

# SUISUN MARSH

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## Conservation Opportunity Region Overview

### Regional Setting

The 116,000-acre Suisun Marsh (Marsh) is a key area of public focus for many short- and long-term planning processes. The Marsh is located at the western edge of the Delta, downstream of the Sacramento–San Joaquin River Delta, and the eastern edge of the San Francisco Bay, in Solano County. The Marsh lies within a unique geographic mixing zone of the fresh water outflow of the Central Valley and the tidal mixing of salt water from the San Francisco Bay, creating a unique and ecologically rich brackish wetland complex. Located downstream of the Sacramento–San Joaquin Delta, the Marsh is a mosaic of brackish tidal and managed wetlands, bays, and sloughs and extensive uplands that provide habitat for resident and migratory fish and wildlife; preserves and enhances California’s wetland resources; and also supports significant private and public recreational opportunities.

The Marsh is protected under the 1974 Suisun Marsh Preservation Act and the 1976 Suisun Marsh Protection Plan to “preserve the integrity and assure continued wildlife use” and maintain habitat for waterfowl. Primary land uses in the Marsh are the conservation of 52,000 acres of managed wetland and wildlife habitat as waterfowl management areas and duck clubs. The Marsh is a principal area for wintering waterfowl of the Pacific



Figure 1: Suisun Marsh sunset. Photo: Cliff Feldheim

Flyway and is the largest contiguous brackish marsh remaining on the Pacific Coast of the United States,<sup>1</sup> and it represents approximately 12 percent of California’s wetland habitat. The Marsh is a mosaic of public and privately owned lands. The largest public landowner is California Department of Fish and Wildlife (CDFW), managing over 15,000 acres of wildlife management areas and refuges on the Grizzly Island Wildlife Area complex. The exterior levees of the Marsh’s managed wetlands not only protect the ecological and aesthetic values of the Marsh, but also protect California’s Delta water supply from salt water intrusion and extensive private and public infrastructure. Significant examples of infrastructure in the Marsh include the Southern Pacific Railroad, Amtrak Capitol Corridor, the petroleum product pipelines, Solano County roads, natural gas production wells and transmission pipelines, electrical transmission lines, and the Department of Water Resources (DWR) and U.S. Bureau of Reclamation (Reclamation) water conveyance facilities.

The Marsh has also been identified as an area with high potential for tidal restoration as a result of its suitable elevations, location in the estuary, abundance of undeveloped existing managed wetlands habitats, high turbidity, high primary and secondary productivity, and use by Delta smelt (*Hypomesus transpacificus*), Chinook salmon (*Oncorhynchus tshawytscha*), and other native fishes. Both federal and state wildlife agencies consider the Marsh as a prime area to advance habitat conservation to benefit endangered species in the Sacramento-San Joaquin Delta. Located below the Sacramento–San Joaquin River Delta, the Marsh could be affected by actions further upstream, especially modification to state and federal water conveyance operations, local water district use, the location of X2, salt water intrusion, and habitat restoration projects.

45 **Planning History**

46 The Marsh has had a long history of wetland protection, conservation, and stewardship of its natural resources. In  
47 1974, Suisun Marsh landowners requested and supported the California Legislature’s passage of the Nejedly-  
48 Bagley-Z’berg Suisun Marsh Preservation Act (Act). The Act required that the San Francisco Bay Conservation and  
49 Development Commission (BCDC) and CDFW prepare a Suisun Marsh Protection Plan (SMPP). The Act also  
50 provided for various restrictions on development within the Marsh. When complete, the SMPP and the Fish and  
51 Wildlife Element of the SMPP were formally adopted as part of the enactment of the 1977 Suisun Marsh  
52 Preservation Act. The Suisun Marsh Preservation Act repealed the 1974 Act, provided a mechanism to preserve  
53 and enhance the wildlife habitat of the Marsh, and assured retention of upland areas adjacent to the Marsh for  
54 uses compatible with its protection. The primary responsibility for carrying out the provisions of the Suisun Marsh  
55 Preservation Act was assigned to the local governments and state agencies.

56 To meet the legislative requirements of the 1977 Suisun Marsh Preservation Act and the recently adopted 1978 State  
57 Water Quality Control Plan  
58 Water Rights Decision 1485  
59 (Suisun Marsh salinity  
60 standards), Reclamation  
61 prepared the 1981 Suisun  
62 Marsh Management Plan, and  
63 DWR prepared the 1984 Plan of  
64 Protection for the Suisun  
65 Marsh, including an  
66 Environmental Impact Report  
67 (EIR). Reclamation and DWR  
68 were required to develop a  
69 plan to mitigate for the adverse  
70 effects of increased salinity on  
71 the Marsh from the operations  
72 of the Central Valley Project  
73 and the State Water Project  
74 and a portion of the adverse  
75 effects of the other upstream diversions. There were four key elements of both plans: 1) Delta outflow, 2)  
76 physical facilities, 3) a monitoring program, and 4) the employment of efficient Marsh management, operation,  
77 and maintenance activities of public and private managed wetlands in the Marsh.



Figure 2: Tule elk (*Cervus canadensis nannodes*) are one of the prominent mammals utilizing Suisun Marsh uplands. Photo: Cliff Feldheim

78  
79 Over the next 20 years, the resources agencies, Suisun Resource Conservation District (SRCD), and private  
80 landowners implemented provisions of the Suisun Marsh Preservation Act, 1984 Plan of Protection for the Marsh,  
81 and various other local and regional activates to preserve, protect, and enhance the quality and diversity of Suisun  
82 Marsh aquatic and wildlife habitats. This is done with an emphasis on maintaining the waterfowl carrying capacity  
83 of the Marsh’s managed wetlands.

84  
85 In 2001, the Suisun Marsh Principal Agencies were directed to develop a plan for the Marsh that would balance the  
86 needs of the 2000 CALFED Bay-Delta Program (CALFED), the Suisun Marsh Preservation Agreement, and other plans  
87 by protecting and enhancing existing land uses; existing waterfowl and wildlife values, including those associated  
88 with the Pacific Flyway; endangered species; and state and federal water project supply. This directive led  
89 to the completion of the 2013 Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP) and  
90 companion EIR/Environmental Impact Statement. The SMP is a 30-year comprehensive regional implementation  
91 plan designed to address the various conflicts regarding use of Marsh resources, with the focus on achieving an  
92 acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of managed  
93 wetlands and their functions. The SMP addresses habitats and ecological process, public and private land use, levee  
94 system integrity, and water quality through restoration and managed wetland activities. As such, the SMP is  
95 intended to be a flexible, science-based, management plan for the Marsh, consistent with the revised Suisun Marsh  
96 Preservation Agreement, CALFED Program, and the Delta Stewardship Council (DSC) Delta Plan. It also will set the  
97 regulatory foundation for future actions.

98 The SMP was developed by the Suisun Principal Agencies, a group of agencies with primary responsibility for Suisun  
99 Marsh management, and is intended to balance the benefits of tidal wetland restoration with other habitat uses  
100 in the Marsh by evaluating alternatives that provide a politically acceptable change in Marsh-wide land uses,  
101 such as salt-marsh harvest mouse (*Reithrodontomys raviventris*) habitat, managed wetlands, public use, and  
102 upland habitat. It relies on the incorporation of existing science and information developed through adaptive  
103 management. The Principals are U.S. Fish and Wildlife Service (USFWS), Reclamation, CDFW, DWR, National Marine  
104 Fisheries Service, SRCD, and DSC. The Principals also consulted with other participating agencies, such as the U.S.  
105 Army Corps of Engineers, BCDC, the Regional Water Quality Control Board, and the State Water Resources Control  
106 Board, in developing the SMP. The SMP is intended to address the full range of issues in the Marsh, which are  
107 linked geographically, ecologically, and ideologically. Many of these issues have been recognized in other planning  
108 documents, such the CALFED Record of Decision, and the Revised Suisun Marsh Preservation Agreement. The SMP  
109 incorporates these plans and directives, while meeting the following plan objectives.

- 110 • **Habitats and Ecological Processes**—Implement the CALFED Ecosystem Restoration Program Plan  
111 restoration target for the Suisun Marsh ecoregion of 5,000 to 7,000 acres of tidal marsh and protection  
112 and enhancement of 40,000 to 50,000 acres of managed wetlands.
- 113 • **Public and Private Land Use**—Maintain the heritage of waterfowl hunting and other recreational  
114 opportunities, and increase the surrounding communities’ awareness of the ecological values of Suisun  
115 Marsh.
- 116 • **Levee System Integrity**—Maintain and improve the Suisun Marsh levee system integrity to protect  
117 property, infrastructure, and wildlife habitats from catastrophic flooding.
- 118
- 119 • **Water Quality**—Protect and, where possible, improve water quality for beneficial uses in Suisun Marsh,  
120 including estuarine, spawning, and migrating habitat uses for fish species as well as recreational uses and  
121 associated wildlife habitat.
- 122

123 The SMP requires that these  
124 interrelated and interdependent  
125 objectives be implemented to some  
126 extent concurrently through all SMP  
127 actions. For example, the levee system  
128 integrity objective will ensure that  
129 managed wetlands are protected  
130 from catastrophic flooding, thus  
131 contributing to meeting the portion of  
132 the habitats and ecological processes  
133 objective that addresses protection of  
134 managed wetlands. Similarly, the  
135 restoration of certain properties may  
136 help to protect and/or improve water  
137 quality, achieve the habitats and  
138 ecological processes objective, and  
139 also help to achieve the private and  
140 public land use objective. Recognizing  
141 these relationships, the SMP is  
142 proposed to contribute to meeting  
143 each of the objectives in parallel over the 30-year planning period by providing adequate restoration both to  
144 mitigate impacts related to managed wetland activities and to contribute to recovery of listed species. As such,  
145 both restoration and managed wetland activities could proceed simultaneously. An adaptive management plan  
146 is an essential component of the SMP, as it provides a mechanism to collect and use information to optimize  
147 restoration activity benefits.



Figure 3: Migratory waterfowl utilizing Suisun Marsh. Photo: Cliff Feldheim

148 The SMP also serves as the CALFED Ecosystem Restoration Program Implementation Strategy and as the *Regional*  
149 *Conservation Strategy* under the Delta Conservation Framework for the Suisun Marsh Region. The SMP is also  
150 consistent with the 2013 USFWS Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California.

151 There are a number of tidal habitat restoration projects currently being planned in the Marsh through California  
152 *EcoRestore* and the DWR Fish Restoration Program Agreement, including: Hill Slough, Tule Red, Bradmoor Island,  
153 and Meins Landing.  
154

## 155 [Link to Delta Conservation Framework](#)

156 The Delta Conservation Framework is a high-level planning framework with a landscape-scale focus across the  
157 entire Delta, Suisun Marsh, and Yolo Bypass, to guide conservation efforts between 2017-2050. Implementation of  
158 its overarching goals and strategies is recommended in the context of regionally focused, multi-stakeholder  
159 partnerships that develop *Regional Conservation Strategies* with detailed regional objectives and implementation  
160 actions.

161 The cornerstones for successful conservation  
162 planning and implementation are: 1)  
163 establishing and maintaining trust among  
164 stakeholders, best achieved through  
165 continuous communication and evaluating  
166 goal-based progress; 2) an agreed-upon  
167 structure for roles and responsibilities to  
168 govern an implementation partnership; and 3)  
169 principles for stakeholder engagement based  
170 on inclusiveness, open and ongoing  
171 communication, and science-based decision  
172 support. Since starting in late 2001, the Suisun  
173 Marsh Principal Agencies have developed a  
174 sound partnership approach with clear roles  
175 and responsibilities and an SMP Adaptive  
176 Management Team.  
177



Figure 4: Young boaters visiting Suisun Marsh. Photo: Cliff Feldheim

## 178 [Opportunities for Conservation](#)

179 The Marsh offers notable conservation value for species associated with tidal wetlands, diked managed wetlands,  
180 seasonal wetlands, and grasslands. This includes resident and anadromous fish native to the Delta, native plant  
181 and animal species, including the endangered salt marsh harvest mouse, endangered California Ridgway's rail  
182 (*Rallus obsoletus obsoletus*), threatened California black rail, (*Laterallus jamaicensis coturniculus*), and  
183 endangered Suisun thistle (*Cirsium hydrophilum hydrophilum*). The Marsh has been established as an important  
184 region of the Delta, supporting populations of  
185 endangered Delta smelt, and provides spawning  
186 and rearing habitat for populations migrating from  
187 the estuary's low-salinity zone.<sup>2,3</sup> Additionally,  
188 undeveloped lowland grasslands of the Jepson  
189 Prairie span the short distance between the  
190 Marsh and the Cache Slough Complex. This region  
191 offers a wildlife corridor between the two areas,  
192 benefitting native species populations and  
193 providing sea level rise accommodation space over  
194 the long term.<sup>4</sup> The Marsh fits into a "grand  
195 strategy to create an inter-connected series of  
196 habitats, mostly tidal and managed wetlands, in  
197 this region"<sup>5</sup> as a result of its potential for  
198 biodiversity conservation and location at the  
199 western edge of the Delta. This "grand strategy"  
200 has been referred to as the "North Delta Habitat  
201 Arc" (see Figure 5) and consists of a reconciled  
202 ecosystem strategy to create an arc of habitats  
203 connected by the flows of the Sacramento River

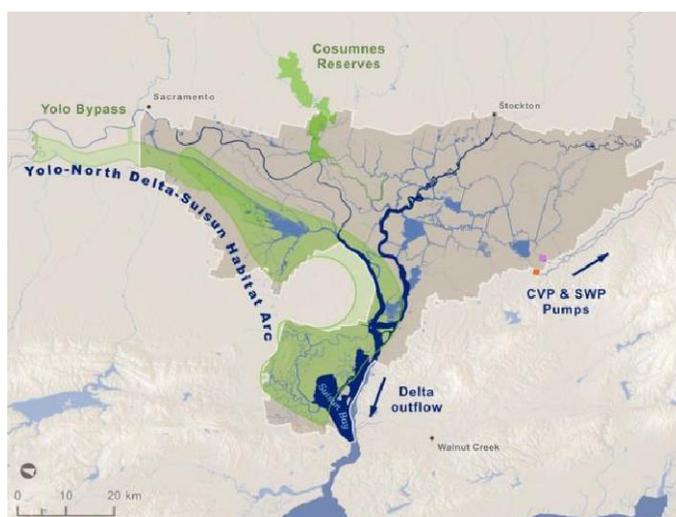


Figure 5: The Delta, showing the North Delta Habitat Arc.  
Source: UC Davis Center for Watershed Sciences

204 and contributions from the Yolo Bypass and the Cache-Lindsey Slough-Liberty Island region down into the Suisun  
205 Marsh.<sup>5</sup>

206 Throughout the Marsh, land subsidence has been relatively modest, due to the history of wetland conservation and  
207 limited agricultural practices at the turn of the century. The hydrodynamic, habitat, and salinity variability in the  
208 region *supports a range of native species*, aquatic and terrestrial. The gradual alluvial slopes of the surrounding  
209 uplands may *accommodate sea level rise* through lateral marsh expansion .<sup>4</sup>

210 Due to its proximity to the Cache-Lindsey Slough-Liberty Island region, the lower Sacramento River, and western  
211 Delta, the Marsh also benefits from natural flood pulse flows, *providing seasonal migration, spawning, and*  
212 *rearing habitats for adult and juvenile native and anadromous fish*. The operations of the seasonally flooded  
213 managed wetlands are a *primary source of food web productivity* during the winter and spring. The Marsh is also  
214 adjacent to a biologically unique, broad, lowland grassland/vernal pool complex, which connects to the Cache  
215 Slough Complex to the north. The proximity of these biologically rich areas with important ecotones and  
216 ecological corridors should favor efforts to *revitalize terrestrial and aquatic wildlife populations*.

## 217 Potential Solutions to Recognized Challenges

### 218 *Climate Change and Adaptation Opportunities for Long-term Sustainability*

219 The Suisun Marsh region  
220 will be affected by  
221 climate change induced  
222 sea level rise within the  
223 next 30-100 years.

224 Diked managed wetlands  
225 are protected by nearly  
226 200 miles of exterior  
227 levees and are currently  
228 in the intertidal zones.  
229 Rising water levels will  
230 affect and submerge  
231 current shorelines and  
232 tidal wetland habitats.

233 The increased pressure  
234 of rising water levels and  
235 flooding from storm  
236 events will threaten  
237 levee system integrity  
238 and the long-term  
239 viability of the existing

240 managed wetlands. Levee foundations will face  
241 increased pressure and require raising of the  
242 levees' crown heights and widths. In some areas,  
243 sea level rise will mean that current managed  
244 wetlands will likely be lost. Increased salt water  
245 intrusion from the San Francisco Bay, reduced  
246 fresh water flow from the Central Valley, and  
247 prolonged droughts could *significantly increase*  
248 *regional salinity levels in the Suisun Marsh*. These  
249 increases in salinity could significantly affect  
250 wetland diversity, species composition, and  
251 existing habitat functions and values of Suisun  
252 Marsh managed and tidal wetlands. Further,  
253 flood dynamics will likely change over the next

254 decade, with more frequent and extreme storm and rainfall events and associated flood events coming from the  
255 Central Valley and local watersheds. *Scenario planning will be needed to help project likely impacts on*



Figure 7: Migratory Northern Pintail (*Anas acuta*) utilizing Suisun Marsh throughout winter.  
Photo: Cliff Feldheim



Figure 6: Young hunting aid places decoys to attract waterfowl for upcoming hunt. Photo: Cliff Feldheim

256 *ecosystems and species and to integrate these into the long-term conservation planning picture.*

257 Levees are maintained primarily by private landowner assessments, local Reclamation Districts, or public  
258 agencies such as CDFW. Currently, there is no state or federal funding for a majority of the levee maintenance  
259 expenses in the Marsh. A long-term levee maintenance program and fund (similar to the Delta Levee  
260 Subvention Program) is necessary to protect and sustain the existing managed wetland habitat values and  
261 protect the Delta's water quality from salt-water intrusion. Scenario planning is needed to help project likely  
262 impacts on ecosystems and species. This type of planning will also evaluate salinity changes with restoration,  
263 over the near- and long-term, and allow for the potential to use adaptive management with restoration  
264 and management activities. Scenario reevaluation as each project is developed will allow for  
265 adjustments to plan implementation and short- and long-term cost evaluation.

266 *Ongoing and Future Land Use*

267 The SMP anticipates potential conflict between  
268 future tidal restoration projects and existing  
269 managed wetland/waterfowl hunting club land  
270 uses. These potential impacts include  
271 modification of the Suisun Marsh salinity regime,  
272 the degradation of the water quality conditions  
273 for habitat management, the direct conversion  
274 and loss of existing managed wetland values and  
275 functions, dampening of the tidal stage,  
276 redirection of tidal energy, and degradation of  
277 the existing ecological characteristics of the  
278 managed wetlands. The SMP has tidal  
279 restoration targets of 5,000 to 7,000 acres over  
280 the next 30 years. The SMP also requires that  
281 tidal restoration projects be regionally  
282 distributed, with detailed environmental  
283 commitments, avoidance and minimization measures to be implemented, and salinity modeling of restoration  
284 design to ensure that local and regional salinity conditions are protected as part of the project development,  
285 including post-construction verification. Additionally, the SMP requires that all land acquisitions for tidal  
286 restoration must be from willing sellers. Increased tidal restoration may also create the need for increased  
287 mosquito control, the potential for increased mercury  
288 contamination, and conflict from increased public access.  
289 Waterfowl hunting and managed wetland conservation and  
290 management have been the main way of life and cultural  
291 linkage to the land for Suisun Marsh landowners for several  
292 generations. These landowners have a strong cultural tie to  
293 the land and grave concern that that tidal restoration  
294 projects could displace existing land use and decrease the  
295 number of wintering waterfowl in the Marsh, impacting the  
296 future of managed wetlands and continued investments in  
297 sustaining these habitats. The net effect to overall salinity  
298 levels and the future of the Marsh is unclear. In addition,  
299 higher acreage goals for tidal restoration could have short-  
300 and long-term impact on salt-marsh harvest mouse  
301 populations.



Figure 9: Attaching a radio tag to a mallard (*Anas platyrhynchos*) for monitoring purposes. Photo: Cliff Feldheim



Figure 8: Release of tagged male mallards in Suisun Marsh. Photo: Cliff Feldheim

302 *Adequate Financial Resources for Interim and Long-term Land Management*

303 Tidal restoration projects require the acquisition of a suitable sites and a commitment for planning and permitting  
304 over multiple years. Newly acquired restoration sites will not manage themselves. These sites require significant  
305 qualified staff resources, with adequate land management budgets and a willingness to expend money on the  
306 property, while restoration planning occurs. These long-term financial commitments do not end when the  
307 restoration construction is complete. Tidal restoration sites in the Marsh will continue to require a commitment  
308 to long-term land management, oversight, maintenance, repairs, and public access control.  
309 Increased public ownership and public access is generally viewed as a deterrent to local private landowners and  
310 neighbors. Also, increased public access includes human disturbance to wildlife and negative effects such as  
311 trespass, littering, theft, and vandalism.

312 *Invasive Species Control*

313 Most of the wetland and upland habitats of the Suisun Marsh are currently colonized by non-native invasive  
314 species. These invasive species modify and  
315 degrade existing habitat conditions,  
316 displace native species, and threaten to  
317 colonize newly restored habitats. Control of  
318 invasive species is very labor intensive,  
319 costly, and requires diligence and usually a  
320 long-term commitment. Eradication is  
321 unlikely, but ignoring existing conditions  
322 will ensure continued degradation of  
323 existing habitat and likely failed restoration  
324 of targeted habitats. Ecosystem  
325 restoration projects must consider invasive  
326 species control and removal during interim  
327 management and part of the long-term site  
328 management into the future. Limited  
329 resources exist for invasive plant species  
330 management once a site has been  
331 breached. Projects should expect to  
332 incorporate some type of control  
333 mechanism, including the ability to dry out  
334 a site for plant control.



Figure 10: Young naturalist netting a fish in a Suisun Marsh channel.  
Photo: Cliff Feldheim

- <sup>1</sup> Meng, L. and S. A. Matern (2001). Native and introduced larval fishes of Suisun Marsh, California: the effects of freshwater flow. *Transactions of the American Fisheries Society*. 130:750–765.
- <sup>2</sup> Merz, J. E., S. Hamilton, P. S. Bergman, and B. Cavallo (2011). Spatial perspective for Delta smelt: A summary of contemporary survey data. *California Fish and Game, California Department of Fish and Game*. 97: 164-189.
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