

1 Restoration of brackish tidal habitat in Suisun Marsh is hypothesized to provide a range of
2 ecosystem and covered species benefits. As described in Appendix X, *DRERIP Evaluations*,
3 however, there are a number of uncertainties regarding the level of benefits that may be provided
4 by tidal habitat restored as well as risks for adverse consequences. These uncertainties will be
5 addressed through effectiveness monitoring, research, and the adaptive management program
6 (see Sections 3. and 3.).

7 Restoring brackish tidal habitat within the Suisun Marsh ROA is expected to:

- 8 • increase rearing habitat area for Chinook salmon, Sacramento splittail, and possibly
9 steelhead (Healey 1991, Siegel 2007);
- 10 • increase the local production of food for rearing salmonids, splittail, and other covered
11 species (Kjelson et al. 1982);
- 12 • provide an important linkage between current and future upstream restored habitat, such
13 as Yolo Bypass/Cache Slough with Suisun Marsh/Bay;
- 14 • increase the availability and production of food in Suisun Bay for delta and longfin smelt
15 by exporting organic material via tidal flow from the marsh plain and phytoplankton,
16 zooplankton, and other organisms produced in tidal channels into the Bay;
- 17 • locally provide areas of cool water refugia for delta smelt (C. Enright pers. comm.);
- 18 • reduce periodic low dissolved oxygen events associated with the discharge of waters
19 from lands managed as seasonal freshwater wetlands that would be restored as brackish
20 tidal habitat (Siegel 2007, C. Enright pers. comm.);
- 21 • increase the extent of habitat available for colonization by Suisun marsh aster and soft-
22 bird's beak; and
- 23 • enhance and increase the extent of salt marsh harvest mouse, California clapper rail, and
24 California black rail habitat.

25 *Adaptive management considerations*

26 Implementation of brackish tidal habitat restoration actions and subsequent management of
27 restored brackish tidal habitats by the Management Entity will be informed through effectiveness
28 monitoring that will be conducted for this conservation measure as described in Section 3.,
29 *Monitoring and Research Plan*, and the adaptive management process described in Section 3.,
30 *Adaptive Management Plan*. Based on analysis of monitoring results, likely elements of this
31 measure that could be adjusted through the adaptive management process include considerations
32 for selecting restoration locations and sequencing restoration of tidal habitat within Suisun Marsh
33 to maintain desirable salinity gradients; methods for establishing marsh plain vegetation,
34 including the establishment of marsh-associated covered plant species; methods and designs for
35 elevating subsided land surfaces to increase restored marsh plain area; design and location of
36 dike breaches; designs for encouraging the development of a high functioning network of tidal
37 channels; and non-native vegetation and wildlife control techniques.

38 **3.4.11 CM11 Channel Margin Habitat Enhancement**


1 The BDCP Management Entity will provide for the enhancement of 20 linear miles of channel
2 margin habitat in the Delta. This conservation measure is directed at improving habitat
3 conditions for covered fish species along Delta channel banks (as measured along one bank line
4 of channels) by improving channel geometry and restoring riparian, marsh, and mudflat habitats
5 along levees. Channel margin habitat will be enhanced only along channels that serve as
6 important rearing and outmigration habitat for juvenile salmonids. Although channel margin
7 enhancements are intended to provide specific benefits for salmonids, enhancement of these
8 habitats is also expected to improve or restore habitat for other species that inhabit channel
9 margin habitats. This measure will be implemented along channels protected by Project and/or
10 non-Project levees within the BDCP Planning Area. Based on results of effectiveness
11 monitoring for this conservation measure, the Management Entity may enhance up to an
12 additional 20 miles of channel margin through the adaptive management decision making
13 process. Any channel margin habitat enhanced above the 20 miles identified in this conservation
14 measure will be funded through surplus funds available through Plan implementation
15 efficiencies.

16 The following are the temporal targets for implementation of channel margin habitat
17 enhancements:

- 18 • At least 5 miles enhanced by year 10 of Plan implementation.
- 19 • At least 5 miles enhanced by year 20 of Plan implementation.
- 20 • At least 5 miles enhanced by year 25 of Plan implementation.
- 21 • At least 5 miles enhanced by year 30 of Plan implementation.

22 Actions to enhance channel margin habitats, as appropriate to site-specific conditions include,
23 but are not limited to:

- 24 • modifying levees or setting back levees to create low benches designed with variable
25 surface elevations to create hydrodynamic complexity and that support emergent
26 vegetation to provide an ecological gradient of habitat conditions, and higher elevation
27 benches that support riparian vegetation;
- 28 • planting riparian and emergent vegetation on created benches;
- 29 • installing large woody material (e.g., tree trunks and stumps) could be anchored into
30 constructed low benches or into existing riprapped levees to provide similar habitat
31 functions;
- 32 • removing riprap from channel margins where levees are setback to restore seasonally
33 inundated floodplain habitat (see cm 12); and
- 34 • modifying channel geometry in unconfined channel reaches or along channels where
35 levees are setback to restore seasonally inundated floodplain habitat (see cm 12) to create
36 backwater salmonid and splittail rearing and splittail spawning habitat.

37 A conceptual depiction of how channel margin habitat may be enhanced is presented in Figure
38 3. 

39 Because channel margin habitat enhancement is expected to require modification of levees that
40 serve flood control functions, channel margin habitat enhancements will be implemented such

1 that flood control functions are maintained or improved. The BDCP Management Entity will
2 coordinate channel margin habitat enhancement planning with the flood control planning efforts
3 of USACE, DWR, the Central Valley Flood Protection Board, and other flood control agencies
4 to assess the desirability and feasibility for channel modifications. Channel margin habitat
5 enhancements will be designed to support the ecological benefits for covered species described
6 below in *Hypothesized Benefits*.

7 Restoration variables that will be considered in the location and design of enhanced channel
8 margin habitat include:

- 9 • the length of habitat that can be practicably enhanced along channel margins;
- 10 • connectivity with existing channel margin habitats supporting high functioning salmonid
11 rearing habitat;
- 12 • the cross sectional profile of enhanced channels (elevation of habitat, topographic
13 diversity, width, variability in edge and bench surfaces, depth, and slope);
- 14 • the amount and distribution of installed woody debris along enhanced channel margins;
15 and
- 16 • the extent of shaded riverine aquatic overstory and understory vegetative cover needed to
17 provide future input of large woody debris.

18 Channel margin enhancement actions will be located along channels that serve as primary
19 rearing and outmigration habitat for juvenile salmonids. These locations include the Sacramento
20 River between Freeport and Walnut Grove, the San Joaquin River between Vernalis and
21 Mossdale, and Steamboat and Sutter Sloughs that are protected by Federal levees and salmonid
22 migration channels in the interior Delta, such as the North and South Forks of the Mokelumne
23 River, that are protected by non-Project levees. At least 5 miles of the 20 miles of channel
24 margin enhancement would be located along the Sacramento River and at least 5 miles along the
25 San Joaquin River. The remaining 10 miles of channel margin enhancement will be distributed
26 among the channels described above.

27 **Problem Statement**

28 Primary Delta channels serve as movement corridors for the covered fish species and support
29 splittail spawning and salmonid, sturgeon, and splittail rearing habitat. These channels are now
30 leveed and, as such, channel margin habitats lack the diversity and complexity of habitat
31 conditions associated with unmodified channels. Increasing the diversity and complexity of
32 channel margin habitats is expected to increase their function as habitat for covered fish species.

33 **Hypothesized Benefits**

34 Enhancement of channel margin habitat is hypothesized to provide the following ecosystem and
35 covered species benefits. As described in Appendix [redacted], *DRERIP Evaluations*, however, there
36 are a number of uncertainties regarding the level of benefits that may be provided by enhancing
37 channel margin habitat as well as risks for adverse consequences. These uncertainties will be
38 addressed through effectiveness monitoring, research, and the adaptive management program
39 (see Sections 3. [redacted] and 3. [redacted]).

1 Enhancing channel margin habitats is expected to:

- 2 • increase the quality of rearing habitat area for Chinook salmon, sturgeon, and possibly
3 steelhead (Sommer et al.2001a,b, 2002, 2007b, 2008, Moyle 2002, Moyle et al. 2004,
4 Feyrer et al. 2006);
- 5 • reducing the risk for predation on covered fish species by non-native fish predators;
- 6 • increase the extent of shaded riverine aquatic cover and increase instream cover by
7 through contributions of instream woody material (USFWS 2004);
- 8 • increasing connectivity among salmonid rearing and outmigration habitat areas;
- 9 • provide inputs of organic material (e.g., leaf and twig drop) in support of aquatic
10 foodweb processes;
- 11 • increase production and export of terrestrial invertebrates into the aquatic ecosystem
12 (Nakano and Murakami 2001);
- 13 • create additional spawning habitat for Sacramento splittail by creating low velocity
14 backwater habitats (Sommer et al. 2001a, 2002, 2007b, 2008, Moyle 2002, Moyle et al.
15 2004, Feyrer et al. 2006); and
- 16 • create tidal mudflat substrate suitable for the establishment of Suisun Marsh aster,
17 Mason's lileopsis, delta mudwort, and delta tule pea.

18 Restoration of riparian forest and scrub that is incorporated into channel margin enhancements is
19 also expected to support habitat for Swainson's hawk, white-tailed kite, and potentially,
20 depending on vegetative structure and patch size, yellow-breasted chat and least Bell's vireo.

21 **Adaptive Management Considerations**

22 Implementation of channel margin habitat enhancement actions by the Management Entity will
23 be informed through effectiveness monitoring that will be conducted for this conservation
24 measure as described in Section 3. [], *Monitoring and Research Plan*, and the adaptive
25 management process described in Section 3 [], *Adaptive Management Plan*. Based on analysis
26 of monitoring results, likely elements of this measure that could be adjusted through the adaptive
27 management process include adjusting the design of subsequent channel margin restoration
28 actions to improve habitat functions for covered fish species and increasing the effectiveness of
29 emergent and riparian vegetation establishment techniques.

30 **3.4.12 CM12: Riparian Habitat Restoration**

31 The BDCP Management Entity will restore at least 5,000 acres of riparian forest and scrub. It is
32 anticipated that riparian forest and scrub will be restored primarily in association with the
33 restoration of tidal and floodplain habitats and channel margin habitat enhancements. The
34 following are the temporal targets for riparian restoration:

- 35 • 1,300 acres restored within 10 years of Plan implementation
- 36 • 2,300 acres (cumulative) restored by year 15 of Plan implementation
- 37 • 5,000 acres (cumulative) restored by year 40 of Plan implementation