for Flood Scenarios

Flood Scenario	Population of Flooded Islands
Case 7, 20 islands flooded	20,548
Case 8, 30 islands flooded	34,887

13.3.3 Sunny Day Failure Consequences

Sunny day failures are assumed to occur one flooded island at a time, for 2005 conditions. Consequences are expected to be similar to single-island consequences of floods or earthquakes. Since sunny day failures are defined to occur in the late spring, summer or early fall (i.e., during the low flow season) there seemed to be some possibility of salinity intrusion and Delta salinity / water export impacts. A single island failure for Brannon-Andrus was considered for all months in the CalSim trace (984 months as different event start times) and no significant impact on water exports was found. The maximum disruption was for less than three months with negligible economic impacts.

13.4 2005 BASE CASE RESULTS SUMMARY

The 2005 base case indicates that the Delta and Suisun area faces considerable risk of multiple island failures from both seismic and flood events. The population at risk and the economic and ecological consequences from a major event are expected to be severe.

Table 13-1 Delta & Suisun Marsh Annual Frequency of Sunny Day Failures

URS_ID	URS Name	Levee Length (Miles)	Annual Mean No. of Failures
4	Webb Tract	12.9	1.30E-03
5	Empire Tract	10.5	1.06E-03
6	Bradford Island	7.4	7.48E-04
7	King Island	9.1	9.15E-04
9	Jersey Island	15.5	1.56E-03
10	Bethel Island	11.5	1.16E-03
11	Quimby Island	7.0	7.07E-04
12	McDonald Tract	13.7	1.38E-03
13	Holland Tract	11.0	1.10E-03
14	Dutch Slough West	1.8	1.85E-04
15	Bacon Island	14.3	1.44E-03
16	Palm Tract	7.9	7.94E-04
17	Jones Tract-Upper and Lower	18.7	1.88E-03
19	Woodward Island	8.9	8.99E-04
20	Orwood Tract	8.6	8.65E-04
21	Victoria Island	15.0	1.52E-03
32	Coney Island	5.5	5.51E-04
62	Walnut Grove	2.9	2.90E-04
63	Tyler Island	22.9	2.31E-03
75	N. of Glanville Tract	6.2	6.22E-04
77	Elk Grove SE (Zones not in MHHW)	1.4	1.45E-04
78	Elk Grove Sth	6.1	6.12E-04
86	Terminous East	1.3	1.36E-04
87	Terminous	19.2	1.93E-03
108	Hotchkiss Tract	6.7	6.71E-04
109	Dutch Slough East	2.0	2.06E-04
112	Union Island East	3.4	3.40E-04
113	Union Island South East	4.3	4.38E-04
114	Stark Tract	5.1	5.14E-04
115	Upper Roberts Island	17.8	1.79E-03
117	Union Island	25.3	2.55E-03
118	Pescadero	9.0	9.10E-04
119	Paradise Junction	7.0	7.07E-04
120	McMullin Ranch	10.2	1.03E-03
121	Kasson District	3.8	3.86E-04
126	Pico Naglee Tract	10.1	1.01E-03
127	Byron Tract	9.8	9.87E-04
129	Veale Tract 1	5.4	5.42E-04
135	West Sacto 1	10.8	1.09E-03
141	Merritt Island	17.7	1.79E-03
143	Rindge Tract	15.8	1.59E-03
144	Mandeville Island	14.3	1.44E-03
146	Sutter Island	12.4	1.25E-03
147	Grand Island	28.3	2.85E-03
148	Elk Grove SW	7.4	7.49E-04
149	Pierson Tract	15.9	1.61E-03
150	Venice Island	12.4	1.25E-03
152	Medford Island	5.9	5.93E-04
153	Rough and Ready Island	6.8	6.85E-04
157	Smith Tract	5.8	5.83E-04
158	Weber Tract	3.8	3.81E-04
159	Boggs Tract	6.1	6.14E-04
162	Fabian Tract2	3.1	3.13E-04
163	Fabian Tract	18.8	1.89E-03
165	Walthal Tract	6.2	6.30E-04
166	RD 17 (Mossdale)	15.8	1.59E-03
168	Libby McNeil Tract 1_2	3.7	3.74E-04
169	McCormack Williamson Tract	8.7	8.79E-04
170	Glanville Tract	11.5	1.16E-03
171	Cosumnes River Area	6.8	6.81E-04
172	New Hope Tract	13.6	1.37E-03
173	Deadhorse Island	2.6	2.61E-04
174	Staten Island	25.3	2.55E-03
175	Canal Ranch	10.6	1.07E-03
176	Brack Tract	10.8	1.09E-03
177	Bouldin Island	17.9	1.81E-03

Table 13-1 Delta & Suisun Marsh Annual Frequency of Sunny Day Failures

URS_ID	URS Name	Levee Length (Miles)	Annual Mean No. of Failures
179	Twitchell Island	11.9	1.20E-03
182	Shin Kee Tract	6.5	6.59E-04
183	Rio Blanco Tract	5.8	5.86E-04
185	Atlas Tract East	1.6	1.63E-04
187	Shima Tract	7.0	7.09E-04
190	Wright-Elmwood Tract	7.1	7.11E-04
191	Sargent Barnhart Tract	7.9	7.94E-04
196	Sacramento Pocket Area	15.7	1.59E-03
197	Elk Grove West	7.4	7.47E-04
210	Ryer Island	20.2	2.04E-03
212	Clifton Crt FW	7.8	7.89E-04
216	Fabian Tract South West 1	2.0	1.99E-04
1000	Netherlands	41.8	4.21E-03
1002	Drexler Tract	9.2	9.26E-04
1003	Roberts Island	29.6	2.98E-03
1004	West Sacto 2	12.6	1.27E-03
1005	Elk Grove	17.4	1.76E-03
1006	Upper Andrus Island	11.2	1.13E-03
1007	Lower Andrus Island	29.9	3.01E-03
1008	Stewart Tract	12.2	1.22E-03
1009	Mossdale R.D. No. 2107	5.7	5.70E-04
1010	Clifton Crt FS	5.2	5.19E-04
1012	Atlas Tract	3.0	3.00E-04
1013	Bishop Tract	8.7	8.72E-04
1014	McMullin Rch2 River Junction Tr	9.3	9.34E-04
1015	Sherman Island	19.4	1.96E-03
1016	Smith Tract - Lincoln Village Tr	5.6	5.60E-04
68	Little Egbert Tract	10.3	1.04E-03
70	Egbert Tract Includes 69	5.4	5.40E-04
72	Peter Pocket	7.5	7.60E-04
79	Peter's Pocket West	3.8	3.85E-04
80	Cache Haas Tract 1 East	2.1	2.07E-04
88	Cache Haas Tr1	8.9	9.01E-04
89	Cache Haas Tr2	7.2	7.25E-04
1001	Hastings Tract 81_82	17.1	1.72E-03
39	SM-39	4.3	7.21E-04
40	SM-40	5.7	9.49E-04
41	SM-41	2.6	4.37E-04
42	SM-42	1.5	2.41E-04
43	SM-43	4.7	7.78E-04
44	SM-44	6.1	1.01E-03
45	SM-45	3.0	4.97E-04
46	SM-46	4.1	6.73E-04
47	SM-47	4.5	7.53E-04
48	SM-48	12.1	2.00E-03
49	SM-49	8.0	1.33E-03
50	SM-1/2_50_58	20.2	3.35E-03
51	SM-51	5.2	8.60E-04
54	SM 54a	7.6	1.26E-03
55	SM-55_56_84_85_131_132	31.6	5.25E-03
59	SM-59a	6.2	1.02E-03
60	SM-60	14.1	2.33E-03
123	SM-123	8.3	1.37E-03
124	SM-57_124	9.9	1.64E-03
133	SM-133_134	8.9	1.48E-03
198	SM-198	9.5	1.57E-03
201	Honker Bay Club_Van Sickle Island	15.0	2.49E-03
202	SM-202	4.7	7.85E-04
203	Simmons-Wheeler Island_SM-204	9.9	1.63E-03
54b	SM 54b	5.3	8.79E-04
59b	SM-59b	4.2	6.91E-04

Table 13-3 Delta & Suisun Marsh Individual Island Rates of Seismic Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
1007	Lower Andrus Island	4.45E-02	67%	89%	99%
1015	Sherman Island	4.28E-02	66%	88%	99%
179	Twitchell Island	3.86E-02	62%	86%	98%
9	Jersey Island	3.75E-02	61%	85%	98%
6	Bradford Island	3.70E-02	60%	84%	98%
10	Bethel Island	3.70E-02	60%	84%	98%
63	Tyler Island	3.62E-02	60%	84%	97%
147	Grand Island	3.61E-02	59%	84%	97%
4	Webb Tract	3.45E-02	58%	82%	97%
150	Venice Island	3.08E-02	54%	79%	95%
127	Byron Tract	2.28E-02	44%	68%	90%
21	Victoria Island	1.98E-02	39%	63%	86%
144	Mandeville Island	1.97E-02	39%	63%	86%
13	Holland Tract	1.97E-02	39%	63%	86%
117	Union Island	1.96E-02	39%	62%	86%
212	Clifton Crt FW	1.95E-02	39%	62%	86%
1003	Roberts Island	1.87E-02	37%	61%	85%
12	McDonald Tract	1.86E-02	37%	61%	84%
177	Bouldin Island	1.83E-02	37%	60%	84%
19	Woodward Island	1.81E-02	36%	60%	84%
108	Hotchkiss Tract	1.72E-02	35%	58%	82%
174	Staten Island	1.71E-02	35%	58%	82%
16	Palm Tract	1.66E-02	34%	56%	81%
149	Pierson Tract	1.65E-02	34%	56%	81%
210	Ryer Island	1.62E-02	33%	55%	80%
163	Fabian Tract	1.58E-02	33%	55%	79%
11	Quimby Island	1.51E-02	31%	53%	78%
143	Rindge Tract	1.50E-02	31%	53%	78%
17	Jones Tract-Upper and Lower	1.46E-02	30%	52%	77%
15	Bacon Island	1.39E-02	29%	50%	75%
146	Sutter Island	1.37E-02	29%	50%	75%
1000	Netherlands	1.37E-02	29%	50%	75%
109	Dutch Slough East	1.36E-02	29%	49%	74%
152	Medford Island	1.33E-02	28%	49%	74%
172	New Hope Tract	1.32E-02	28%	48%	73%
5	Empire Tract	1.31E-02	28%	48%	73%
14	Dutch Slough West	1.25E-02	27%	46%	71%
1010	Clifton Crt FS	1.24E-02	27%	46%	71%
175	Canal Ranch	1.20E-02	26%	45%	70%
162	Fabian Tract2	1.17E-02	25%	44%	69%
20	Orwood Tract	1.14E-02	25%	43%	68%
1002	Drexler Tract	1.13E-02	25%	43%	68%
32	Coney Island	1.09E-02	24%	42%	66%
141	Merritt Island	1.05E-02	23%	41%	65%
216	Fabian Tract South West 1	1.00E-02	22%	39%	63%
191	Sargent Barnhart Tract	9.99E-03	22%	39%	63%
87	Terminous	9.87E-03	22%	39%	63%
190	Wright-Elmwood Tract	9.59E-03	21%	38%	62%
169	McCormack Williamson Tract	9.36E-03	21%	37%	61%
170	Glanville Tract	8.69E-03	20%	35%	58%
7	King Island	8.03E-03	18%	33%	55%
129	Veale Tract 1	8.02E-03	18%	33%	55%
157	Smith Tract	7.71E-03	18%	32%	54%
1006	Upper Andrus Island	7.63E-03	17%	32%	53%
1013	Bishop Tract	7.51E-03	17%	31%	53%
176	Brack Tract	7.11E-03	16%	30%	51%
168	Libby McNeil Tract 1_2	7.00E-03	16%	30%	50%
153	Rough and Ready Island	6.84E-03	16%	29%	50%
197	Elk Grove West	6.57E-03	15%	28%	48%
1005	Elk Grove	6.49E-03	15%	28%	48%
126	Pico Naglee Tract	6.01E-03	14%	26%	45%
183	Rio Blanco Tract	5.62E-03	13%	25%	43%
159	Boggs Tract	5.48E-03	13%	24%	42%
148	Elk Grove SW	5.46E-03	13%	24%	42%
1016	Smith Tract - Lincoln Village Tr	5.27E-03	12%	23%	41%
158	Weber Tract	5.04E-03	12%	22%	40%
114	Stark Tract	5.00E-03	12%	22%	39%

Table 13-3 Delta & Suisun Marsh Individual Island Rates of Seismic Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
171	Cosumnes River Area	4.95E-03	12%	22%	39%
182	Shin Kee Tract	4.74E-03	11%	21%	38%
118	Pescadero	4.64E-03	11%	21%	37%
62	Walnut Grove	4.63E-03	11%	21%	37%
75	N. of Glanville Tract	4.51E-03	11%	20%	36%
113	Union Island South East	4.39E-03	10%	20%	36%
115	Upper Roberts Island	4.38E-03	10%	20%	35%
1008	Stewart Tract	4.34E-03	10%	19%	35%
196	Sacramento Pocket Area	4.14E-03	10%	19%	34%
112	Union Island East	4.00E-03	10%	18%	33%
78	Elk Grove Sth	3.94E-03	9%	18%	33%
119	Paradise Junction	3.87E-03	9%	18%	32%
1014	McMullin Rch2 River Junction Tr	3.80E-03	9%	17%	32%
121	Kasson District	3.79E-03	9%	17%	32%
185	Atlas Tract East	3.79E-03	9%	17%	32%
1009	Mossdale R.D. No. 2107	3.72E-03	9%	17%	31%
120	McMullin Ranch	3.71E-03	9%	17%	31%
165	Walthal Tract	3.59E-03	9%	16%	30%
166	RD 17 (Mossdale)	3.39E-03	8%	16%	29%
173	Deadhorse Island	3.38E-03	8%	16%	29%
1004	West Sacto 2	3.30E-03	8%	15%	28%
187	Shima Tract	3.22E-03	8%	15%	28%
86	Terminous East	3.08E-03	7%	14%	27%
1012	Atlas Tract	2.70E-03	7%	13%	24%
77	Elk Grove SE (Zones not in MHHW)	1.47E-03	4%	7%	14%
135	West Sacto 1	1.32E-03	3%	6%	12%
1001	Hastings Tract 81_82	2.31E-02	44%	68%	90%
68	Little Egbert Tract	1.54E-02	32%	54%	78%
70	Egbert Tract Includes 69	1.42E-02	30%	51%	76%
72	Peter Pocket	1.28E-02	27%	47%	72%
89	Cache Haas Tr2	1.19E-02	26%	45%	70%
88	Cache Haas Tr1	1.14E-02	25%	43%	68%
79	Peter's Pocket West	1.10E-02	24%	42%	67%
80	Cache Haas Tract 1 East	7.61E-03	17%	32%	53%
54b	SM 54b	2.13E-03	5%	10%	19%
39	SM-39	2.03E-03	5%	10%	18%
44	SM-44	1.97E-03	5%	9%	18%
40	SM-40	1.89E-03	5%	9%	17%
47	SM-47	1.35E-03	3%	7%	13%
49	SM-49	1.18E-03	3%	6%	11%
48	SM-48	1.15E-03	3%	6%	11%
54	SM 54a	9.33E-04	2%	5%	9%
46	SM-46	9.31E-04	2%	5%	9%
123	SM-123	7.55E-04	2%	4%	7%
45	SM-45	6.20E-04	2%	3%	6%
203	Simmons-Wheeler Island_SM-204	6.03E-04	1%	3%	6%
59	SM-59a	5.41E-04	1%	3%	5%
198	SM-198	4.62E-04	1%	2%	5%
41	SM-41	4.33E-04	1%	2%	4%
50	SM-1/2_50_58	3.61E-04	1%	2%	4%
43	SM-43	3.59E-04	1%	2%	4%
59b	SM-59b	3.01E-04	1%	1%	3%
51	SM-51	3.01E-04	1%	1%	3%
201	Honker Bay Club_Van Sickle Island	2.93E-04	1%	1%	3%
60	SM-60	2.06E-04	1%	1%	2%
133	SM-133_134	2.01E-04	1%	1%	2%
124	SM-57_124	1.93E-04	0%	1%	2%
55	SM-55_56_84_85_131_132	9.91E-05	0%	0%	1%
202	SM-202	9.11E-05	0%	0%	1%
42	SM-42	4.27E-05	0%	0%	0%
	TOTAL DELTA	**1.17E+00**	**100.00%**	**100.00%**	**100.00%**
	TOTAL CACHE HAAS AREA	**1.07E-01**	**93.18%**	**99.53%**	**100.00%**
	TOTAL SUISUN MARSH	**1.94E-02**	**38.49%**	**62.16%**	**85.68%**
	TOTAL	**1.29E+00**	**100.00%**	**100.00%**	**100.00%**

Table 13-4 Delta & Suisun Marsh Individual Island Rates of Seismic Failures - Seismic Source Contribution

URS_ID	URS Name	Fraction Contribution of Seismic Sources										
		San Andreas	Hayward	Calaveras	Concord	Mt. Diablo	Pittsburg-Kirby Hills	CRSB	Southern Midland	Hunting Creek - Berryesa	Northern Midland	Other
1007	Lower Andrus Island	8%	17%	8%	11%	5%	4%	4%	10%	6%	5%	23%
1015	Sherman Island	8%	17%	9%	12%	6%	5%	3%	11%	4%	3%	23%
179	Twitchell Island	8%	17%	8%	11%	5%	4%	3%	12%	5%	4%	22%
9	Jersey Island	8%	17%	9%	10%	6%	4%	3%	12%	4%	3%	24%
6	Bradford Island	8%	17%	9%	10%	6%	4%	3%	13%	5%	3%	23%
10	Bethel Island	8%	17%	10%	10%	6%	4%	2%	14%	4%	2%	23%
63	Tyler Island	8%	16%	8%	10%	5%	4%	5%	10%	6%	6%	21%
147	Grand Island	8%	16%	7%	10%	4%	4%	6%	10%	7%	8%	19%
4	Webb Tract	8%	16%	9%	9%	6%	4%	3%	14%	5%	3%	22%
150	Venice Island	9%	17%	9%	9%	6%	4%	3%	12%	5%	3%	23%
127	Byron Tract	9%	17%	14%	7%	8%	2%	1%	9%	2%	1%	28%
21	Victoria Island	10%	17%	13%	7%	9%	2%	1%	10%	3%	1%	28%
144	Mandeville Island	9%	17%	10%	9%	7%	3%	2%	12%	4%	3%	24%
13	Holland Tract	9%	16%	10%	9%	7%	3%	2%	14%	4%	2%	24%
117	Union Island	10%	17%	15%	6%	8%	2%	1%	8%	2%	1%	31%
212	Clifton Crt FW	9%	17%	15%	6%	9%	2%	1%	9%	2%	1%	29%
1003	Roberts Island	10%	17%	12%	7%	7%	2%	2%	9%	4%	2%	28%
12	McDonald Tract	9%	17%	11%	8%	7%	3%	2%	11%	4%	3%	25%
177	Bouldin Island	9%	17%	9%	9%	6%	4%	3%	12%	5%	4%	22%
19	Woodward Island	9%	17%	12%	7%	8%	3%	1%	11%	3%	1%	27%
108	Hotchkiss Tract	9%	16%	10%	9%	7%	4%	1%	16%	3%	2%	23%
174	Staten Island	8%	17%	8%	9%	5%	4%	4%	11%	7%	7%	21%
16	Palm Tract	9%	17%	11%	8%	8%	3%	1%	14%	3%	1%	25%
149	Pierson Tract	8%	17%	6%	9%	4%	4%	7%	7%	9%	10%	19%
210	Ryer Island	8%	16%	6%	9%	4%	5%	6%	11%	8%	10%	17%
163	Fabian Tract	11%	17%	15%	5%	9%	1%	0%	8%	2%	0%	32%
68	Little Egbert Tract	8%	16%	6%	10%	4%	5%	5%	12%	7%	9%	18%
11	Quimby Island	9%	17%	10%	8%	7%	3%	2%	14%	4%	2%	23%
143	Rindge Tract	9%	17%	11%	8%	7%	3%	2%	10%	5%	3%	25%
17	Jones Tract-Upper and Lower	10%	17%	12%	6%	9%	2%	1%	11%	3%	1%	27%
15	Bacon Island	10%	17%	11%	7%	8%	3%	2%	14%	4%	2%	24%
146	Sutter Island	8%	16%	5%	9%	4%	5%	7%	9%	9%	12%	16%
1000	Netherlands	8%	16%	4%	8%	3%	4%	9%	7%	11%	15%	14%
109	Dutch Slough East	9%	16%	9%	8%	8%	4%	1%	18%	3%	1%	22%
152	Medford Island	9%	17%	10%	8%	7%	3%	2%	13%	4%	3%	24%
172	New Hope Tract	9%	17%	7%	8%	5%	4%	5%	10%	8%	8%	20%
5	Empire Tract	9%	17%	10%	8%	6%	3%	3%	11%	5%	3%	23%
14	Dutch Slough West	9%	16%	9%	8%	8%	4%	1%	19%	3%	1%	22%
1010	Clifton Crt FS	11%	16%	14%	5%	11%	1%	0%	9%	2%	0%	31%
175	Canal Ranch	9%	17%	8%	8%	5%	4%	4%	11%	8%	7%	20%
162	Fabian Tract2	11%	16%	14%	4%	11%	1%	0%	8%	1%	0%	32%
20	Orwood Tract	10%	16%	11%	6%	10%	2%	1%	17%	3%	1%	24%
1002	Drexler Tract	11%	17%	12%	5%	10%	2%	1%	10%	3%	1%	29%
32	Coney Island	11%	16%	13%	5%	12%	1%	0%	11%	2%	0%	29%
141	Merritt Island	8%	16%	4%	8%	3%	4%	9%	7%	12%	15%	14%
216	Fabian Tract South West 1	11%	16%	14%	4%	11%	1%	0%	7%	1%	0%	34%
191	Sargent Barnhart Tract	10%	18%	12%	6%	8%	2%	2%	9%	4%	2%	27%
87	Terminous	10%	18%	9%	8%	6%	3%	3%	11%	6%	4%	22%
190	Wright-Elmwood Tract	11%	17%	11%	6%	8%	2%	2%	10%	4%	2%	26%
169	McCormack Williamson Tract	9%	17%	6%	8%	4%	4%	5%	10%	9%	9%	18%
170	Glanville Tract	9%	17%	6%	7%	4%	4%	6%	9%	11%	11%	16%
7	King Island	11%	18%	10%	6%	7%	3%	2%	13%	5%	3%	23%
129	Veale Tract 1	9%	15%	9%	6%	9%	3%	1%	23%	3%	1%	21%
157	Smith Tract	11%	18%	11%	6%	8%	2%	1%	9%	4%	2%	28%
1006	Upper Andrus Island	9%	17%	6%	7%	4%	4%	5%	13%	9%	9%	17%
1013	Bishop Tract	11%	18%	10%	6%	7%	3%	2%	12%	6%	3%	23%
176	Brack Tract	9%	18%	8%	7%	5%	3%	4%	12%	8%	6%	20%
168	Libby McNeil Tract 1_2	9%	17%	6%	8%	4%	4%	5%	11%	10%	9%	17%
153	Rough and Ready Island	12%	18%	11%	5%	9%	2%	1%	10%	3%	1%	28%
197	Elk Grove West	8%	17%	4%	7%	2%	4%	9%	6%	15%	16%	12%
1005	Elk Grove	8%	17%	4%	7%	3%	4%	8%	7%	14%	15%	13%
126	Pico Naglee Tract	12%	16%	13%	3%	10%	1%	0%	7%	1%	0%	36%
183	Rio Blanco Tract	11%	18%	9%	6%	7%	3%	2%	12%	6%	3%	22%
159	Boggs Tract	12%	18%	11%	5%	9%	2%	1%	9%	3%	1%	29%
148	Elk Grove SW	8%	17%	4%	7%	3%	4%	7%	8%	13%	15%	13%
1016	Smith Tract - Lincoln Village Tr	12%	18%	11%	5%	9%	2%	1%	10%	4%	2%	26%
158	Weber Tract	12%	18%	11%	5%	9%	2%	1%	9%	4%	1%	28%
114	Stark Tract	13%	16%	12%	3%	10%	1%	0%	7%	1%	0%	36%
171	Cosumnes River Area	10%	18%	6%	6%	4%	4%	5%	11%	11%	10%	16%

Table 13-4 Delta & Suisun Marsh Individual Island Rates of Seismic Failures - Seismic Source Contribution

		Fraction Contribution of Seismic Sources										
URS_ID	**URS Name**	**San Andreas**	**Hayward**	**Calaveras**	**Concord**	**Mt. Diablo**	**Pittsburg-Kirby Hills**	**CRSB**	**Southern Midland**	**Hunting Creek - Berryesa**	**Northern Midland**	**Other**
182	Shin Kee Tract	11%	19%	9%	6%	7%	3%	2%	13%	6%	3%	21%
118	Pescadero	13%	16%	12%	3%	9%	1%	0%	6%	1%	0%	38%
62	Walnut Grove	9%	18%	6%	6%	4%	4%	5%	13%	10%	10%	16%
75	N. of Glanville Tract	8%	18%	5%	7%	3%	4%	7%	9%	13%	14%	13%
113	Union Island South East	13%	17%	12%	3%	10%	1%	0%	7%	1%	0%	36%
115	Upper Roberts Island	13%	17%	12%	3%	10%	1%	0%	7%	1%	0%	36%
1008	Stewart Tract	13%	17%	12%	3%	9%	1%	0%	6%	1%	0%	37%
196	Sacramento Pocket Area	7%	16%	3%	6%	1%	3%	12%	4%	21%	19%	9%
112	Union Island East	13%	17%	12%	3%	10%	1%	0%	8%	2%	0%	34%
78	Elk Grove Sth	8%	18%	5%	6%	3%	4%	7%	8%	15%	15%	12%
119	Paradise Junction	14%	16%	13%	2%	7%	1%	0%	4%	1%	0%	43%
1014	McMullin Rch2 River Junction Tr	15%	14%	13%	2%	5%	0%	0%	2%	0%	0%	48%
121	Kasson District	15%	15%	13%	2%	6%	0%	0%	3%	1%	0%	47%
185	Atlas Tract East	12%	19%	10%	5%	8%	2%	1%	11%	5%	2%	24%
1009	Mossdale R.D. No. 2107	14%	16%	13%	2%	8%	1%	0%	5%	1%	0%	41%
120	McMullin Ranch	14%	15%	13%	2%	6%	0%	0%	3%	1%	0%	45%
165	Walthal Tract	14%	16%	13%	2%	7%	1%	0%	4%	1%	0%	42%
166	RD 17 (Mossdale)	13%	17%	12%	3%	9%	1%	0%	6%	2%	0%	37%
173	Deadhorse Island	9%	18%	6%	6%	4%	4%	4%	14%	11%	9%	15%
1004	West Sacto 2	6%	15%	2%	6%	1%	3%	12%	3%	24%	20%	8%
187	Shima Tract	11%	19%	10%	5%	8%	2%	1%	13%	6%	2%	23%
86	Terminous East	10%	19%	8%	6%	5%	3%	3%	13%	8%	5%	19%
1012	Atlas Tract	12%	19%	10%	5%	9%	2%	1%	12%	5%	2%	24%
77	Elk Grove SE (Zones not in MHHW)	6%	18%	4%	5%	2%	3%	7%	7%	22%	16%	10%
135	West Sacto 1	5%	14%	2%	5%	1%	2%	12%	2%	35%	17%	6%
1001	Hastings Tract 81_82	7%	16%	5%	12%	3%	5%	8%	6%	8%	11%	18%
70	Egbert Tract Includes 69	8%	16%	5%	11%	3%	6%	7%	8%	8%	12%	17%
72	Peter Pocket	8%	15%	4%	10%	3%	6%	8%	6%	10%	18%	14%
89	Cache Haas Tr2	8%	16%	4%	9%	3%	5%	7%	7%	10%	16%	15%
88	Cache Haas Tr1	7%	15%	4%	9%	2%	5%	8%	5%	10%	19%	13%
79	Peter's Pocket West	8%	16%	4%	10%	3%	7%	8%	6%	10%	17%	14%
80	Cache Haas Tract 1 East	7%	15%	3%	8%	2%	6%	8%	5%	11%	24%	11%
550	SM-1/2_50_58	2%	8%	1%	68%	1%	2%	1%	0%	1%	0%	16%
554	SM 54a	1%	4%	1%	80%	0%	1%	0%	0%	0%	0%	13%
654	SM 54b	1%	6%	1%	80%	0%	0%	0%	0%	0%	0%	10%
39	SM-39	1%	5%	0%	80%	0%	0%	1%	0%	1%	0%	11%
40	SM-40	1%	5%	0%	82%	0%	1%	1%	0%	1%	0%	9%
41	SM-41	1%	7%	1%	72%	0%	2%	1%	0%	1%	0%	14%
42	SM-42	1%	4%	0%	48%	0%	8%	5%	0%	3%	0%	30%
43	SM-43	1%	2%	0%	3%	0%	81%	0%	0%	1%	0%	11%
44	SM-44	1%	4%	0%	82%	0%	0%	1%	0%	1%	0%	11%
45	SM-45	1%	5%	0%	79%	0%	1%	1%	0%	1%	0%	11%
46	SM-46	1%	4%	0%	84%	0%	1%	1%	0%	1%	0%	9%
47	SM-47	1%	3%	0%	88%	0%	0%	0%	0%	0%	0%	6%
48	SM-48	1%	3%	0%	88%	0%	0%	0%	0%	0%	0%	6%
49	SM-49	1%	3%	0%	88%	0%	0%	0%	0%	0%	0%	6%
51	SM-51	1%	3%	1%	6%	1%	66%	1%	0%	1%	0%	19%
123	SM-123	3%	10%	1%	63%	1%	2%	2%	0%	2%	0%	16%
555	SM-55_56_84_85_131_132	1%	7%	2%	30%	2%	20%	1%	0%	1%	0%	36%
433	SM-133_134	2%	6%	1%	15%	1%	39%	2%	1%	2%	1%	31%
557	SM-57_124	2%	9%	1%	48%	0%	8%	8%	0%	4%	1%	19%
559	SM-59a	2%	4%	1%	4%	1%	72%	1%	1%	2%	1%	13%
659	SM-59b	1%	2%	0%	3%	0%	77%	1%	0%	1%	0%	14%
60	SM-60	2%	9%	1%	40%	1%	10%	2%	0%	2%	0%	32%
198	SM-198	1%	3%	1%	4%	2%	72%	0%	1%	0%	0%	15%
501	Honker Bay Club_Van Sickle Island	0%	2%	1%	4%	2%	73%	0%	0%	0%	0%	17%
202	SM-202	0%	3%	1%	15%	3%	19%	0%	0%	0%	0%	58%
503	Simmons-Wheeler Island_SM-204	3%	10%	3%	22%	4%	15%	1%	1%	1%	0%	40%
	TOTAL DELTA	**10%**	**17%**	**9%**	**7%**	**7%**	**3%**	**3%**	**10%**	**6%**	**5%**	**24%**
	TOTAL CACHE HAAS AREA	**8%**	**16%**	**4%**	**10%**	**3%**	**6%**	**8%**	**6%**	**10%**	**17%**	**14%**
	TOTAL SUISUN MARSH	**1%**	**5%**	**1%**	**49%**	**1%**	**22%**	**1%**	**0%**	**1%**	**0%**	**18%**
	TOTAL AVERAGE	9%	17%	10%	9%	6%	3%	3%	11%	5%	4%	24%

Table 13-6 Delta & Suisun Marsh Individual Island Rates of Flood Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
150	Venice Island	7.25E-02	84%	97%	100%
176	Brack Tract	6.69E-02	81%	96%	100%
172	New Hope Tract	6.48E-02	80%	96%	100%
177	Bouldin Island	6.31E-02	79%	96%	100%
170	Glanville Tract	5.94E-02	77%	95%	100%
4	Webb Tract	5.44E-02	74%	93%	100%
1007	Lower Andrus Island	5.41E-02	74%	93%	100%
16	Palm Tract	5.35E-02	74%	93%	100%
13	Holland Tract	5.12E-02	72%	92%	99%
17	Jones Tract-Upper and Lower	5.10E-02	72%	92%	99%
191	Sargent Barnhart Tract	5.04E-02	72%	92%	99%
108	Hotchkiss Tract	5.00E-02	71%	92%	99%
86	Terminous East	5.00E-02	71%	92%	99%
167	Libby McNeil Tract 1_2	5.00E-02	71%	92%	99%
9	Jersey Island	4.67E-02	69%	90%	99%
5	Empire Tract	4.41E-02	67%	89%	99%
10	Bethel Island	4.10E-02	64%	87%	98%
6	Bradford Island	4.01E-02	63%	87%	98%
63	Tyler Island	4.01E-02	63%	87%	98%
174	Staten Island	3.91E-02	62%	86%	98%
15	Bacon Island	3.86E-02	62%	85%	98%
169	McCormack Williamson Tract	3.63E-02	60%	84%	97%
11	Quimby Island	3.60E-02	59%	83%	97%
144	Mandeville Island	3.53E-02	59%	83%	97%
1006	Upper Andrus Island	3.41E-02	57%	82%	97%
182	Shin Kee Tract	3.25E-02	56%	80%	96%
1003	Roberts Island	3.25E-02	56%	80%	96%
1002	Drexler Tract	3.25E-02	56%	80%	96%
1015	Sherman Island	3.23E-02	55%	80%	96%
1013	Bishop Tract	3.19E-02	55%	80%	96%
152	Medford Island	3.09E-02	54%	79%	95%
179	Twitchell Island	3.09E-02	54%	79%	95%
20	Orwood Tract	3.07E-02	54%	78%	95%
21	Victoria Island	2.75E-02	50%	75%	94%
173	Deadhorse Island	2.71E-02	49%	74%	93%
187	Shima Tract	2.48E-02	46%	71%	92%
32	Coney Island	2.35E-02	44%	69%	90%
12	McDonald Tract	2.06E-02	40%	64%	87%
62	Walnut Grove	1.88E-02	37%	61%	85%
127	Byron Tract	1.73E-02	35%	58%	82%
210	Ryer Island	1.72E-02	35%	58%	82%
147	Grand Island	1.52E-02	32%	53%	78%
87	Terminous	1.40E-02	29%	50%	75%
1016	Smith Tract - Lincoln Village Tr	1.30E-02	28%	48%	73%
19	Woodward Island	9.90E-03	22%	39%	63%
149	Pierson Tract	9.90E-03	22%	39%	63%
143	Rindge Tract	9.90E-03	22%	39%	63%
1000	Netherlands	9.90E-03	22%	39%	63%
109	Dutch Slough East	9.90E-03	22%	39%	63%
175	Canal Ranch	9.90E-03	22%	39%	63%
141	Merritt Island	9.90E-03	22%	39%	63%
190	Wright-Elmwood Tract	9.90E-03	22%	39%	63%
7	King Island	9.90E-03	22%	39%	63%
129	Veale Tract 1	9.90E-03	22%	39%	63%
157	Smith Tract	9.90E-03	22%	39%	63%
168	Libby McNeil Tract 1_2	9.90E-03	22%	39%	63%
153	Rough and Ready Island	9.90E-03	22%	39%	63%
197	Elk Grove West	9.90E-03	22%	39%	63%
1005	Elk Grove	9.90E-03	22%	39%	63%
183	Rio Blanco Tract	9.90E-03	22%	39%	63%
159	Boggs Tract	9.90E-03	22%	39%	63%
148	Elk Grove SW	9.90E-03	22%	39%	63%
158	Weber Tract	9.90E-03	22%	39%	63%
171	Cosumnes River Area	9.90E-03	22%	39%	63%
75	N. of Glanville Tract	9.90E-03	22%	39%	63%
196	Sacramento Pocket Area	9.90E-03	22%	39%	63%
112	Union Island East	9.90E-03	22%	39%	63%
78	Elk Grove Sth	9.90E-03	22%	39%	63%
1004	West Sacto 2	9.90E-03	22%	39%	63%
1012	Atlas Tract	9.90E-03	22%	39%	63%
77	Elk Grove SE	9.90E-03	22%	39%	63%
135	West Sacto 1	9.90E-03	22%	39%	63%

Table 13-6 Delta & Suisun Marsh Individual Island Rates of Flood Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
146	Sutter Island	9.52E-03	21%	38%	61%
121	Kasson District	9.39E-03	21%	37%	61%
120	McMullin Ranch	9.13E-03	20%	37%	60%
1014	McMullin Rch2 River Junction Tr	9.03E-03	20%	36%	59%
117	Union Island	8.69E-03	20%	35%	58%
113	Union Island South East	8.52E-03	19%	35%	57%
119	Paradise Junction	8.45E-03	19%	34%	57%
185	Atlas Tract East	7.40E-03	17%	31%	52%
126	Pico Naglee Tract	7.21E-03	16%	30%	51%
1008	Stewart Tract	4.37E-03	10%	20%	35%
1009	Mossdale R.D. No. 2107	4.37E-03	10%	20%	35%
115	Upper Roberts Island	4.03E-03	10%	18%	33%
165	Walthal Tract	3.94E-03	9%	18%	33%
166	RD 17 (Mossdale)	3.84E-03	9%	17%	32%
1010	Clifton Crt FS	3.74E-03	9%	17%	31%
162	Fabian Tract2	3.74E-03	9%	17%	31%
163	Fabian Tract	3.53E-03	8%	16%	30%
216	Fabian Tract South West 1	3.19E-03	8%	15%	27%
118	Pescadero	3.04E-03	7%	14%	26%
114	Stark Tract	1.01E-03	2%	5%	10%
80	Cache Haas Tract 1 East	2.23E-01	100%	100%	100%
79	Peter's Pocket West	1.56E-01	98%	100%	100%
72	Peter Pocket	1.17E-01	95%	100%	100%
68	Little Egbert Tract	9.43E-02	91%	99%	100%
69	Egbert Tract East	5.00E-02	71%	92%	99%
89	Cache Haas Tr2	5.00E-02	71%	92%	99%
1001	Hastings Tract 81_82	3.71E-02	60%	84%	98%
82	Hastings Tract South west	5.00E-02	71%	92%	99%
88	Cache Haas Tr1	4.03E-02	63%	87%	98%
70	Egbert Tract	3.30E-02	56%	81%	96%
41	SM-41	4.75E-01	100%	100%	100%
1	SM-1	4.66E-01	100%	100%	100%
2	SM-2	4.66E-01	100%	100%	100%
42	SM-42	4.66E-01	100%	100%	100%
57	SM-57	4.66E-01	100%	100%	100%
58	SM-58	4.66E-01	100%	100%	100%
60	SM-60	4.66E-01	100%	100%	100%
123	SM-123	4.66E-01	100%	100%	100%
124	SM-124	4.66E-01	100%	100%	100%
39	SM-39	4.48E-01	100%	100%	100%
55	SM-84-85 and others	4.07E-01	100%	100%	100%
56	SM-84-85 and others	4.07E-01	100%	100%	100%
84	SM-84-85 and others	4.07E-01	100%	100%	100%
85	SM-84-85 and others	4.07E-01	100%	100%	100%
131	SM-84-85 and others	4.07E-01	100%	100%	100%
132	SM-84-85 and others	4.07E-01	100%	100%	100%
40	SM-40	3.54E-01	100%	100%	100%
46	SM-46	2.89E-01	100%	100%	100%
202	SM-202	2.60E-01	100%	100%	100%
48	SM-48	8.13E-02	87%	98%	100%
200	SM-200	8.00E-02	86%	98%	100%
201	SM-201	8.00E-02	86%	98%	100%
204	SM-204	8.00E-02	86%	98%	100%
49	SM-49	6.20E-02	79%	96%	100%
44	SM-44	5.51E-02	75%	94%	100%
203	SM-203	5.00E-02	71%	92%	99%
54	SM-54	4.00E-02	63%	86%	98%
45	SM-45	3.97E-02	63%	86%	98%
50	SM-50	3.76E-02	61%	85%	98%
47	SM-47	3.34E-02	57%	81%	96%
59	SM-59 and others	3.14E-02	54%	79%	96%
133	SM-133 and others	1.13E-02	25%	43%	68%
134	SM-133 and others	1.13E-02	25%	43%	68%
51	SM-51	9.26E-03	21%	37%	60%
43	SM-43	9.13E-03	20%	37%	60%
198	SM-198	5.53E-03	13%	24%	42%
	TOTAL DELTA	**2.09E+00**	**100.00%**	**100.00%**	**100.00%**
	TOTAL CACHE HAAS AREA	**8.50E-01**	**100.00%**	**100.00%**	**100.00%**
	TOTAL SUISUN MARSH	**8.71E+00**	**100.00%**	**100.00%**	**100.00%**
	TOTAL	**1.17E+01**	**100.00%**	**100.00%**	**100.00%**

Table 13-8 Delta & Suisun Marsh Individual Island Composite Rates of Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
150	Venice Island	1.03E-01	92%	99%	100%
1007	Lower Andrus Island	9.86E-02	91%	99%	100%
4	Webb Tract	8.89E-02	89%	99%	100%
9	Jersey Island	8.42E-02	88%	99%	100%
177	Bouldin Island	8.14E-02	87%	98%	100%
172	New Hope Tract	7.80E-02	86%	98%	100%
10	Bethel Island	7.79E-02	86%	98%	100%
6	Bradford Island	7.71E-02	85%	98%	100%
63	Tyler Island	7.63E-02	85%	98%	100%
1015	Sherman Island	7.51E-02	85%	98%	100%
176	Brack Tract	7.40E-02	84%	98%	100%
13	Holland Tract	7.09E-02	83%	97%	100%
16	Palm Tract	7.01E-02	83%	97%	100%
179	Twitchell Island	6.95E-02	82%	97%	100%
170	Glanville Tract	6.80E-02	82%	97%	100%
108	Hotchkiss Tract	6.72E-02	81%	97%	100%
17	Jones Tract-Upper and Lower	6.55E-02	81%	96%	100%
191	Sargent Barnhart Tract	6.04E-02	78%	95%	100%
5	Empire Tract	5.72E-02	76%	94%	100%
174	Staten Island	5.62E-02	75%	94%	100%
144	Mandeville Island	5.50E-02	75%	94%	100%
86	Terminous East	5.31E-02	73%	93%	100%
15	Bacon Island	5.25E-02	73%	93%	99%
147	Grand Island	5.13E-02	72%	92%	99%
1003	Roberts Island	5.12E-02	72%	92%	99%
11	Quimby Island	5.11E-02	72%	92%	99%
167	Libby McNeil Tract 1_2	5.00E-02	71%	92%	99%
21	Victoria Island	4.73E-02	69%	91%	99%
169	McCormack Williamson Tract	4.57E-02	68%	90%	99%
152	Medford Island	4.43E-02	67%	89%	99%
1002	Drexler Tract	4.38E-02	67%	89%	99%
20	Orwood Tract	4.21E-02	65%	88%	99%
1006	Upper Andrus Island	4.17E-02	65%	88%	98%
127	Byron Tract	4.01E-02	63%	87%	98%
1013	Bishop Tract	3.94E-02	63%	86%	98%
12	McDonald Tract	3.92E-02	62%	86%	98%
182	Shin Kee Tract	3.73E-02	61%	84%	98%
32	Coney Island	3.44E-02	58%	82%	97%
210	Ryer Island	3.33E-02	57%	81%	96%
173	Deadhorse Island	3.05E-02	53%	78%	95%
117	Union Island	2.83E-02	51%	76%	94%
19	Woodward Island	2.80E-02	50%	75%	94%
187	Shima Tract	2.80E-02	50%	75%	94%
149	Pierson Tract	2.64E-02	48%	73%	93%
143	Rindge Tract	2.49E-02	46%	71%	92%
87	Terminous	2.38E-02	45%	70%	91%
1000	Netherlands	2.36E-02	45%	69%	91%
109	Dutch Slough East	2.35E-02	44%	69%	90%
62	Walnut Grove	2.34E-02	44%	69%	90%
146	Sutter Island	2.32E-02	44%	69%	90%
175	Canal Ranch	2.19E-02	42%	67%	89%
141	Merritt Island	2.04E-02	40%	64%	87%
190	Wright-Elmwood Tract	1.95E-02	39%	62%	86%
163	Fabian Tract	1.93E-02	38%	62%	86%
1016	Smith Tract - Lincoln Village Tr	1.83E-02	37%	60%	84%
7	King Island	1.79E-02	36%	59%	83%
129	Veale Tract 1	1.79E-02	36%	59%	83%
157	Smith Tract	1.76E-02	36%	59%	83%
168	Libby McNeil Tract 1_2	1.69E-02	34%	57%	82%
153	Rough and Ready Island	1.67E-02	34%	57%	81%
197	Elk Grove West	1.65E-02	34%	56%	81%
1005	Elk Grove	1.64E-02	34%	56%	81%
1010	Clifton Crt FS	1.62E-02	33%	55%	80%
183	Rio Blanco Tract	1.55E-02	32%	54%	79%
162	Fabian Tract2	1.54E-02	32%	54%	79%
159	Boggs Tract	1.54E-02	32%	54%	79%
148	Elk Grove SW	1.54E-02	32%	54%	78%
158	Weber Tract	1.49E-02	31%	53%	78%
171	Cosumnes River Area	1.49E-02	31%	52%	77%
75	N. of Glanville Tract	1.44E-02	30%	51%	76%
196	Sacramento Pocket Area	1.40E-02	30%	50%	75%
112	Union Island East	1.39E-02	29%	50%	75%

Table 13-8 Delta & Suisun Marsh Individual Island Composite Rates of Failures

URS_ID	URS Name	Annual Mean No. of Failures	Probability of Failure in 25 years	Probability of Failure in 50 years	Probability of Failure in 100 years
78	Elk Grove Sth	1.38E-02	29%	50%	75%
126	Pico Naglee Tract	1.32E-02	28%	48%	73%
1004	West Sacto 2	1.32E-02	28%	48%	73%
216	Fabian Tract South West 1	1.32E-02	28%	48%	73%
121	Kasson District	1.32E-02	28%	48%	73%
113	Union Island South East	1.29E-02	28%	48%	73%
120	McMullin Ranch	1.28E-02	27%	47%	72%
1014	McMullin Rch2 River Junction Tr	1.28E-02	27%	47%	72%
1012	Atlas Tract	1.26E-02	27%	47%	72%
14	Dutch Slough West	1.25E-02	27%	46%	71%
119	Paradise Junction	1.23E-02	27%	46%	71%
77	Elk Grove SE (Zones not in MHHW)	1.14E-02	25%	43%	68%
135	West Sacto 1	1.12E-02	24%	43%	67%
185	Atlas Tract East	1.12E-02	24%	43%	67%
1008	Stewart Tract	8.71E-03	20%	35%	58%
115	Upper Roberts Island	8.41E-03	19%	34%	57%
1009	Mossdale R.D. No. 2107	8.09E-03	18%	33%	55%
118	Pescadero	7.68E-03	17%	32%	54%
165	Walthal Tract	7.53E-03	17%	31%	53%
166	RD 17 (Mossdale)	7.23E-03	17%	30%	51%
114	Stark Tract	6.00E-03	14%	26%	45%
80	Cache Haas Tract 1 East	2.30E-01	100%	100%	100%
79	Peter's Pocket West	1.67E-01	98%	100%	100%
72	Peter Pocket	1.30E-01	96%	100%	100%
68	Little Egbert Tract	1.10E-01	94%	100%	100%
69	Egbert Tract East	6.42E-02	80%	96%	100%
89	Cache Haas Tr2	6.19E-02	79%	95%	100%
1001	Hastings Tract 81_82	6.02E-02	78%	95%	100%
82	Hastings Tract South west	6.14E-02	78%	95%	100%
88	Cache Haas Tr1	5.17E-02	73%	92%	99%
70	Egbert Tract	4.72E-02	69%	91%	99%
1	SM-1	4.66E-01	100%	100%	100%
2	SM-2	4.66E-01	100%	100%	100%
39	SM-39	4.50E-01	100%	100%	100%
40	SM-40	3.55E-01	100%	100%	100%
41	SM-41	4.75E-01	100%	100%	100%
42	SM-42	4.66E-01	100%	100%	100%
43	SM-43	9.49E-03	21%	38%	61%
44	SM-44	5.70E-02	76%	94%	100%
45	SM-45	4.03E-02	64%	87%	98%
46	SM-46	2.90E-01	100%	100%	100%
47	SM-47	3.47E-02	58%	82%	97%
48	SM-48	8.24E-02	87%	98%	100%
49	SM-49	6.32E-02	79%	96%	100%
50	SM-50	3.79E-02	61%	85%	98%
51	SM-51	9.56E-03	21%	38%	62%
54	SM-54	4.09E-02	64%	87%	98%
55	SM-84-85 and others	4.07E-01	100%	100%	100%
56	SM-84-85 and others	4.07E-01	100%	100%	100%
57	SM-57	4.66E-01	100%	100%	100%
58	SM-58	4.66E-01	100%	100%	100%
59	SM-59 and others	3.20E-02	55%	80%	96%
60	SM-60	4.66E-01	100%	100%	100%
84	SM-84-85 and others	4.07E-01	100%	100%	100%
85	SM-84-85 and others	4.07E-01	100%	100%	100%
123	SM-123	4.67E-01	100%	100%	100%
124	SM-124	4.66E-01	100%	100%	100%
131	SM-84-85 and others	4.07E-01	100%	100%	100%
132	SM-84-85 and others	4.07E-01	100%	100%	100%
133	SM-133 and others	1.15E-02	25%	44%	68%
134	SM-133 and others	1.15E-02	25%	44%	68%
198	SM-198	5.99E-03	14%	26%	45%
200	SM-200	8.03E-02	87%	98%	100%
201	SM-201	8.03E-02	87%	98%	100%
202	SM-202	2.61E-01	100%	100%	100%
203	SM-203	5.06E-02	72%	92%	99%
204	SM-204	8.06E-02	87%	98%	100%
	TOTAL DELTA	**3.24E+00**	**100.00%**	**100.00%**	**100.00%**
	TOTAL CACHE HAAS AREA	**9.83E-01**	**100.00%**	**100.00%**	**100.00%**
	TOTAL SUISUN MARSH	**8.73E+00**	**100.00%**	**100.00%**	**100.00%**
	TOTAL	**1.28E+01**	**100.00%**	**100.00%**	**100.00%**

Table 13-9. Seismic Failure Scenarios Analyzed in Risk Evaluation

			Assumed Event Month and Hydrologic Year for Wet Year		Assumed Event Month and Hydrologic Year for Average Year		Assumed Event Month and Hydrologic Year for Dry Year	
Seismic Scenario	**No. of Flooded Islands**	**No. of Damaged, but Non-Flooded Islands**	**Event Month**	**Hydrologic Year**	**Event Month**	**Hydrologic Year**	**Event Month**	**Hydrologic Year**
1	1	2	February	Consequences are independent of water year type.				
2	3	0	June	1927	August	1972	October	1930
3	3	4	June	1927	August	1972	October	1930
4	10	0	June	1927	August	1972	October	1930
5	20	6	June	1927	August	1972	October	1930
6	30	6	June	1927	August	1972	October	1930

Table 13-11a. Summary of Economic Costs of Seismic Failure Scenarios

Seismic Failure Scenario	No.of Flooded Islands	No.of Non-Flooded, Damaged Islands	Spring, Wet Water Year			Summer, Average Water Year			Fall, Dry Water Year		
			In-Delta Cost ($M)	Statewide Cost ($M)	Total Cost ($M)	In-Delta Cost ($M)	Statewide Cost ($M)	Total Cost ($M)	In-Delta Cost ($M)	Statewide Cost ($M)	Total Cost ($M)
1	1	2	1,329	325	1,654	1329	325	1654	1329	325	1654
2	3	0	2,150	285	2,435	2,153	287	2,440	2,221	457	2,678
3	3	4	2,477	308	2,786	2,480	310	2,791	2,568	528	3,096
4	10	0	6,298	552	6,850	6,290	547	6,836	6,296	1,797	8,092
5	20	6	9,934	5,949	15,882	9,847	2,937	12,784	10,095	14,846	24,941
6	30	6	14,059	9,836	23,895	13,908	6,584	20,492	13,922	19,634	33,556

Table 13-11b. Summary of Economic Impacts of Seismic Failure Scenarios

Seismic Failure Scenario	No. of Flooded Islands	No. of Non-Flooded, Damaged Islands	Spring, Wet Water Year				Summer, Average Water Year				Fall, Dry Water Year			
			Value of Lost Output ($M)	Lost Employment (Jobs)	Lost Labor Income ($M)	Lost Value Added ($M)	Value of Lost Output ($M)	Lost Employ-ment (Jobs)	Lost Labor Income ($M)	Lost Value Added ($M)	Value of Lost Output ($M)	Lost Employ-ment (Jobs)	Lost Labor Income ($M)	Lost Value Added ($M)
1	1	2	228	2,664	71	117	228	2,664	71	117	228	2,664	71	117
2	3	0	284	3,071	88	144	278	3,199	89	146	603	6,181	171	289
3	3	4	287	3,104	89	145	280	3,233	90	148	782	7,560	211	362
4	10	0	841	11,486	301	486	832	11,407	298	495	3,743	17,950	664	1,675
5	20	6	6,682	46,213	2,929	1,974	5,199	31,058	1,032	2,394	42,213	179,007	8,894	17,650
6	30	6	11,974	67,743	4,148	3,997	14,501	69,114	2,695	6,502	56,090	247,425	12,273	23,408

Table 13-12. Ecosystem Consequences Case 2 Spring Wet Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	12.5	-10.71	-43.48	23.33	0	-11.54	-4	33.33						

Table 13-13. Ecosystem Consequences Case 2 Summer Average Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	0	-5	-43.48	33.33	-12.5	-11.54	-8	33.33						

Table 13-14. Ecosystem Consequences Case 2 Fall Dry Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-25	-25	-86.96	-26.67	-25	-26.92	-30	20						

Table 13-15. Ecosystem Consequences Case 3 Spring Wet Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	0	-21.43	-86.96	10	-12.5	-23.08	-24	20						

Table 13-16. Ecosystem Consequences Case 3 Summer Average Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-12.5	-15.71	-86.96	20	-25	-23.08	-28	20						

Table 13-17. Ecosystem Consequences Case 3 Fall Dry Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	0.1	0.96	0	0.3	0	3.16	0.21	0	1.47	3.51	2.93	2.23	7.64	1.44
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.03	0	7.59	0	0	0	6.53							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-37.5	-35.71	-130.43	-40	-37.5	-38.46	-50	6.67						

Table 13-18. Ecosystem Consequences Case 4 Spring Wet Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	1.21	1.07	0	0.98	0	16.57	1.4	0.35	23.39	3.87	10.42	2.34	13.72	7.04
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.4	0	9.38	0	0	0	9.37							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	50	-7.14	-65.22	36.67	37.5	-15.38	20	46.67						

Table 13-19. Ecosystem Consequences Case 4 Summer Average Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	1.21	1.07	0	0.98	0	16.57	1.4	0.35	23.39	3.87	10.42	2.34	13.72	7.04
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.4	0	9.38	0	0	0	9.37							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	37.5	-15.71	-108.7	33.33	-12.5	-30.77	-4	33.33						

Table 13-20. Ecosystem Consequences Case 4 Fall Dry Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic veg	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	1.21	1.07	0	0.98	0	16.57	1.4	0.35	23.39	3.87	10.42	2.34	13.72	7.04
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	0.4	0	9.38	0	0	0	9.37							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-12.5	-32.86	-152.17	-26.67	12.5	-46.15	-26	20						

Table 13-21. Ecosystem Consequences Case 5 Spring Wet Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic veg	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	7.91	1.75	0.43	5.11	0	23.46	3.79	0.35	33.02	8.27	18.06	2.59	15.25	12.23
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	2.88	0	16.56	0	0	0	20.3							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	0	-51.43	-239.13	-6.67	0	-69.23	-60	-6.67						

Table 13-22. Ecosystem Consequences Case 5 Summer Average Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic veg	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	7.91	1.75	0.43	5.11	0	23.46	3.79	0.35	33.02	8.27	18.06	2.59	15.25	12.23
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	2.88	0	16.56	0	0	0	20.3							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-12.5	-61.43	-282.61	-20	-37.5	-84.62	-80	-20						

Table 13-23. Ecosystem Consequences Case 5 Fall Dry Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic veg	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetlar
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	7.91	1.75	0.43	5.11	0	23.46	3.79	0.35	33.02	8.27	18.06	2.59	15.25	12.23
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	2.88	0	16.56	0	0	0	20.3							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-62.5	-97.14	-391.3	-73.33	-75	-123.08	-160	-73.33						

Table 13-24. Ecosystem Consequences Case 6 Spring Wet Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetla
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	11.08	1.95	0.59	6.25	0	29.57	4.94	0.35	39.49	8.36	23.55	7.44	29.19	16.75
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	4.03	0	32.35	0	0	0	42.52							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-12.5	-61.43	-282.61	-20	-12.5	-84.62	-80	-20						

Table 13-25. Ecosystem Consequences Case 6 Summer Average Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetla
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	11.08	1.95	0.59	6.25	0	29.57	4.94	0.35	39.49	8.36	23.55	7.44	29.19	16.75
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	4.03	0	32.35	0	0	0	42.52							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-12.5	-61.43	-282.61	-20	-12.5	-84.62	-80	-20						

Table 13-26. Ecosystem Consequences Case 6 Fall Dry Seismic Scenario

Vegetation	Vegetation types	Alkali high	Alkali low r	Alkali midd	Aquatic ve	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Herbaceou	Shrub upla	Shrub wetl	Tree uplan	Tree uplan	Tree wetla
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	11.08	1.95	0.59	6.25	0	29.57	4.94	0.35	39.49	8.36	23.55	7.44	29.19	16.75
Wildlife	Wildlife species	BlackRail	ClapperRa	Crane	Yellowthro	HarvestMo	OrnateShr	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	4.03	0	32.35	0	0	0	42.52							
Aquatics	Aquatic Species	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-62.5	-97.14	-391.3	-73.33	-75	-123.08	-160	-73.33						

Table 13-30 Summary of Economic Costs of Flood Failure Scenarios

Failure Scenario	No. of Flooded Islands	No. of Damaged Islands	In-Delta Costs ($M)	Statewide Cost ($M)	Total Cost ($M)
7	20	0	14,628	369	14,997
8	30	0	21,364	380	21,744

Table 13-31 Summary of Economic Impacts of Flood Failure Scenarios

Failure Scenario	No. of Flooded Islands	No. of Damaged Islands	Total Statewide Economic Impacts			
			Value of Lost Output ($M)	Lost Employ-ment (Jobs)	Lost Labor Income ($M)	Lost Value Added ($M)
7	20	0	5,723	46,551	1,801	2,901
8	30	0	7,501	60,893	2,393	3,884

Table 13-32. Ecosystem consequences Case 7 Winter Flood (20 levee breach)

Vegetation	Vegetation	ALKALI_HI	ALKALI_LO	ALKALI_M	AQUATIC_	HERB_UPI	HERB_UPI	HERB_WE	HERB_WE	HERB_WE	SHRUB_U	SHRUB_W	TREE_UPI	TREE_UP_	TREE_WETLAND
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	3.3	0.46	0	4.03	0.11	9.43	1.86	0.02	3.2	0.65	6.66	34.41	22	18.87
Wildlife	Wildlife spe	BlackRail	ClapperRai	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	1.08	0	34.37	0	0	0	22.32							
Aquatics	Aquatic Sp	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-62.5	-13.57	21.74	-40	-62.5	-2.31	-40	-60						

Table 13-33. Ecosystem consequences Case8 Winter Flood (30 levee breach)

Vegetation	Vegetation	ALKALI_HI	ALKALI_LO	ALKALI_M	AQUATIC_	HERB_UPI	HERB_UPI	HERB_WE	HERB_WE	HERB_WE	SHRUB_U	SHRUB_W	TREE_UPI	TREE_UP_	TREE_WETLAND
	Acres	7748.29	16355.71	16179.72	4368.59	498.36	57760.48	16832.44	3171.38	9947.63	464.93	6410.7	2005.66	4125.57	6687.15
	Percent	3.66	0.5	0	4.96	0.11	13.11	2.72	0.02	7.18	0.95	9.34	45.42	34.89	21.15
Wildlife	Wildlife spe	BlackRail	ClapperRai	Crane	Yellowthroa	HarvestMo	OrnateShre	Waterfowl							
	Acres	23679.27	14646.5	174383.1	26300.3	11681.84	11681.84	418890							
	Percent	1.2	0	57.12	0	0	0	36.48							
Aquatics	Aquatic Sp	DeltaSmelt	Chinook	Sturgeon	Silverside	LongfinSm	Steelhead	StripedBas	ThreadfinShad						
	Risk Index	-62.5	-13.57	21.74	-40	-62.5	-2.31	-40	-60						

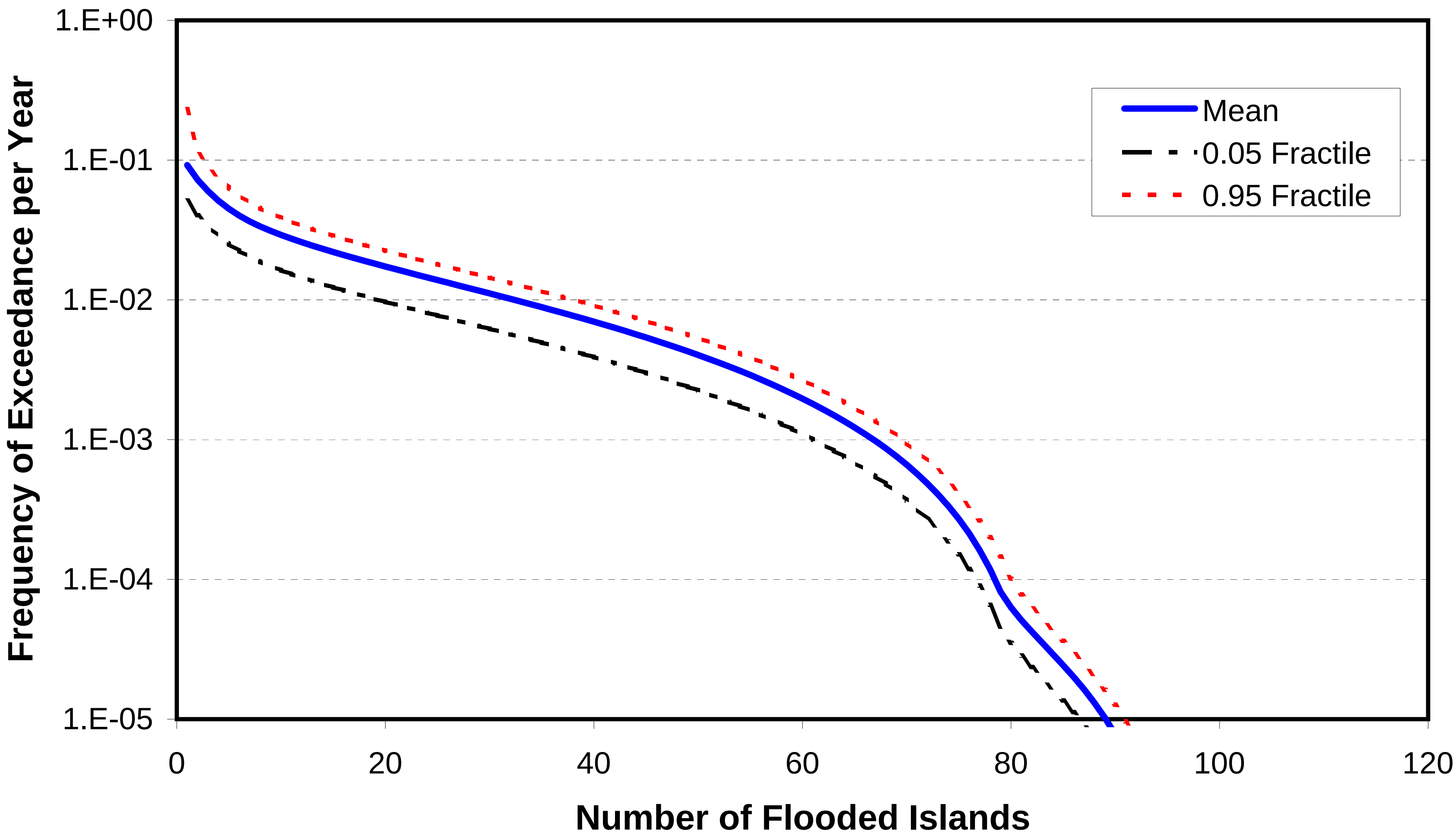


Figure 13-1 Frequency distribution on the number of flooded islands that may occur as a result of a seismic event

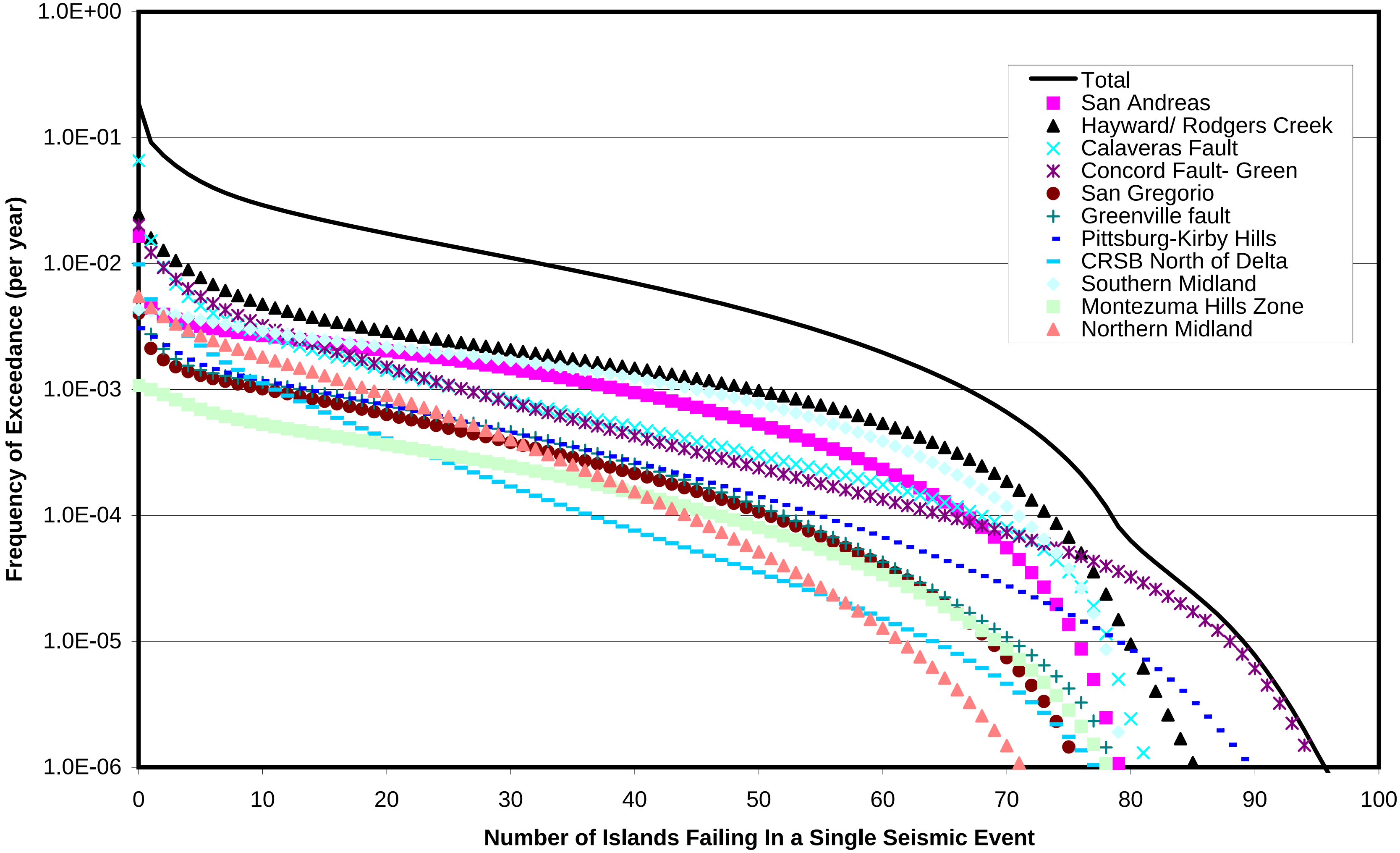


Figure 13-2 Deaggregation of the mean frequency distribution on the number of flooded islands by seismic source

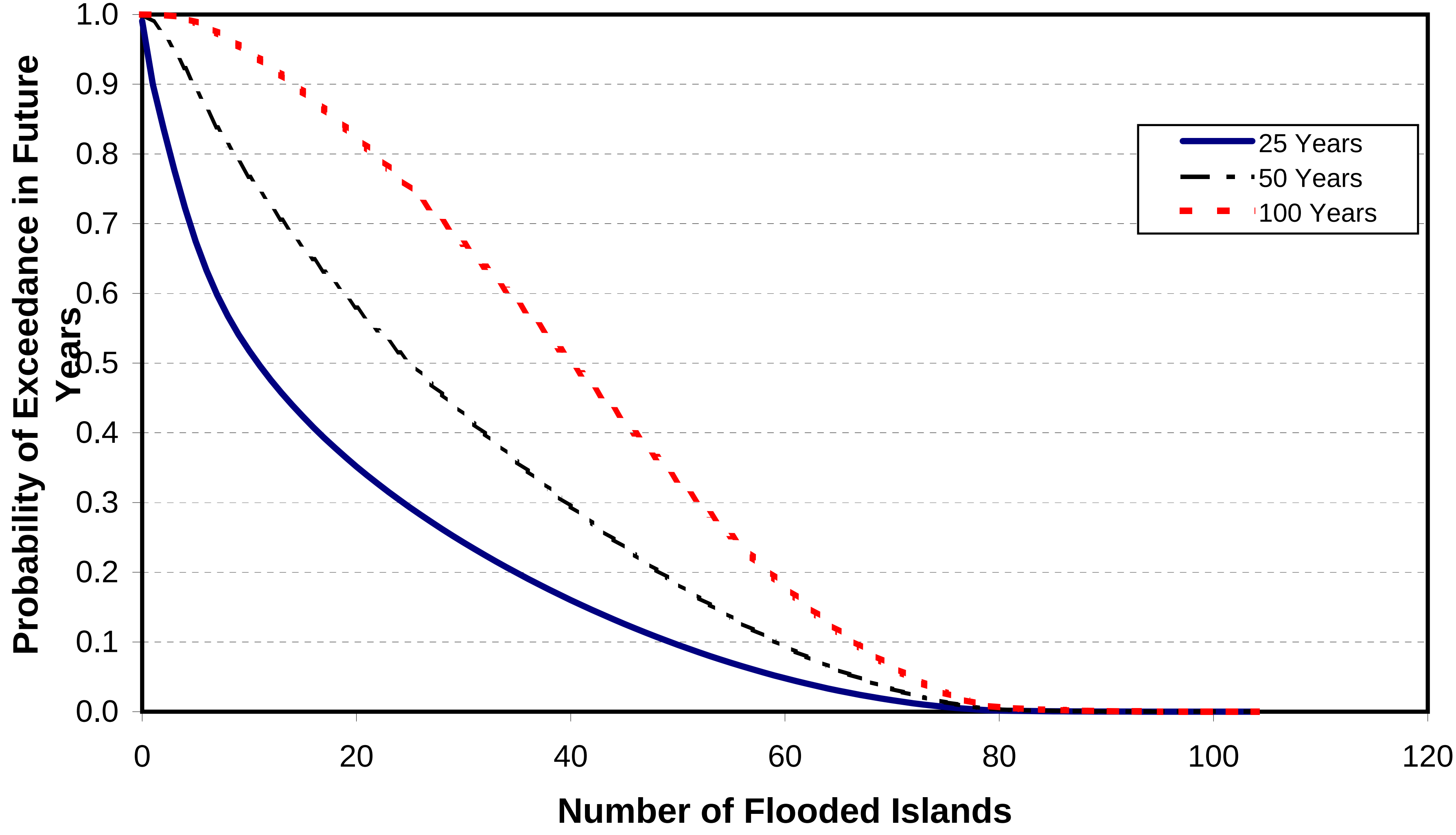


Figure 13-3 Estimate of the probability of occurrence of flooded islands due to seismic events for exposure periods of (a) 25, (b) 50 and (c) 100 years

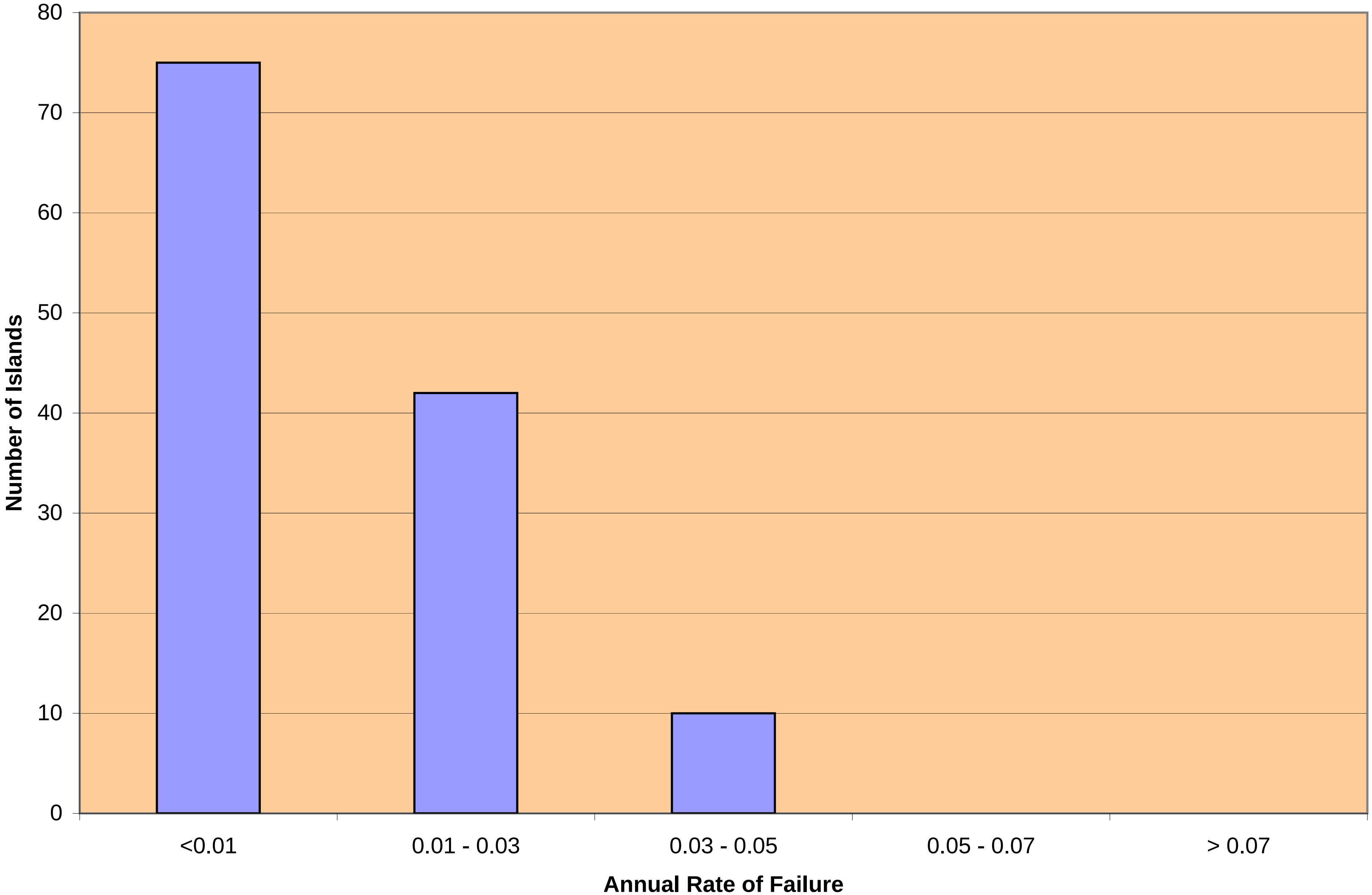


Figure 13-4: Number of Islands in Various Seismic Failure Rate Catergories

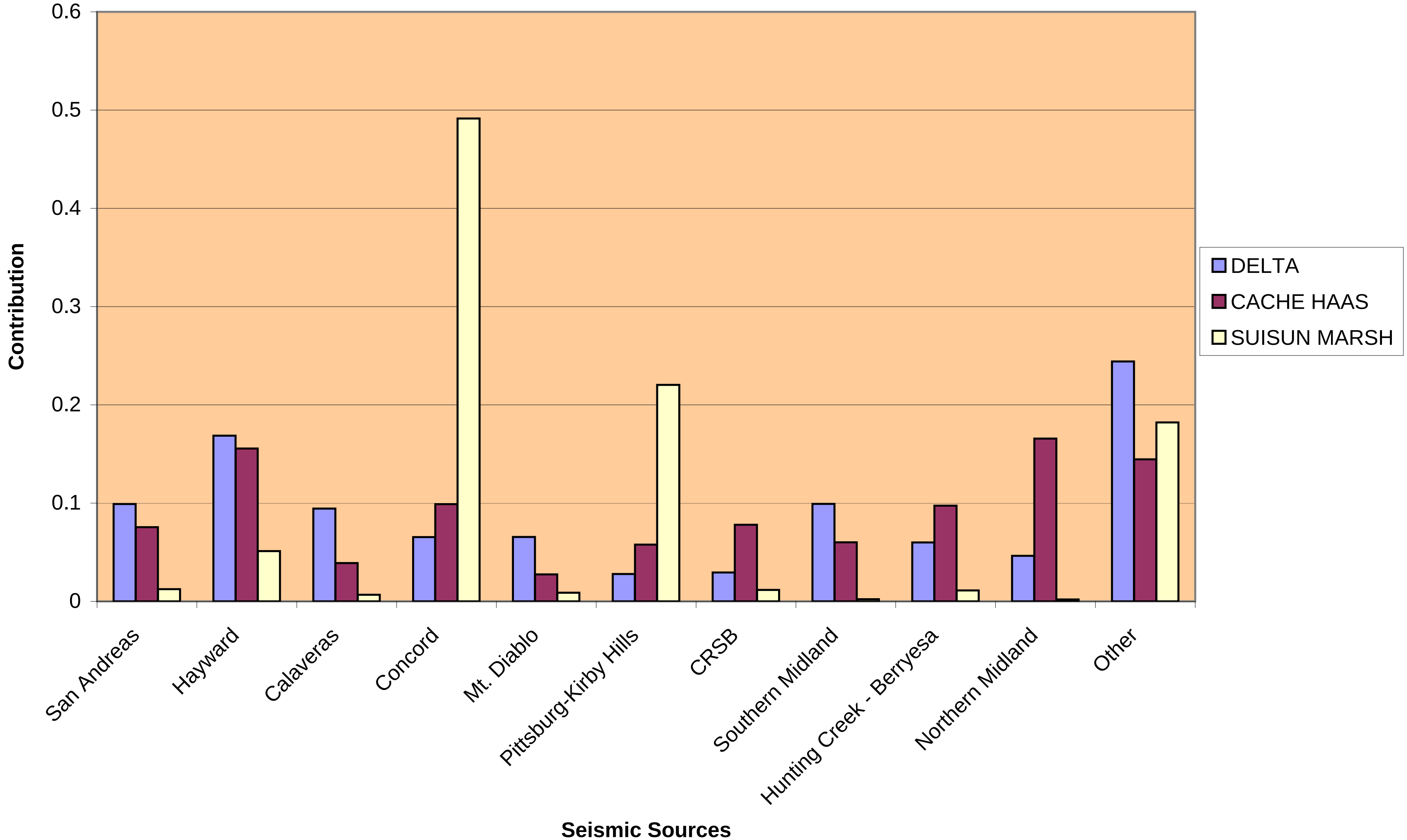
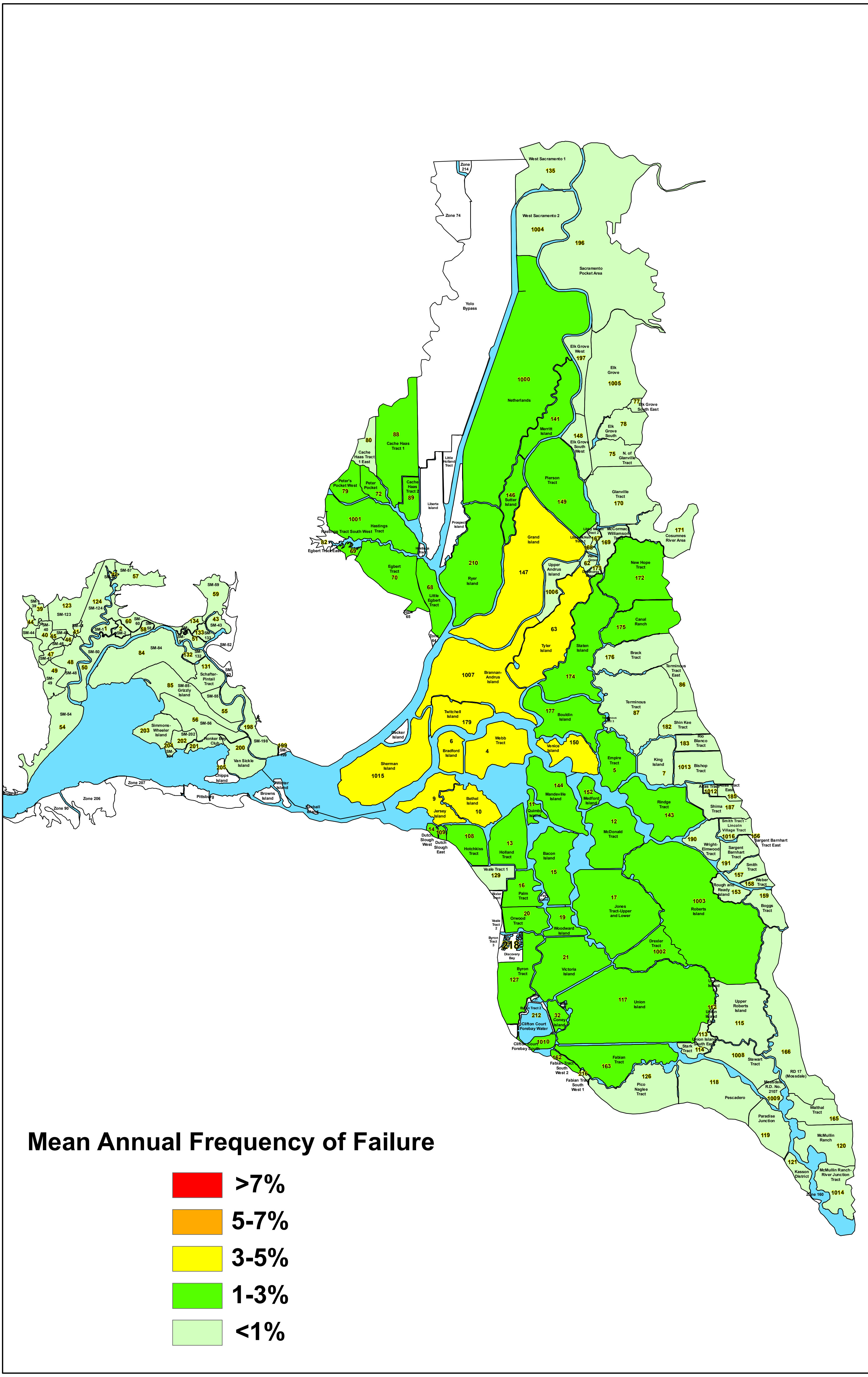


Figure 13-5: Source Contributions to Individual Island Seismic Failures



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Mean Annual Frequency of Failure for Individual Islands Under Seismic Events

Figure 13-6

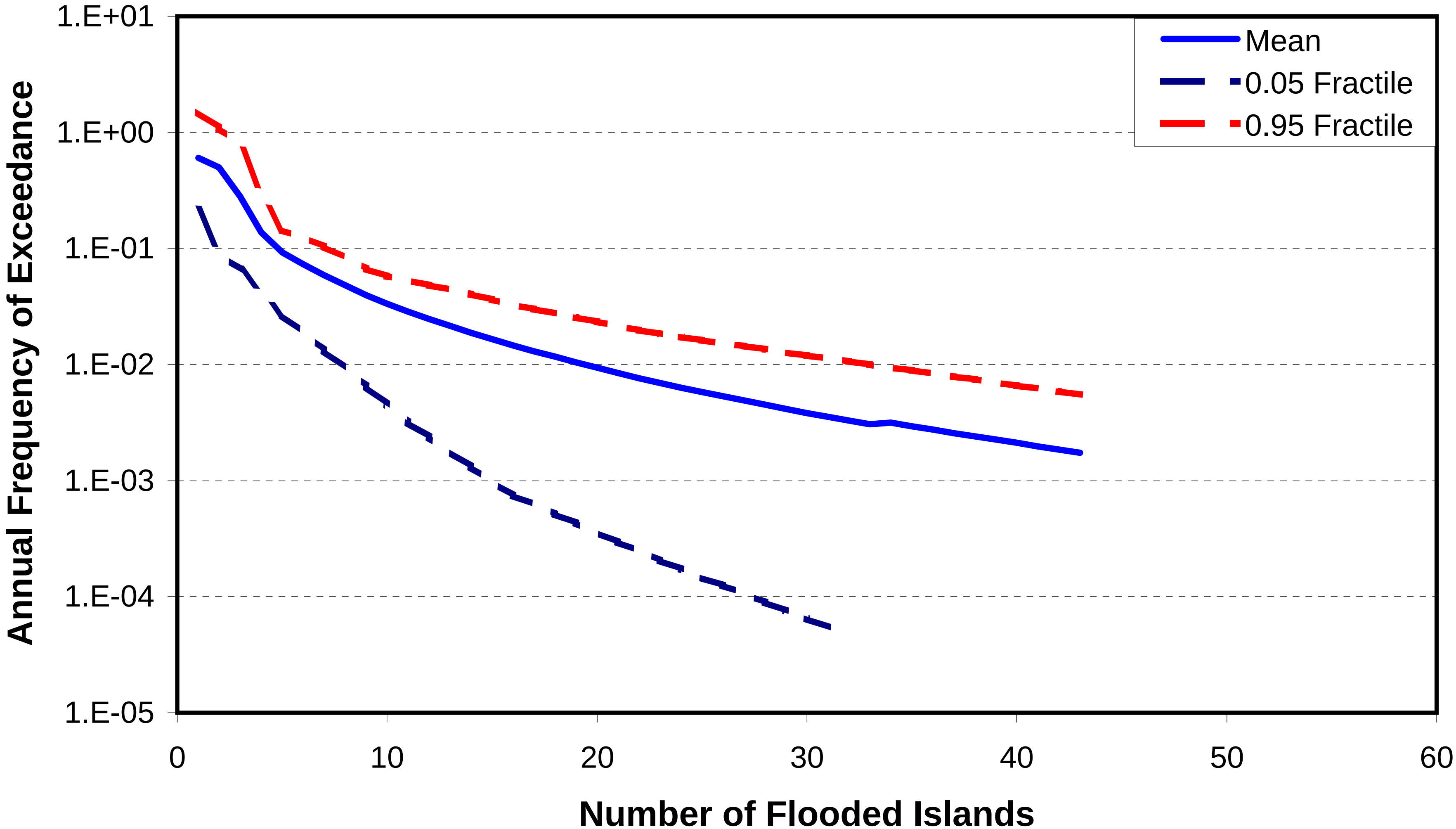
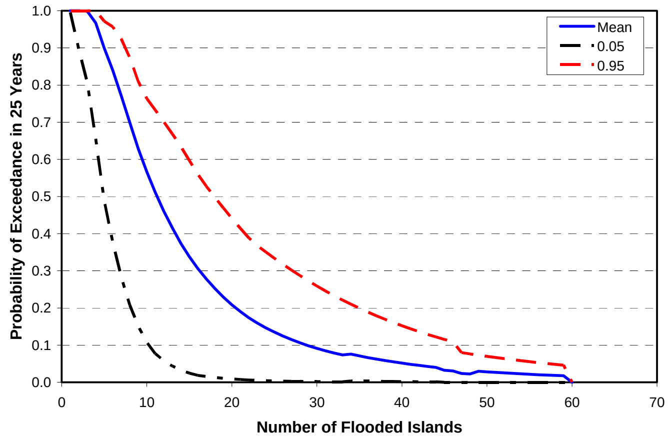
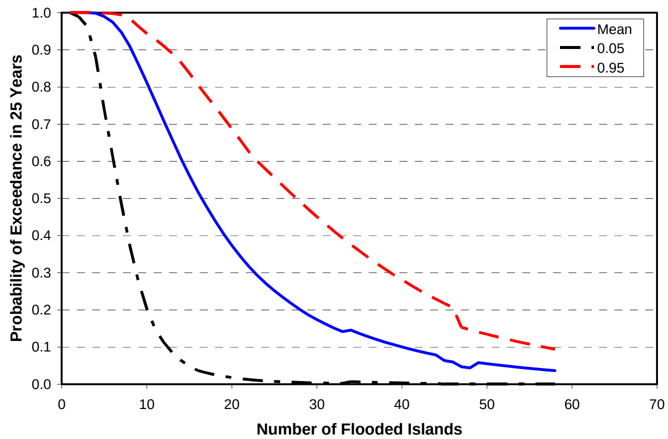


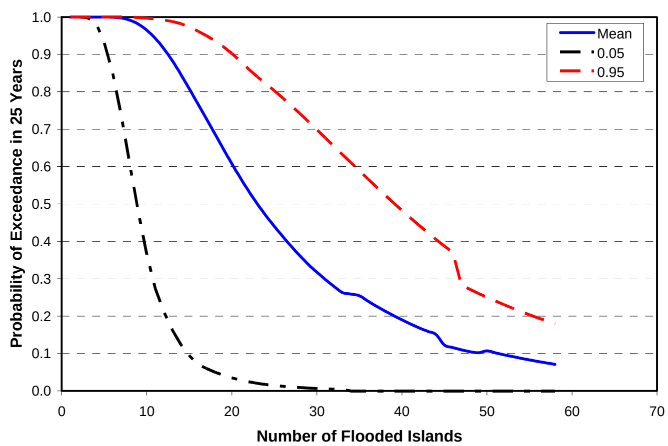
Figure 13-7 Frequency distribution on the number of flooded islands that may occur as a result of hydrologic events



(a) Probability of Exceedance in 25 Years



(b) Probability of Exceedance in 50 Years



(c) Probability of Exceedance in 100 Years

Figure 13-8 Estimate of the probability of occurrence of flooded islands due to hydrologic events for future periods of a)25, b) 50 and c) 100 years

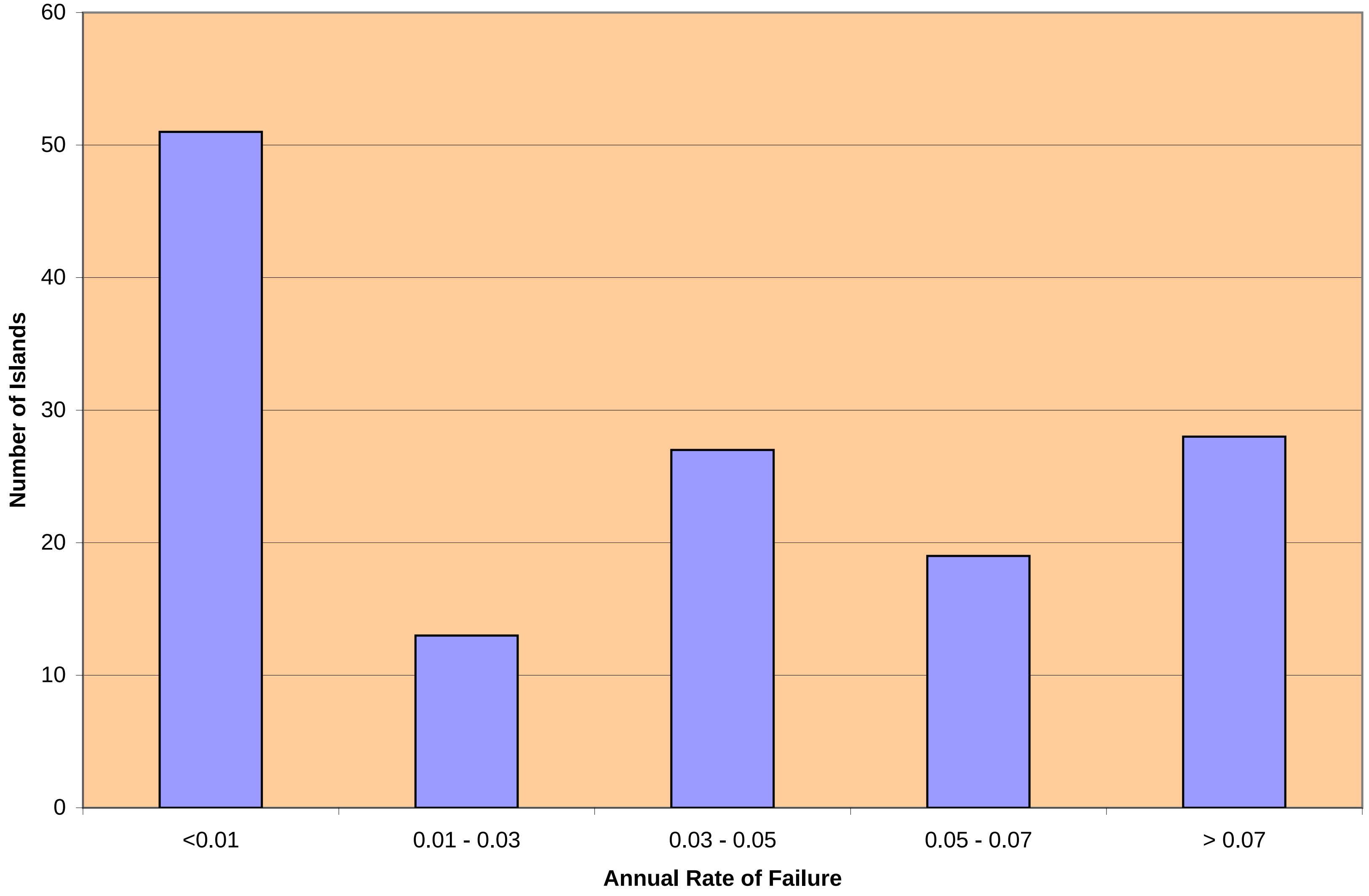
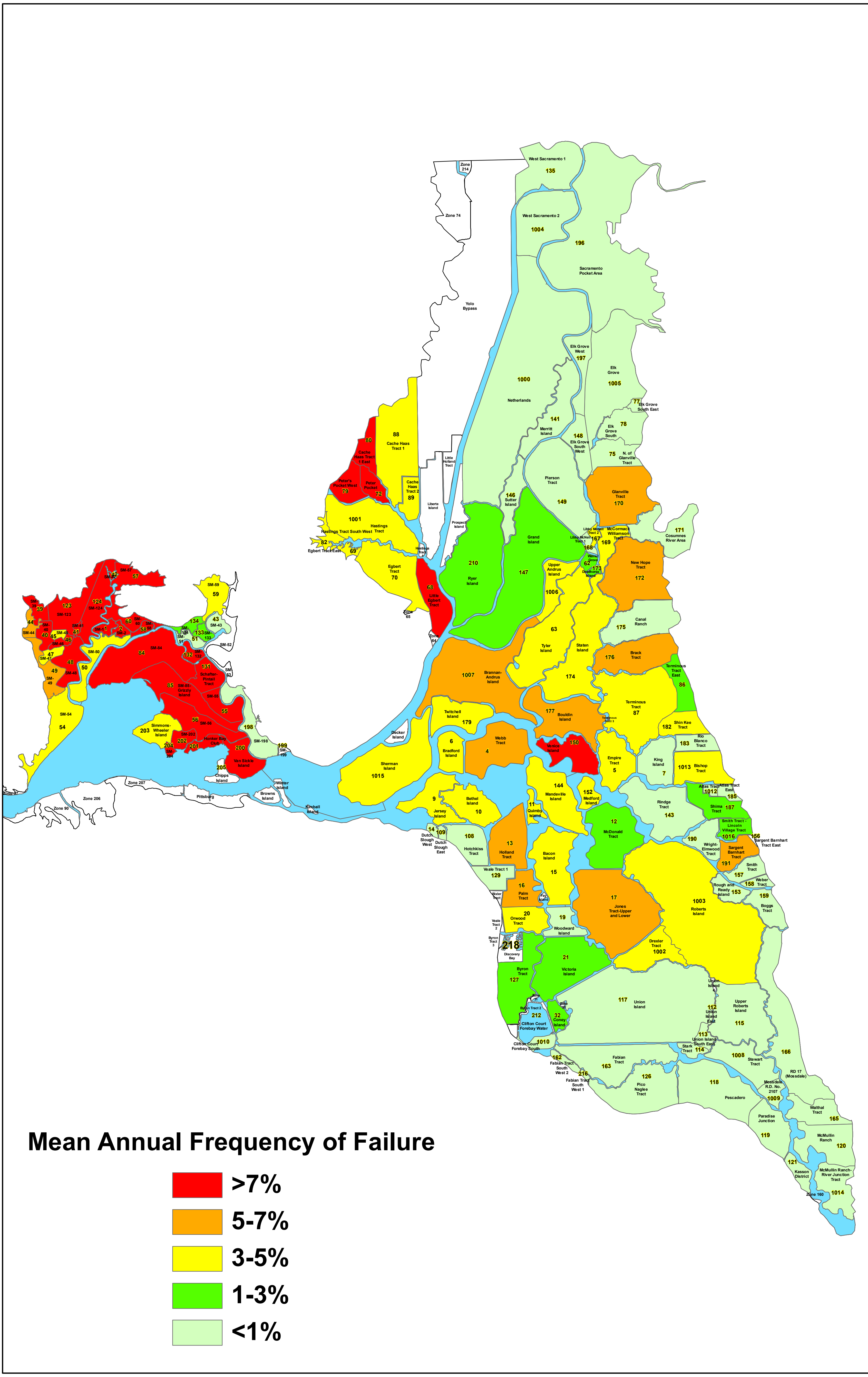


Figure 13-9: Number of Islands in Various Flood Failure Rate Catergories



0 5 10 Miles

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Mean Annual Frequency of Failure for Individual Islands Under Flooding Events

Figure 13-10a

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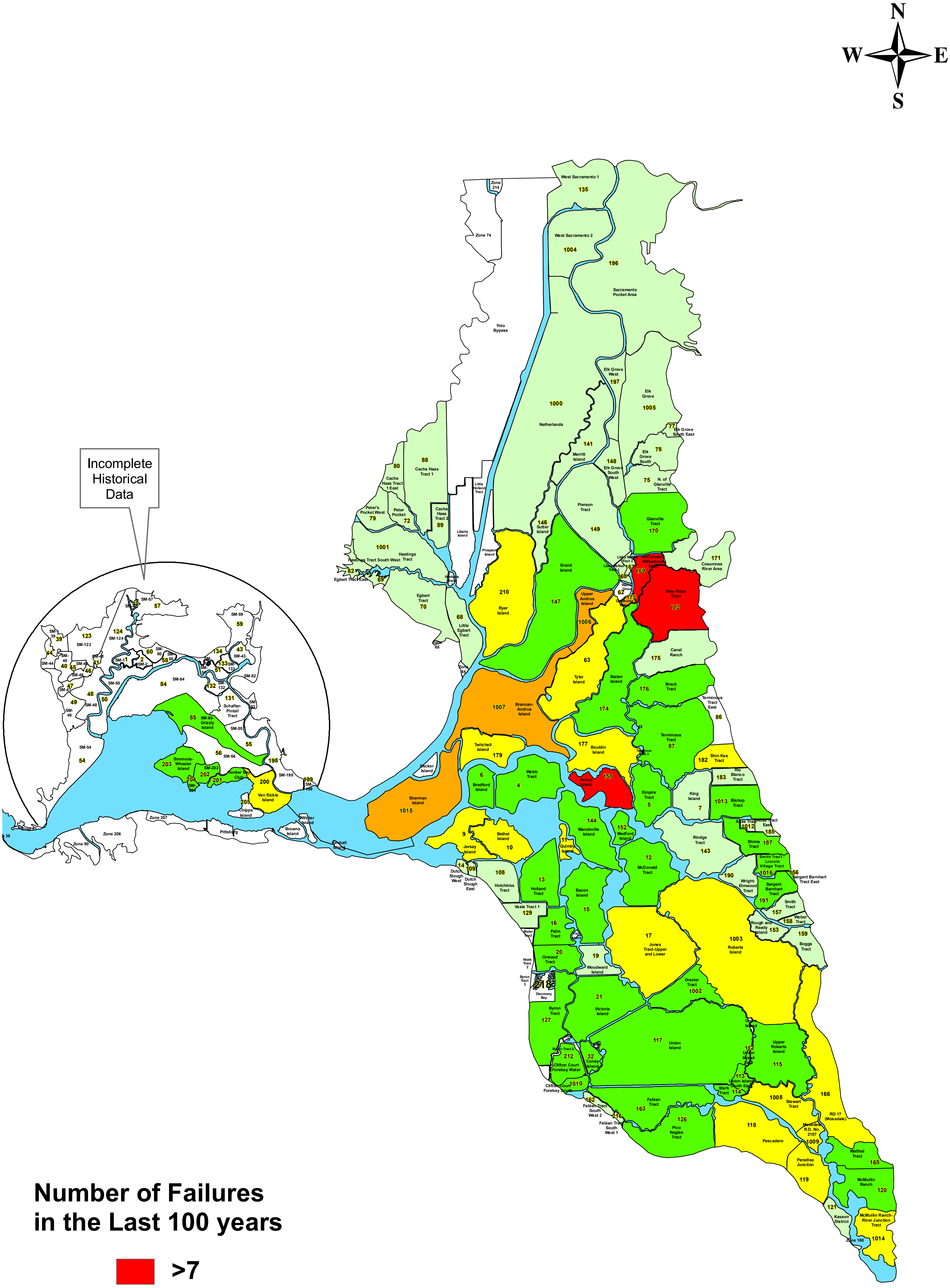


Number of Failures in the Last 100 years

- >7
- 5-7
- 3-5
- 1-3
- <1

0 2.5 5 10 Miles

URS	DRMS 26815935	Historical Number of Failures in the Last 100 years for Individual Islands Under Flooding Events	Figure 13-10b

URS Corporation, Oakland, CA, dhwrigh0   P:\GIS\GIS_Phase_II_Project_Files\MXD\Current Working Documents\Risk\Flooding\Historical Inundation Failure Map.mxd - 6/25/2007 @ 4:59:11 PM

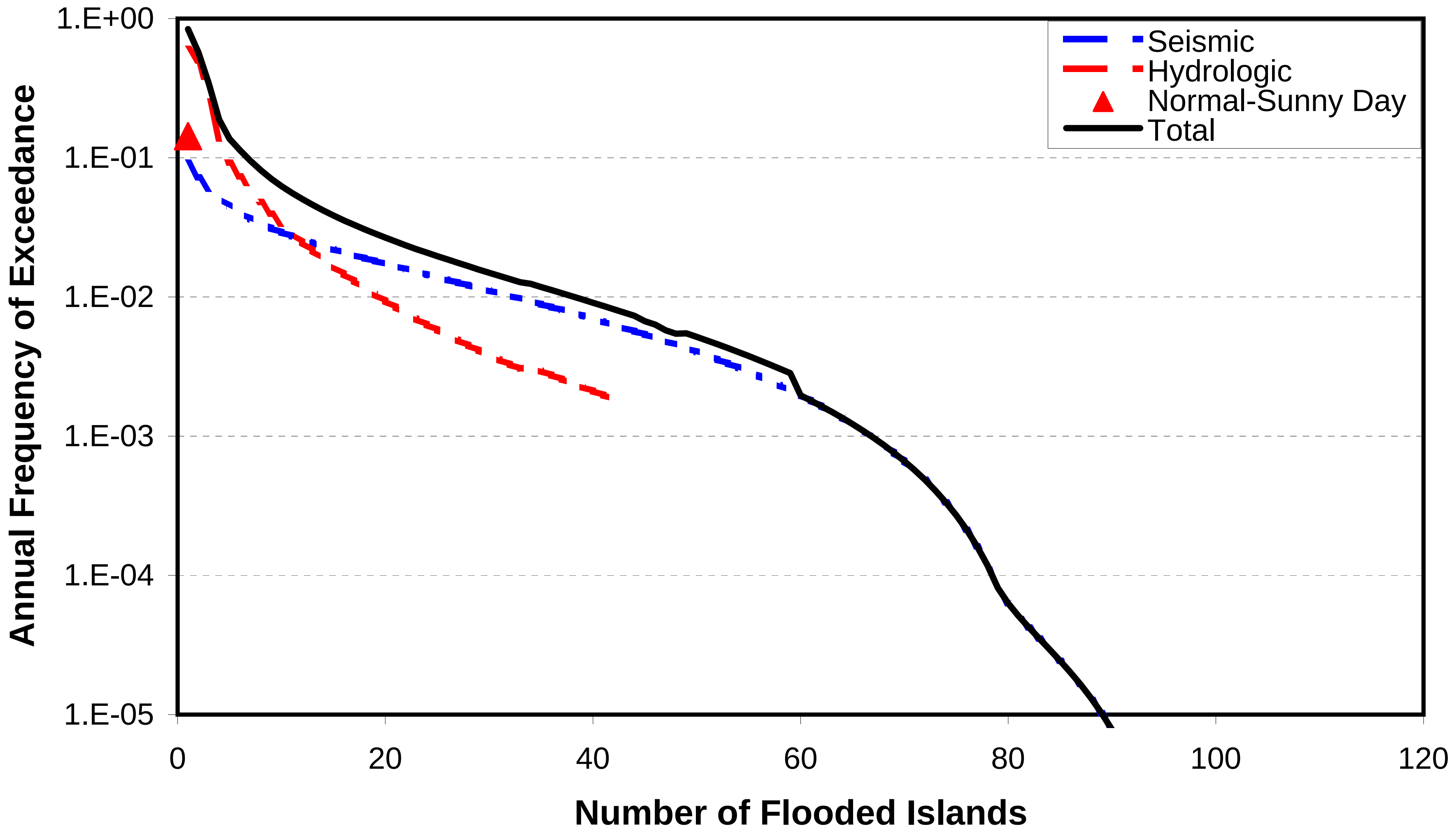


Figure 13-11 Comparison of the mean frequency distribution on the number of flooded islands due to seismic, hydrologic and normal, sunny-day events

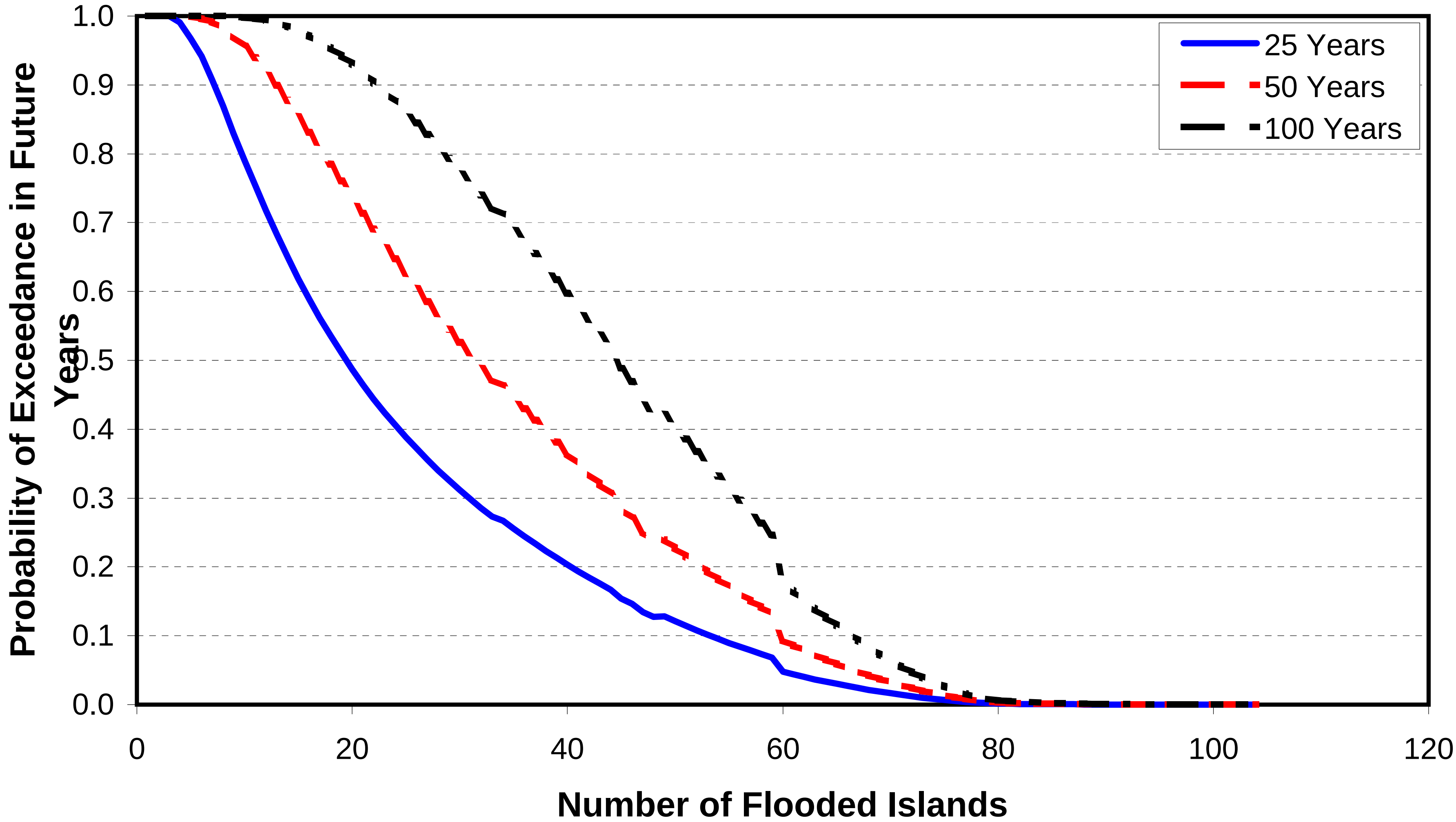
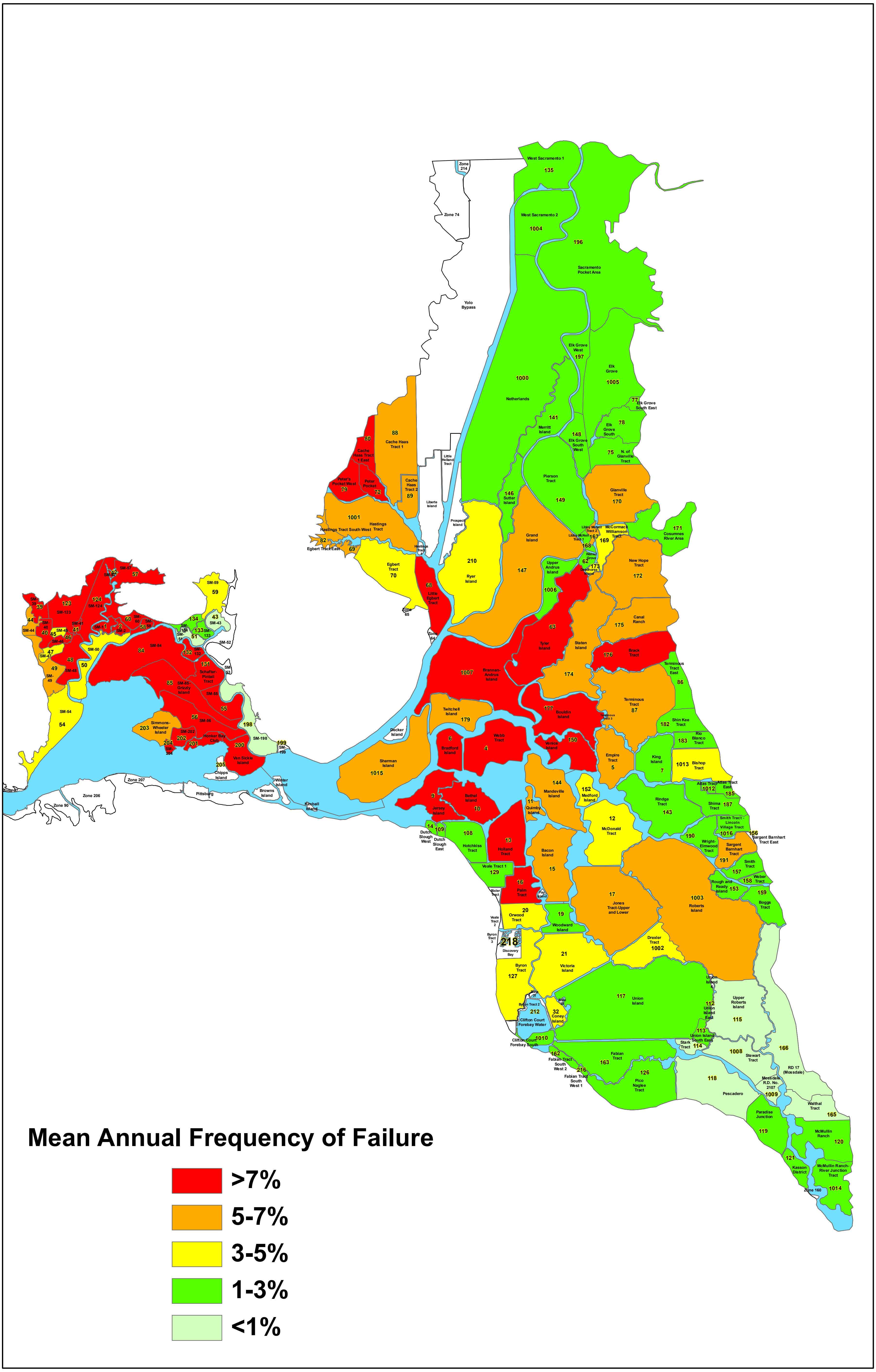


Figure 13-12 Probability of Exceedance for Number of Islands Inundated Simultaneously due to All Hazards in 25, 50, and 100 Years of Exposure



0 5 10 Miles

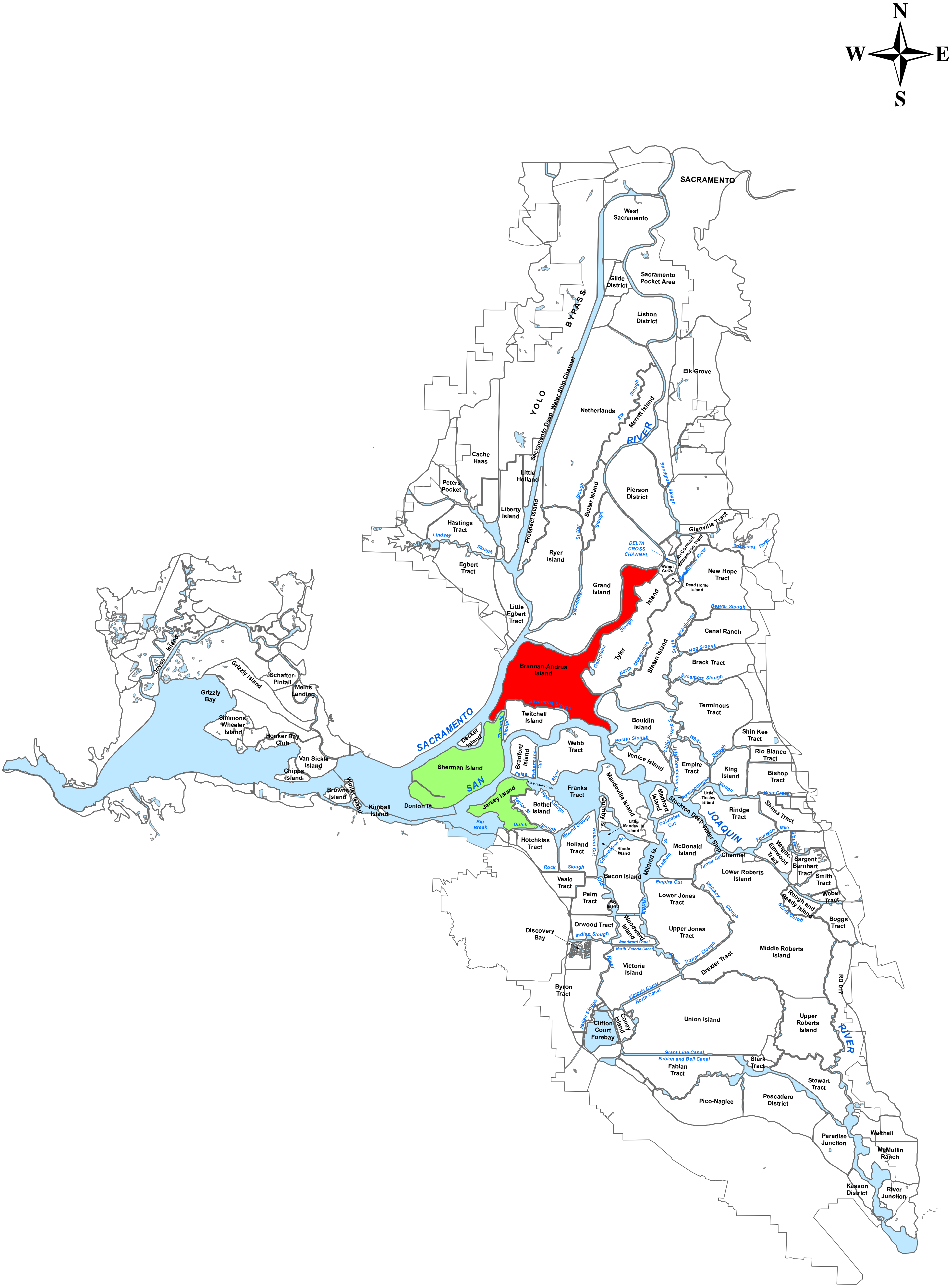
URS

DRMS

26815431

Mean Annual Frequency of Failure for Individual Islands Under Combined Flooding and Seismic Risk

Figure 13-13



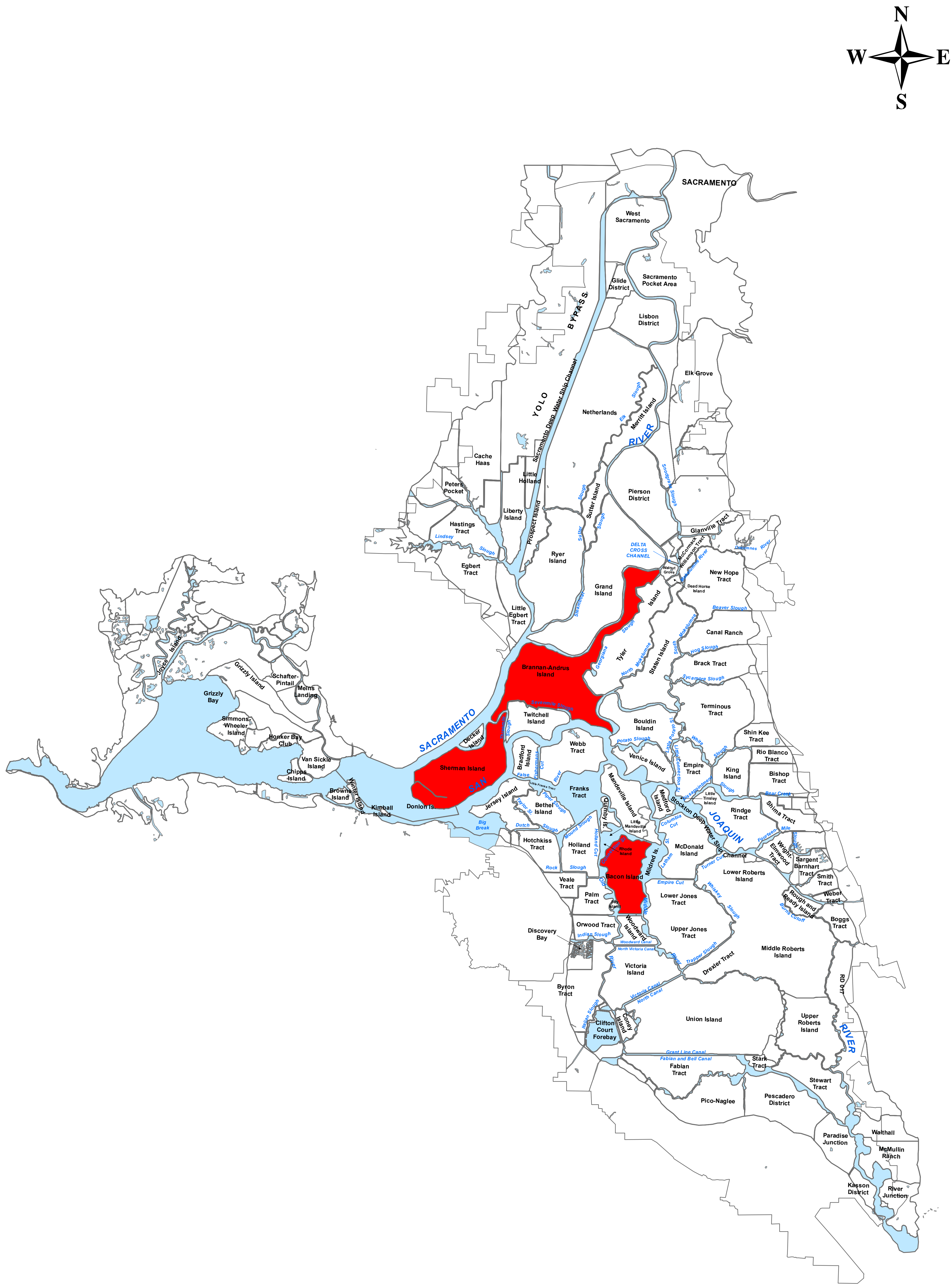
NOT FLOODED

FLOODED

DAMAGED

0 2.5 5 10 Miles

URS	DRMS	Case 1 Seismic Scenario 1 Island Flooded & 2 Others Damaged	Figure 13-14
	26815431		



NOT FLOODED

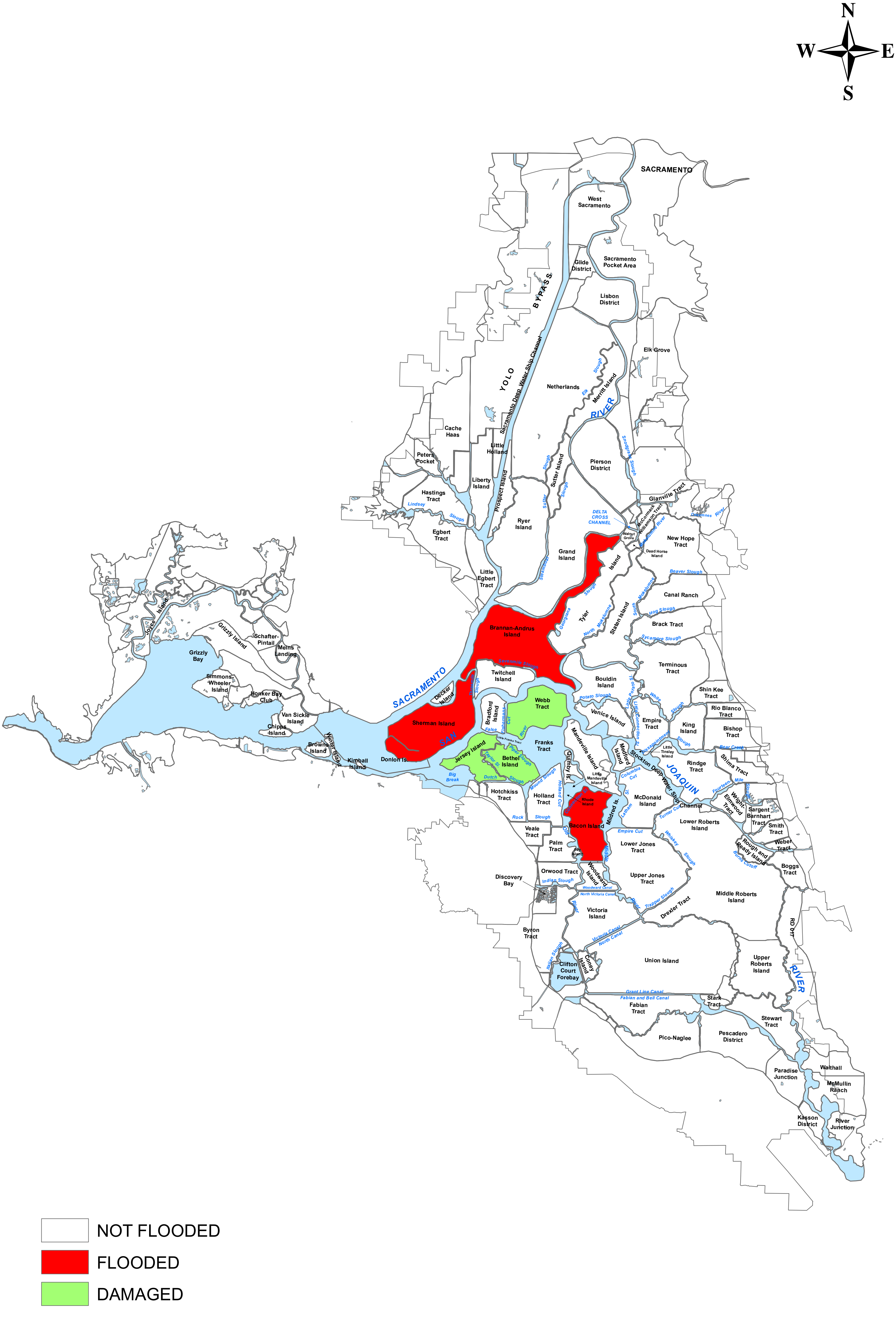
FLOODED

DAMAGED

0 2.5 5 10 Miles

DRMS	Case 2 Seismic Scenario 3 Islands Flooded & No Others Damaged	Figure 13-15
26815431		

URS Corporation - Oakland CA - cxrauma0 P:\GIS\GIS_Project_Files\MXD\Analysis\Levee Failure Potential\Problem Areas, Failure Areas\Inundation_Case_2.mxd



URS	DRMS	Case 3 Seismic Scenario 3 Islands Flooded & 3 Others Damaged	Figure 13-16
	26815431		

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