CHAPTER 8. IMPLEMENTATION COSTS AND FUNDING SOURCES

***[Note to Reviewers:** This chapter will ultimately address both estimated BDCP implementation costs and sources of funding that will be relied upon to cover these costs. This draft provides descriptions of the assumptions used to develop cost estimates associated with the implementation of the BDCP conservation measures, program administration, and other Plan-related actions. As these proposed actions are still under review and discussion, some may be modified and others removed from the final draft Plan. Moreover, these estimates are very preliminary and subject to revision. As such, the cost estimates set out in this chapter will be adjusted as conservation measures are added or deleted and when more detailed cost information becomes available. Costs for some parts of the conservation strategy (e.g., the monitoring and research program and the adaptive management program) have not been estimated at this time as there is need for additional specific cost information or additional information or refinement to the actions. Section 8.9 "Funding Sources and Assurances" will not be prepared until the total cost estimate has been completed, and hence funding needs can be ascertained and a funding plan developed. It should be emphasized that the PREs have not committed to pay for any BDCP costs beyond the conveyance component, and substantial public and other sources of funding are expected to contribute to the cost of implementing the elements of the Plan.]*

8.1 Introduction

This chapter outlines estimates of the costs associated with implementation of the Bay Delta Conservation Plan (BDCP) over the proposed 50-year term of the Plan, including the costs related to each of its primary components. The Endangered Species Act requires that habitat conservation plans specify "the funding that will be available to implement" conservation actions that minimize and mitigate impacts on covered species.[1] The Natural Community Conservation Planning Act requires that natural community conservation plans contain "provisions that ensure adequate funding to carry out the conservation actions indentified in the Plan."[2] Based on the estimated costs for BDCP implementation, this chapter identifies the sources of funding that will be relied upon for plan implementation and the mechanisms that will be utilized to secure such funds, and describes the basis for the assurances provided by the Plan Participants that adequate funding will be available to support the implementation of the Plan.

*[**Note to Reviewers**: "Sources and assurances of funding" will be described in a subsequent draft of this chapter.]*

8.1.1 Scope and Purpose of the Cost Analysis

The BDCP identifies a range of actions that will be implemented over the term of the Plan to meet the biological goals and objectives described in the Conservation Strategy and to comply with the requirements of the ESA and the NCCPA. Among those actions are measures to avoid,

[1] U.S.C. section 1539(a)(2)(A)

[2] Cal. Fish and Game Code section 2820(a)(10)

minimize, and mitigate the effects of activities covered by the BDCP on species and natural communities addressed by the Plan and to provide for the conservation of those species. In addition, the BDCP establishes commitments of the Plan Participants to carry out an adaptive management and monitoring program for the species covered by the Plan and to take identified steps to respond to changed circumstances. The BDCP also establishes specific obligations of the Plan Participants regarding plan implementation.

The cost analysis conducted for the BDCP quantifies both the overall cost of the BDCP and the cost of specific plan components. These estimates were used to establish the funding requirements for plan implementation over the course of a 50 year term and to guide decisions regarding the allocation of funding responsibilities among the Plan Participants.

Specifically, the analysis addresses costs related to the following components of the BDCP:

- Conservation Measures
  - **Water Facilities Construction and Operations.** This category covers those conservation measures related to water facilities and water operations. The costs associated with these measures include the development of new water conveyance and other water management facilities that will be located both within and around the Delta. This category also includes actions associated with the operations of both existing and new facilities. These actions were described in Chapter 3, *Conservation Strategy*.
  - **Physical Habitat Restoration and Protection.** This category includes conservation measures associated with the preservation, restoration, and protection of habitat. Specifically, the cost analysis considered actions related to the restoration of 65,000 acres of tidal wetland and associated estuarine habitat, 5,000 acres of riparian habitat, 2000 acres of grassland, 400 acres of non-tidal wetlands and associated aquatic habitat, 200 acres of vernal pool complex, up to 5,000 acres of managed wetlands, and 10,000 acres of floodplain habitat; the enhancement of 20 linear miles of channel margin habitat; and the protection of existing 8,000 acres of grassland, 400 acres of non-tidal wetlands, 300 acres of vernal pool complex, 400 acres of seasonal alkali wetland complex, up to 2,000 acres of managed wetlands, and up to 32,640 acres of agricultural land. The analysis also covers costs related to the mitigation of impacts to terrestrial habitat that are expected to occur as a result of certain covered activities. These measures are described in Chapter 3, *Conservation Strategy*.
  - **Other Stressors.** This category covers conservation measures designed to reduce the direct and indirect adverse effects of various stressors on ecological functions, covered species, and natural communities. Such stressors include toxic contaminants and other factors affecting water quality, non-native species, harvest, hatcheries, diversions unrelated to the SWP or CVP, predators, and migration barriers and other impediments to movement. The range of conservation measures that address other stressors are described in Chapter 3, *Conservation Strategy*.
  - **Monitoring and Adaptive Management**. This category includes the start-up and on-going costs of the monitoring, research, and adaptive management programs, including expenses related to research and data collection, management, and analysis.

The BDCP monitoring and adaptive management programs are described in Chapter 3, *Conservation Strategy*.

- **Changed Circumstances.** This category covers the cost of implementing measures to respond to changed circumstances. Those measures are set forth in Chapter 6, *Implementation Plan*.
- **Program Administration.** This category consists of expenditures necessary to administer the BDCP. It includes the start-up cost of establishing the Management Entity and the ongoing costs of administration, including expenses associated with personnel, offices and other facilities, equipment, vehicles, contracted services, and other overhead and related expenses. A description of the approach to the administration of the BDCP is described in Chapter 7, *Implementation Structure*.

The cost analysis includes sections describing how funding needs were estimated for each plan component, including the assumptions and data used to determine the level and timing of funding needed over the course of plan implementation. Many of the cost estimates are based on conceptual and engineering designs for water facilities and habitat restoration projects available at the time of plan formulation.

This chapter also identifies the sources of funding to implement the BDCP and sets out assurances that adequate funding will be available to perform the terms and conditions of the Plan, consistent with the ESA and the NCCPA. Both the ESA and the NCCPA require that conservation plans include provisions that ensure adequate funding to carry out identified conservation actions. The nature of the BDCP assurances of funding for each of the primary components of the Plan, including actions associated with conservation measures, adaptive management and monitoring, and plan administration, is described in this chapter.

8.1.2 Organization of Chapter

The remainder of this chapter is organized as follows:

- Section 8.2 describes common assumptions used to estimate BDCP implementation costs.
- Sections 8.3 thru 8.7 describe the methods, data, and specific assumptions used to estimate implementation costs related to conservation measures, monitoring, research, adaptive management, and plan administration.
- Section 8.8 summarizes the overall implementation costs for the Plan.
- Section 8.9 identifies the sources of funding for the BDCP and describes how such funding will be assured by the Plan participants.
- Section 8.10 provides an analysis of net costs of BDCP implementation. Appendix XX provides additional detail on the data and assumptions used to estimate costs presented in this chapter.

8.2 Common Assumptions for Cost Estimation

Certain common assumptions were applied to all cost estimates developed for the BDCP. These common assumptions are described in the following subsections.

8.2.1 Cost Periods

Cost estimates are described within 5-year periods, commencing with the first year in which regulatory authorizations have been issued by the fish and wildlife agencies, and concluding at the expiration of the permits term. The cost estimation assumes that the initial 5-year period covers 2011 to 2015 and the final 5-year period covers 2056 to 2060. Every cost estimate has a temporal dimension, reflecting when those costs are expected to be incurred over the term of the BDCP.

8.2.2 Financial Assumptions

In cases where present values were calculated or capital costs were amortized, a nominal discount rate of 4.375 percent and a long-term inflation rate of 2.1 percent are assumed. The discount rate was selected to match the FY 2010 rate that the USACE and Reclamation are required to use for developing and evaluating proposed plans for water project plan formulation and evaluation.[3] The long-term inflation rate is based on the spread between nominal and inflation-indexed 30-year Treasury notes, as published in Appendix C of Office of Management and Budget (OMB) Circular No. A-94 (revised January 2008).

Costs are reported in constant 2009 dollars.[4] Historical costs have been converted to 2009 dollars using various price indices, including consumer and producer price indices published by the Bureau of Labor Statistics, and civil works construction cost indices published by the USACE.

8.2.3 Transaction Costs Associated with the Acquisition of Interests in Land

Purchases of interests in land, including in fee title or through easements, for the purpose of carrying out habitat restoration actions, ensuring the protection of resources, and undertaking construction of water facilities, are assumed to involve transactional costs in addition to the price paid for that property interest. These transaction costs are likely to consist of: (1) the cost of conducting due diligence, and (2) the cost of undertaking pre-acquisition boundary and habitat surveys. The common assumptions used for computing due diligence and pre-acquisition survey costs are set forth in Tables 8.1 and 8.2, respectively. Transactional costs are based on the average parcel size and boundary length computed for each BDCP Conservation Zone, Restoration Opportunity Area (ROA), floodplain region, and water facility right-of-way.

[3] The published rate of 4.0% (rounded) does not include any adjustment that may be needed to show the maximum rate of change of ¼ of one percent per year. The FY 2009 rate was 4.625%, hence the adjusted FY 2010 rate cannot be less than 4.375%.

[4] This means the costs presented in this chapter have been adjusted to reflect 2009 price levels and dollar purchasing power. Adjusting costs for inflation in this way allows for a more accurate comparison of costs over time.

Table 8.1 Land Acquisition Due Diligence Cost Assumptions

Due Diligence Multiplier*	1.25
Appraisal Cost ($/Parcel)	$5,200
Preliminary Title Report ($/Parcel)	$520
Phase 1 Site Assessment ($/Parcel)	$6,760
Legal Description ($/Parcel)	$4,264
Boundary Survey ($/Linear Foot of Boundary)	$0.47
Monumentation ($/Linear Foot of Boundary)	$0.36
Note: *Applied to the number of acquired parcels to account for the number of parcels considered for purchase but ultimately not purchased.	

Table 8.2 Pre-Acquisition Survey Cost Assumptions

Survey Multiplier*	1.25
Land cover type survey (hrs/100 acres)	12
Covered species habitat survey (hrs/100 acres)	16
Covered plant habitat survey (hrs/100 acres)	32
Covered wildlife survey (hrs/100 acres)	28
Contractor Cost ($/hr)	$128
Note: *Applied to the number of acquired acres to account for the number of acres surveyed for purchase but ultimately not purchased.	

8.2.4 Delta Real Estate Values

Interests in land for the purpose of physical habitat restoration actions, resource protection, and water facilities development may be obtained through the acquisition of fee title or through easement. The average cost of acquiring land in fee or by easement to facilitate physical habitat restoration within ROAs in the Delta is based on the per acre land values shown in Table 8.4. The cost of acquiring Delta land in fee or by easement in Conservation Zones outside of the ROAs for terrestrial land conservation and water facilities construction is based on the per acre land values shown in Table 8.5. The values shown in the tables are based on the following methods and data.

ROA Land Values

DWR land use survey data at the DAU level was combined with parcel assessment data in order to estimate land values by land use classification.[5]

Land uses within the ROAs were categorized as: (1) field and truck crop production, which includes pasture, hay, grain, other field crops, and vegetable crops; (2) orchard and vine crops, which includes deciduous tree and citrus crops and vineyards; (3) semi-agricultural land uses, which includes farm roads, yards, and structures, and other land uses supporting agricultural

[5] The DWR Land and Water Use Program collects land use data and develops water use estimates used in statewide water planning. It accomplishes this by conducting surveys of agricultural, urban and environmental land uses, and developing annual estimates of land uses on a regional basis. Since 1986, DWR has compiled land use survey data into georeferenced digital maps. The smallest level of resolution for these maps is the Detailed Analysis Unit (DAU), the smallest study area used by DWR, generally defined by hydrologic features or boundaries or organized water service agencies. In the major agricultural areas, a DAU typically includes 100,000 to 300,000 acres.

production; (4) urban land uses, which includes residential, commercial, and industrial land uses; (5) and native vegetation.

Parcel assessment data were used to estimate ROA land values from 2000 through 2009. Assessments that were made earlier than 2009 were updated to correspond to 2009 values using property value indices. For those parcels primarily under agricultural or semi-agricultural use or that consist of native vegetation, the USDA's three California land value series for irrigated cropland, un-irrigated cropland, and "farmland & buildings" were used to update pre-2009 assessments. For parcels designated for urban uses, the S&P/Case-Shiller housing value index for the San Francisco Bay Region was used.[6]

Parcels primarily used for a single purpose (e.g., field and truck crop production) were evaluated to establish an average value for that use. In the case of agricultural and native vegetation land uses, parcels for which these uses comprised at least two-thirds of the area of the parcel were used to derive the average value. In the case of urban land uses, parcels for which these uses occurred on at least half of the area of the parcel were used.[7] Values for agricultural land uses – which comprise the dominant land uses in the ROAs – were developed for each ROA. The small number of parcels classified as native vegetation or urban prevented separate estimates for each ROA. For these land uses, the parcel samples were combined for all ROAs and a single estimate was derived.

Easement values may range from 10 to 90 percent of fee value, depending on the conditions placed on the land under easement.[8] Upon review of recent conservation easement valuations in the Delta, it appears that an assumption of 60 percent of fee value would provide a conservative basis for estimates of conservation easement costs within the ROAs.[9]

Broader Delta Land Values

Agricultural fee title values for the broader Delta are based on the midpoints of the value ranges listed in the 2009 California Trends in Agricultural Land and Lease Values published by the California Chapter of the American Society of Farm Managers and Rural Appraisers (CSFMRA) as shown in Table 8.3. Fee title values for the broader Delta for native, semi-agricultural, and urban land classifications are assumed to be the same as for the ROAs.

Conservation easement values in the broader Delta are assumed to be 60 percent of fee values, as they are for the ROAs. Subsurface easements are expected to be appraised at between 30 and 50 percent of fee value.[10] For the purpose of conducting the cost analysis, it was assumed subsurface easements would cost 40 percent of fee value.

[6] The indices were used to measure the rates of increase in property values over the period 2000 to 2009. Thus, absolute differences in property values for different parts of the region (e.g., Marin versus Solano) are not of consequence, since property values were escalating at similar rates over this period.

[7] A smaller percentage is used for the urban land use classification because most parcels in the ROAs contain only a small amount of land classified as urban.

[8] Letter correspondence with Allan Davis, Supervising Land Agent, Department of Water Resources, January 29, 2010.

[9] This is based on a sample of recent conservation easement sales and appraisals for San Joaquin and Stanislaus counties obtained from the Conservation Land Group (www.conserveland.com).

[10] Letter correspondence with Allan Davis, Supervising Land Agent, Department of Water Resources, January 29, 2010.

Table 8.3 CSFMRA Agricultural Land Values Used for Broader Delta

Delta County	*CSFMRA Agricultural Land/Lease Values*			
	Field Crops	***Truck Crops***	***Orchard***	***Vineyard***
Contra Costa	Region 3, Northern San Joaquin County Westside Cropland	Region 3, Northern San Joaquin County Westside Cropland	Region 3, Northern San Joaquin County Cherry Orchards	Region 3, Northern San Joaquin County Vineyards
Sacramento, Solano, Yolo	Region 1, South Sutter, Western Placer, Solano, and Yolo counties, Class II/III irrigated field crops	Region 1, South Sutter, Western Placer, Solano, and Yolo counties, Class I/II vegetable crops	Region 1, South Sutter, Western Placer, Solano, and Yolo counties, Pear Orchards	Region 1, South Sutter, Western Placer, Solano, and Yolo counties, Vineyards
San Joaquin	Region 3, Northern San Joaquin County Delta Cropland	Region 3, Northern San Joaquin County Delta Cropland	Region 3, Northern San Joaquin County Almond Orchards (excluding South/Central region)	Region 3, Northern San Joaquin County Vineyards

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Table 8.4. ROA Land Value Assumptions ($/Acre, 2009 dollars)

ROA	*% of ROA Land Use*				*Avg. Fee Value*	*Avg. Easement Cost*
	Native Veg.	**Field/ Truck**	**Orchard/ Vineyar**	**Semi Ag/ Urban**		
Cache Slough	31.5%	67.4%	0.8%	0.3%	$1,700	$1,000
Cos./Mokelumne/East Delta	0.4%	76.8%	22.1%	0.7%	$7,800	$4,700
South Delta	0.9%	94.8%	2.8%	1.5%	$7,400	$4,400
Suisun Marsh	96.1%	3.3%	0.0%	0.6%	$2,300	$1,400
West Delta	38.4%	58.6%	2.4%	0.5%	$4,700	$2,800
Yolo Bypass	15.2%	81.6%	2.9%	0.4%	$2,400	$1,400

Notes: Values rounded to nearest $100. Fee values are acreage-weighted average assessment values (updated to 2009 values) for parcels consisting primarily of indicated land use classification. Values for native, semi-agricultural, and urban land use classifications are weighted averages across all ROAs. Values for the crop land use classifications are weighted averages for individual ROAs. Surface easement values are 60 percent of fee values.

Table 8.5. Broader Delta Land Value Assumptions ($/Acre, 2009 dollars)

Delta County	*Native Veg.*	*Field Crop*	*Truck Crop*	*Orchard*	*Vine yard*
	Fee Title Value				
Contra Costa	1,500	6,300	6,300	17,500	16,500
Sacramento, Solano, Yolo	1,500	6,900	8,300	9,000	20,000
San Joaquin	1,500	5,800	5,800	15,000	16,500
	Surface Conservation/Construction Easement Value				
Contra Costa	900	3,800	3,800	10,500	9,900
Sacramento, Solano, Yolo	900	4,100	5,000	5,400	12,000
San Joaquin	900	3,500	3,500	9,000	9,900
	Subsurface Construction Easement Value				
Contra Costa	600	2,500	2,500	7,000	6,600
Sacramento, Solano, Yolo	600	2,800	3,300	3,600	8,000
San Joaquin	600	2,300	2,300	6,000	6,600

Notes: Land values for agricultural land uses are based on the midpoint of the value ranges listed in the 2009 CSFMRA *Trends in Agricultural Land and Lease Values* for the regions shown in Table 8.3. Land values for native vegetation land uses are the same as the ROA values.

8.2.5 Employee Salary Costs and Benefits Multiplier

Plan administration costs include salary costs (Section 8.4, *Plan Administration*). The Management Entity will build a staff to oversee or carry out the actions outlined in the BDCP (Chapter 7, *Implementation Structure*). The salary cost estimates associated with these personnel needs are based on proposed FY 2008-09 salary scales for reference positions within various departments of the California Natural Resources Agency, as reported by the California Department of Finance.[11] While federal employees may also be involved in the Management Entity, differences between federal and state salaries are expected to be small and inconsequential with respect to overall BDCP administrative costs.

The cost analysis includes a benefits multiplier to account for certain assumed benefits, such as paid leave, health, retirement and other employee benefits, that would be provided to employees of the Management Entity. A benefits multiplier of 1.35 was applied to all staff salary costs associated with the BDCP Management Entity, except in cases where the estimated staffing cost accounted for employee benefits.[12]

8.2.6 Cost Contingency

Various conservation measures include engineering and construction of large scale facilities such as the pipeline/tunnel conveyance, gates on Fremont Weir, and new levees for floodplain restoration. The American Association of Cost Engineers define contingency as a specific provision for unforeseeable elements of cost within the defined project scope. Cost uncertainties may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. For planning studies, standard contingencies typically range from 20 and 30 percent, but may be as high as 50 percent for experimental or special conditions. In cases where cost contingency has not been explicitly factored into the cost estimate, a 20 percent contingency has been added.

8.3 Cost Estimate for Conservation Measures

This section describes the data, methods, and specific assumptions used to estimate the cost of implementing the BDCP conservation measures. Different costing approaches were used for different conservation measures, depending on the conceptual and engineering design and cost information available at the time of Plan formulation. The approach taken for each conservation measure and the sources of data and other information used for the analysis are described in the following subsections.

8.3.1 CM 1: Water Facilities and Operation

*[**Note to Reviewers**: In the main text, low and high construction cost estimates are presented for the all pipeline/tunnel conveyance facility option. Because a preferred project has not been*

[11] www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm.

[12] The multiplier is based on average benefits paid by state and local governments as a percent of total employee compensation in 2009, as reported by the U.S. Bureau of Labor Statistics.

selected at this time, the preliminary cost estimate for the eastern alignment option for the conveyance facility is also presented at the end of this section. For the pipeline/tunnel alignment, the low cost estimate is based on the DHCCP cost estimate presented at the December 3, 2009 Steering Committee meeting. The high cost estimate is based on the 5RMK cost estimate presented at the February 11, 2010 Steering Committee meeting. Operating cost estimates for the tunnel and canal options are taken from the DHCCP cost estimate presented at the December 3, 2009 Steering Committee meeting. All intake and conveyance cost estimates are preliminary and subject to further refinement and change. The final chapter will contain a fuller description of the methodology and assumptions used to estimate conveyance facility costs.]

Cost estimates are presented for the following components of water facilities construction and operation:

- Design, project management, construction management;
- Intake and conveyance construction costs;
- Construction cost contingency;
- Land acquisition for facility footprint; and
- Annual operation, maintenance, and energy.

*[**Note to Reviewers**: Capital replacement costs for major equipment and structures have not yet been estimated and are not included in the preliminary cost estimate.]*

Facility features are summarized in Table 8.6. Low and high cost estimates are presented in Table 8.7.[13] All costs are expressed in 2009 constant dollars. Design, project management, and construction management costs are assumed to be 18 percent of construction cost. Direct construction costs are based on a 10 percent design level and utilize deterministic and stochastic estimating methods.[14] Construction labor costs are based on prevailing wages as published by the California Department of Industrial Relations. Construction equipment costs are based on ownership and operating costs as published by USACE. Costs for major materials are based on budgetary quotes received from U.S. vendors. Construction contingencies are set to 35 percent for tunneling elements and 25 percent for all other construction elements.

Land acquisition costs are based on the per acre fee title, surface easement, and subsurface easement costs listed in Table 8.5. Surface and subsurface facility footprint, staging, and borrow site acreage by land use category were estimated by intersecting data from DWR land use surveys for Delta counties with hypothetical facility, staging, and borrow site footprints. Land acquisition costs include a 10 percent markup to account for transaction costs and a 20 percent cost contingency.

*[**Note to Reviewers**: The initial conveyance volume assumptions used to cost facility operations differ from the results of the long-term operations study. DHCCP is currently re-estimating facility operation costs. The revised estimate will be incorporated into the next draft of Chapter 8.]*

[13] The low construction cost estimate is set to the upper-bound of the DHCCP cost estimate presented at the December 3, 2009 Steering Committee meeting. The high construction cost estimate is set to the 5RMK independent cost estimate presented at the February 11, 2010 Steering Committee meeting.

[14] The construction cost estimate has Class 3 estimate quality, as defined by the Association for the Advancement of Cost Estimating International Practices.

Annual energy, operation and maintenance costs were estimated by DHCCP for each of the major intake and conveyance components. Annual energy costs depend largely on the volume of water pumped and conveyed, which varies from year to year primarily due to hydrologic variation. For estimation purposes, the following conveyance volumes are assumed:

- Average year diversion is 3.6 million acre-feet;
- Dry year diversion is 2.3 million acre-feet; and
- Wet year diversion is 5.7 million acre-feet.

Energy costs were calculated at $0.15 per kilowatt-hour.

The construction cost estimates were developed using a combination of unit prices developed for similar work in various locations around the United States; historical unit prices compiled over time by the DHCCP estimating staff; unit prices recorded by the State of California Department of Transportation in the Contract Cost Data guide; budgetary vendor pricing; and bottoms-up estimates developed for specific portions of work by DHCCP. Where necessary, the various historical and unit prices were escalated using United States Bureau of Reclamation cost escalations charts or other methods.

Labor Rates used in the estimates were developed using the Prevailing Wage Determinations for Northern California and Sacramento, San Joaquin, Yolo and Contra Costa counties.

Equipment Rates were developed using United States Army Corps of Engineers, Region VII "Construction Equipment Ownership and Operating Expense Schedule," State of California Department of Transportation "Labor Surcharge and Equipment Rental Rates," and Northern California rental vendor quotes.

Material costs were developed from quotes from Northern California vendors and internet search. All costs are expressed in April 2009 US dollars. Other assumptions used to develop the construction cost estimated included:

- All import borrow material necessary to construct the Intermediate Forebay will be available within an average 5 mile haul (one-way, using off-highway equipment).
- All excess dirt can be spoiled at an average one mile haul using off-highway equipment.
- No import borrow royalty payment is included.
- No allowance for upgrading the existing roadways and/or bridges to accommodate the required number of highway truck trips is included.
- The soil can be dewatered effectively.
- For construction of the North Delta Intake facility, once sheet pile cofferdams are in place, work will be conducted on a year-round basis.
- Work will proceed on a ten-hour day, six-days per week schedule, potentially two shifts per day.
- Tunneling work may proceed on a 24/7 schedule.
- All required permits will be in place prior to start of construction.

- Acquisition of property does not cause delays to the construction schedule.

Table 8.6 Summary of Intake and Conveyance Facility Features

Item	*Quantities*			
Intakes with Pumping Plants	5 @ 3,000 CFS			
Conveyance Pipeline	1 mile (twin 16-ft diameter)			
Intermediate Pumping Plant	15,000 CFS			
Intake Capacity	15,000 CFS			
Canals	none			
Tunnels	3 each (43 miles)			
Box Culvert Siphons	None			
Forebay Total Acreage	1,400 acres			
Bridges	none			
Utilities	70 conflicts			
Gravity Bypass	Up to 7,000 CFS			
Installed Power Demand	230 MW			
Surge Towers	5 each			
Estimated Privately Owned Acreage Required for Facility, Staging and Borrow Site Footprints, by Land Use and County				
Surface Acreage	***Alameda/Contra Costa***	***Sacramento***	***San Joaquin***	***Yolo***
Ag – Field Crop	733	2,626	535	44
Ag – Truck Crop	0	312	313	76
Ag – Orchard	0	30	0	0
Ag – Vineyard	299	552	0	13
Semiagricultural	53	113	29	3
Urban	7	19	0	0
Native	272	176	17	21
Total Surface Acreage	1,363	3,827	893	157
Subsurface Acreage	***Alameda/Contra Costa***	***Sacramento***	***San Joaquin***	***Yolo***
Ag – Field Crop	31	319	544	68
Ag – Truck Crop	28	52	69	31
Ag – Orchard		76		
Ag – Vineyard		116		55
Semiagricultural	7	27	27	12
Urban	3	36	6	4
Native	14	74	145	21
Total Subsurface Acreage	83	700	791	191
Notes: CFS = Cubic Feet per Second. MW = megawatts				

Table 8.7 Summary of Intake and Conveyance Facility Costs (Mil. $)

*[**Note to Reviewers:** Estimated costs in this table are for the pipeline/tunnel option]*

Cost Item	Low	High
Construction		
Design, Project & Construction Management	$1,607	$1,826
Direct Construction	$6,768	$7,633
Subsurface Construction Contingency	$1,641	$1,985
All Other Construction Contingency	$519	$497
Total Construction	$10,537	$11,973
Land Acquisition	$102	$102
Annual Operating Cost ($/yr)	$35.4	$35.4

Estimated costs of water facility construction and operation over the 50-year term of the BDCP are shown in Table 8.8.

Table 8.8 Water Facility and Operations Cost Incidence over Term of BDCP

*[**Note to Reviewers:** Estimated costs in this table are for the pipeline/tunnel option]*

	Total Cost for Water Facility and Operations										Total
Low Cost	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	Cost
Intake and Conveyance Facilities	7,238	3,299	0	0	0	0	0	0	0	0	10,537
Land Acquisition	102	0	0	0	0	0	0	0	0	0	102
Energy	0	54	109	109	109	109	109	109	109	109	926
O&M	0	34	69	69	69	69	69	69	69	69	586
Total Cost	7,340	3,387	178	178	178	178	178	178	178	178	12,151
Running Total	7,340	10,727	10,905	11,083	11,261	11,439	11,617	11,795	11,973	12,151	12,151
	Total Cost for Water Facility and Operations										Total
High Cost	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	Cost
Intake and Conveyance Facilities	8,224	3,749	0	0	0	0	0	0	0	0	11,973
Land Acquisition	102	0	0	0	0	0	0	0	0	0	102
Energy	0	54	109	109	109	109	109	109	109	109	926
O&M	0	34	69	69	69	69	69	69	69	69	586
Total Cost	8,326	3,837	178	178	178	178	178	178	178	178	13,587
Running Total	8,326	12,163	12,341	12,519	12,697	12,875	13,053	13,231	13,409	13,587	13,587

[Eastern Alignment Surface Canal Conveyance Option Cost Estimate]

*[**Note to Reviewers**: Because a preferred project has not been selected the preliminary cost estimate for the eastern alignment conveyance facility is presented in the following tables. Estimated construction costs were prepared by DHCCP and presented to Steering on December 3, 2009. Estimated land acquisition costs are based on the land acquisition cost assumptions presented in this chapter.]*

Summary of Features for the East Canal Conveyance Option

Item	*East Canal Conveyance*
Intakes with Pumping Plants	5@3,000 CFS
Conveyance Pipeline	5.9 miles (twin 16' diameter)
Intermediate Pumping Plant	15,000 CFS
Intake Capacity	15,000 CFS
Canals	40 miles
Tunnels	4 each (2.1 miles)
Box Culvert Siphons	8 each
Forebay Total Acreage	630 acres
Bridges	18 bridges
Utilities	150 conflicts
Gravity Bypass	none
Installed Power Demand	95 MW
Surge Towers	none

Assumptions made for estimating East Canal Conveyance costs and schedule include:

- All import borrow will be available at an average 5 mile haul using off-highway equipment.
- All excess dirt can be spoiled at an average 1 mile haul using off-highway equipment.
- No import borrow royalty payment is included.
- No allowance for upgrading the existing roadways and/or bridges to accommodate the required number of highway truck trips is included.
- The soil can be dewatered effectively.
- Certain sloughs can be completely diverted to allow for complete box culvert siphon construction.
- For construction of the North Delta Intake facility, once sheet pile cofferdams are in place, work can continue year-round in water.
- Work would proceed on a ten-hour day, six-days per week schedule, potentially two shifts per day.All required permits would be in place prior to start of construction.
- Real estate acquisition would not delay the construction schedule.

East Intake and Conveyance Facility Costs (Mil. $)

*[**Note to Reviewers:** Estimated costs in this table are for the East Conveyance option]*

Cost Item	*East Canal Conveyance*
Construction	
Design, Project & Construction Management	$1,159
Direct Construction	$5,088
Tunneling Construction Contingency	$280
All Other Construction Contingency	$1,072
Total Construction	$7,600
Land Acquisition	$335
Annual Operating Cost (mil $/yr)	$50.6

East Canal Conveyance Facility and Operations Cost over Term of BDCP Term

*[**Note to Reviewers:** Estimated costs in this table are for the East Conveyance option]*

East Conveyance	*Total Cost for Water Facility and Operations*										*Total Cost*
	1-5	*6-10*	*11-15*	*16-20*	*21-25*	*26-30*	*31-35*	*36-40*	*41-45*	*46-50*	
Intake and Conveyance Facilities	$4,940	$2,660	$0	$0	$0	$0	$0	$0	$0	$0	$7,600
Land Acquisition	$335	$0	$0	$0	$0	$0	$0	$0	$0	$0	$335
Energy	$0	$83	$165	$165	$165	$165	$165	$165	$165	$165	$1,403
O&M	$0	$44	$88	$88	$88	$88	$88	$88	$88	$88	$748
Total Cost	$5,275	$2,787	$253	$253	$253	$253	$253	$253	$253	$253	$10,086
Running Total	$5,275	$8,062	$8,315	$8,568	$8,821	$9,074	$9,327	$9,580	$9,833	$10,086	$10,086

8.3.2 8.3.2 CM 2: Stockton Deep Water Ship Channel Dissolved Oxygen Levels

This conservation measure, which will occur within the Stockton Deep Water Ship Channel, is designed to maintain dissolved oxygen concentrations at levels that will not adversely affect covered fish species during periods when these fish are present in the channel. The BDCP Management Entity will operate and maintain an oxygen aeration facility in the channel to increase dissolved oxygen concentrations between Turner Cut and Stockton to meet Total Maximum Daily Load (TMDL) objectives established by the CVRWQCB (2005) (above 6.0 mg/L from September 1 through November 30 and above 5.0 mg/L at all times). The existing aeration facility will be modified as necessary and, if necessary, additional aerators and associated infrastructure will be added to optimize oxygen delivery to the river, contingent upon results of an ongoing demonstration project conducted by DWR.

Operating costs at DWR's existing demonstration facility vary depending on the flows through the ship channel. During dry years, the facility may operate for up to 100 days per year, while in wet years no operations may be required. Depending on flow conditions, annual operating costs range from $10,000 to $300,000 per year. For the purpose of the cost analysis, a mean annual

operating cost of $150,000 has been assumed. This cost estimate is conservative given expected flows through the ship channel.[15]

DWR's existing aeration facility, constructed in 2007, cost $3.5 million and is expected to have a 15 year useful life.[16] For the cost analysis, it was assumed the facility and its associated equipment would be replaced sometime between year 11 and 15 of the term of the BDCP.

Estimated costs of this measure over the term of the BDCP are shown in Table 8.9.

Table 8.9 Estimated Costs for Stockton Deep Water Ship Channel DO Diffusers

	Cost Period										*Total*
Cost by Period (mil. $)	**1-5**	**6-0**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	*Cost*
Equipment Costs	0.00	0.00	3.50	0.00	0.00	3.50	0.00	0.00	3.50	0.00	10.50
Operating Costs	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	7.50
Total Cost	0.75	0.75	4.25	0.75	0.75	4.25	0.75	0.75	4.25	0.75	18.00
Running Total	0.75	1.50	5.75	6.50	7.25	11.50	12.25	13.00	17.25	18.00	18.00

8.3.3 CM 3: Illegal Harvest

This conservation measure provides for the funding of actions designed to reduce incidence of illegal harvest of covered fish species. Over the course of the BDCP, funding will be provided to support 17 field wardens and 5 supervisory staff that will be assigned to the Delta-Bay Enhanced Enforcement Program (DBEEP). Funding will be used to cover the following expenses: (1) salaries, wages, and benefits, (2) operating expenses, (3) minor equipment, (4) major equipment, and (5) overhead. Cost estimates for each category of expense are based on information provided by DFG.

Salaries, Wages, and Benefits

Estimated annual staffing costs are based on the DFG positions and salaries shown in Table 8.10, and the employee benefit assumptions described in Section 8.2.

[15] The operating cost estimate prepared by DWR assumed the facility would operate on average 50 days per year. However, recent changes to the City of Stockton's Regional Wastewater Treatment Facility have resulted in improved water quality in the ship channel. If ship channel water quality improves further as a result of San Joaquin River restoration or Delta improvements, average operating days may dip below the level assumed for the cost analysis (McLaughlin, William. Senior Engineer, Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Project Bay-Delta Office California Department of Water Resources. Personal Communication).

[16] McLaughlin, William. Senior Engineer, Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Project Bay-Delta Office California Department of Water Resources. Personal Communication.

Table 8.10 DFG Game Warden and Support Staff Wage and Salary Assumptions

Position	*Annual FTE Salary**	*FTE Positions*	*Resources Agency Reference Position*
Fish & Game Warden	$60,000	17	Fish and Game Warden, DFG Law Enforcement Div.
Patrol Lieutenant - Supervisor	$73,500	1.0	Fish and Game Patrol Lieutenant – Supervisor, DFG Law Enforcement Div.
Associate Governmental Program Analyst	$60,600	1.0	Associate Governmental Program Analyst, DFG Law Enforcement Div.
Staff Services Analyst-General	$48,600	2.0	Staff Services Analyst-General, DFG Law Enforcement Div.
Secretary	$37,900	1.0	Secretary, DFG Law Enforcement Div.

Notes:
* Salary estimates based on proposed salaries for 2008-09 for corresponding positions within the Resources Agency, as reported by the California Department of Finance (www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm). Annual salary amounts shown in this table were multiplied by 1.35 to account for paid leave, health, retirement and other benefits.

Operating Expenses

Operating expenses have been estimated by DFG to be approximately $1.3 million annually. Operating costs include allowances for facilities, vehicles, travel, training, general office expenses, and employee overtime.[17]

Minor and Major Equipment

Costs for minor equipment were estimated by DFG to be approximately $410,000. Minor equipment is expected to be replaced every five years. Costs for major equipment were estimated by DFG to be approximately $892,000. Major equipment is expected to be replaced every ten years. Boat costs were estimated by DFG to cost $1.15 million. Boats are expected to be replaced every 15 years.

Overhead

An overhead multiplier of 0.23 was applied to labor, operating, and equipment costs to account for associated overhead costs DFG expects to incur to support the additional staff and equipment assigned to the DBEEP program.

Total costs of this conservation measure over the term of the BDCP are summarized in Table 8.11.

[17] Naslund, Brian. Captain, Delta-Bay Enhanced Enforcement Program, California Department of Fish and Game. Personal Communication.

Table 8.11 Estimated Illegal Harvest Reduction Costs by Cost Period

Costs by Period (mil. $)	Cost Period										Total Cost
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	
Salaries & Benefits	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	87.02
Operating Expenses	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	67.07
Minor Equipment	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	4.38
Major Equipment	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	9.62
Overhead	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	38.66
Total Cost	20.68	20.68	20.68	20.68	20.68	20.68	20.68	20.68	20.68	20.68	206.75
Running Total	20.68	41.35	62.03	82.70	103.38	124.05	144.73	165.40	186.08	206.75	206.75

8.3.4 CM 4: Hatchery and Genetic Management Plans

This conservation measure provides for the accelerated development and implementation of Hatchery and Genetic Management Plans (HGMPs) for state Chinook salmon and steelhead hatcheries located in California's Central Valley. Several coordinating actions with DFG and National Marine Fisheries Service (NMFS) associated with this conservation measure will be undertaken by the BDCP Management Entity. The costs associated with these efforts will primarily be staff-related and were included in the estimated costs for BDCP Program Administration presented later in this chapter.

In addition to these coordinating actions, the BDCP Management Entity will provide funding for: (1) the development of the HGMPs, (2) a new DFG HGMP staff position, and (3) additional staff at Central Valley hatcheries needed for HGMP implementation and updating. The costs estimated for each action are as follows.

HGMP Development and Updating

The cost analysis assumed 12 HGMPs would be updated every five years.[18] Recent genetic management plans developed by DWR for the Feather River Hatchery have cost $125,000 on average, with approximately 90 percent of this being consultant time, and 10 percent DWR staff time.[19] The estimated cost for all twelve plans is estimated to be $1.5 million every five years.

DFG HGMP Coordinator Staff Position

An HGMP Coordinator will be hired to coordinate the development, updating, and implementation of the HGMPS among the state hatcheries. It was assumed the salary for this position would be equivalent to that for a Supervising Biologist with DFG's Fisheries Division. DFF estimated overhead and operating costs for the position at $20,000 per year.[20] Total estimated cost to fund the position, including employee benefits and overhead, is $128,000 per year.

[18] Appendix XX provides the list of Central Valley hatcheries for which it is assumed HGMPs will be developed.

[19] Kindopp, Jason. Feather River Program, California Department of Water Resources. Personal Communication.

[20] Shaffer, Kevin. Environmental Scientist, Native Anadromous Fish and Watershed Branch, California Department Fish and Game. Personal Communication.

Central Valley Hatcheries Staff Positions and Operations

It was assumed that each hatchery would need to hire a biologist to oversee the implementation of the individual management plans. DFG estimated the cost of the position at $92,000 per year, including benefits.[21] It was assumed four biologists would be needed for the state hatcheries and two for the federal hatcheries. DFG estimated overhead and operating costs for each position at $20,000 per year.[22] Each hatchery was assumed to undertake genetic testing of 10 salmonids stocks every three years. The cost analysis assumed each test would require 50 samples at a cost of $200 per sample. It was also assumed each hatchery would need to seasonally hire technicians to collect and record population data during salmon runs at a cost of $40,000 per year.[23]

Estimated costs for this conservation measure over the term of the BDCP are summarized in Table 8.12.

Table 8.12 Estimated HGMP Development and Implementation Support Costs by Cost Period

Costs by Period (mil. $)	*Cost Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
HGMP Development	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	15.0
DFG Coordinator	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	6.4
Hatcheries Staffing	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	36.0
Genetic testing/data	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	3.70
Total Cost	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	61.1
Running Total	6.11	12.22	18.33	24.44	30.55	36.66	42.77	48.88	54.99	61.1	61.1

8.3.5 CM 5: Conservation Hatcheries

***[Note to Reviewers:** Cost estimates for smelt propagation programs are likely to be refined upon further input from staff at UC Davis Fish Culture Lab and USFWS.]*

This conservation measure provides for the support of existing and establishment of new conservation propagation programs for delta and longfin smelt. The conservation measure includes the following: (1) the development of a USFWS delta and longfin smelt conservation hatchery to house a delta smelt refugial population and provide a source of delta and longfin smelt for supplementation or reintroduction, if deemed necessary by Fishery Agencies, and (2) the expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory to serve as a population safeguard in case of a catastrophic event in the wild.

[21] Ibid.
[22] Ibid.
[23] Lee, Dennis. Consulting Fisheries Scientist. Personal Communication.

USFWS Delta and Longfin Smelt Conservation Hatchery

The proposed USFWS hatchery is described in Chapter 3, *Conservation Strategy*. Estimated construction costs for the facility, as developed by USFWS, are $19.4 million.[24] Annual operating costs, also developed by USFWS, are $1.5 - $2.0 million.[25] It was assumed the facility will be constructed by the end of the fifth year of the BDCP and that an annual operating cost of $1.75 million will be incurred starting in the sixth year of the BDCP.

Expansion of Delta and Longfin Smelt Refugial Population

The current fish facility at the University of California, Davis will be expanded to support delta and longfin smelt refugial populations in the near term. U.C. Davis has estimated facility expansion will cost $5 million. It is also estimated that annual operating costs will be $2 million. Operating costs are expected to decrease to approximately $800,000 in the eighth year, once the USFWS hatchery is in full operation.[26] It is further assumed that expansion will be completed within the first two years of plan implementation and that annual operating costs will accrue starting the third year of plan implementation.

Estimated costs for this conservation measure over the term of the BDCP are shown in Table 8.13.

Table 8.13 Delta and Longfin Smelt Propagation Program Costs by Cost Period

	Cost Period										
Costs by Period (mil. $)	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Total Cost***
USFWS Smelt Hatchery	19.4	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	98.2
Smelt Refugium	11.0	6.4	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	49.4
Total Cost	30.4	15.2	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8	147.6
Running Total	30.4	45.6	58.3	71.1	83.8	96.6	109.3	122.1	134.8	147.6	147.6

8.3.6 CM 6: Non-Native Predator Control

This conservation measure addresses the local effects of non-native predators on covered fish species by supporting focused predator control in high predator density locations. The BDCP will conduct focused predator control using a variety of methods in locations in the Delta that are known to have high densities of predators ("predator hot spots"). Locations of hot spots in which focused predator control will occur and assumptions used to estimate predator control costs for these sites are listed in Table 8.14.

[24] Clarke, Robert. Regional Program Coordinator, National Fish Passage Program, U.S. Fish and Wildlife Service.
[25] Ibid.
[26] Lindberg, Joan. Co-Director, Fish Culture Laboratory, University of California, Davis. Personal Communication.

Table 8.14 Focused Non-Native Predator Control Locations in Delta

Delta Non-Native Predator Hot Spot	*Assumptions for Cost Estimate*
1. Old structures in or hanging over Delta waterways, such as pier pilings or other artificial structures, that are no longer functional or have been abandoned but affect flow fields and provide shade	Up to 20 structures removed per year
2. Vessels that were abandoned throughout the Delta	Up to 10 vessels removed per year
3. New intake structures of the North Delta Diversions	Daily predator harvest using large purse seine nets at 5 locations from October through May.
4. The deep hole just downstream of the Head of Old River in the San Joaquin River	Daily predator harvest using large purse seine nets at 1 location from October through May.
5. Specific locations in Georgiana Slough, as identified by fishery agencies	Daily predator harvest using large purse seine nets at 3 locations from October through May.
6. Specific locations in Sutter and Steamboat sloughs, as identified by fishery agencies	Daily predator harvest using large purse seine nets at 4 locations from October through May.
7. Release sites of salvaged fish from CVP/SWP facilities	Weekly predator harvest using large purse seine nets at 4 locations from October through May.

Structure Removal Cost Assumptions

An average cost of $7,800 per structure was assumed. Average structure removal costs are based on costs to remove 30 feet of docking with piles spaced at 10 foot intervals. Dock demolition and disposal was assumed to cost $100 per foot. Pile removal was assumed to cost $800 per pile. Dock and pile removal costs are based on cost information provided by the Contra Costa County Sherriff Department.[27] It was assumed that up to 20 structures per year will be removed.

Vessel Removal Cost Assumptions

Vessel removal costs are based on the average cost per vessel for removal of 408 vessels in 2002-03 and 2003-04 by Department of Boating and Waterways.[28] The average cost of removal was approximately $3,050 per vessel (in 2009 dollars). It was assumed that up to 10 vessels would be removed per year.

Focused Predator Control Cost Assumptions

Predator control using large purse seine nets was assumed to occur daily at 13 locations and weekly at 4 locations in the Delta (Table 8.14) between October and May. A predator control event was assumed to require three boat passes over a hot spot, requiring on average 1.5 hours, plus 0.5 hours for travel between sites. It was estimated that 3.4 full-time-equivalent boat crews would be required to operate 241 days per year.

Boat crews were assumed to consist of two mates and a DFG fish habitat specialist. Labor rates were based on FY 2008-09 salary scales for reference positions within the DFG, as reported by

[27] Doug Powell, Contra Cost County Sheriff Department. Personal Communication.

[28] www.dbw.ca.gov/PDF/Reports/AVAC_Report.pdf, page 10, accessed on 3/25/2010

the California Department of Finance.[29] Labor rates were increased by a factor of 1.35 to account for benefits. A cost contingency of 20% was added to calculated labor costs.

Boats used for predator control were assumed to cost $40,000 and have a 10-year useful life.[30] An annual operating cost, covering fuel, maintenance, repairs, and other incidental costs of $48,200 per boat was estimated.[31] A cost contingency of 20% was added to calculated boat purchase and operating costs.

Estimated costs for this conservation measure over the term of the BDCP are summarized in Table 8.15.

Table 8.15 Focused Non-Native Predator Control Costs

	Cost Period										
Costs by Period (mil. $)	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Total Cost***
Hot Spot Pred. Control	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	36.2
Vessel Removal	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.8
Structure Removal	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	9.4
Total Costs	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	47.4
Running Total Costs	4.7	9.5	14.2	19.0	23.7	28.4	33.2	37.9	42.7	47.4	47.4

8.3.7 CM 7: Non-Physical Fish Barriers

This conservation measure provides funding for the installation and operation of non-physical barriers at the heads of various Delta channels to redirect outmigrating juvenile salmonids. Potential locations for non-physical barriers are described in Chapter 3, *Conservation Strategy*, and include the Head of Old River, the Delta Cross Channel, Georgiana Slough, Turner Cut, Columbia Cut, the Delta Mendota Canal intake, and the Clifton Court Forebay.

A pilot project was carried out at the Head of Old River, using 14 sections of bubble generators, each 8 meters long. This project used leased equipment and consultant operators. For the spring season of 2009, the facility was estimated to cost $1.3 million dollars to operate.[32] DWR expects the experience gained through this pilot program will allow a ten percent reduction in future operating costs.

Estimated costs were based on the installation and operation of non-physical barriers at seven Delta locations during outmigration periods. The annual cost of operating each barrier was assumed to equal 90 percent of the pilot program costs plus a 20 percent cost contingency. Estimated costs of this conservation measure over the term of the BDCP are summarized in Table 8.16.

[29] www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm

[30] Boat cost assumption based on a sample of prices for new 20-25 foot center console fishing boats.

[31] Operating costs are based on sample of hourly vessel operating costs for DFG 20-25 ft boats used for IEP surveys. Costs include fuel, maintenance, repairs, and haul out. Operating costs calculated with DFG Vessel Op Costs spreadsheet model (VesselOpCosts2009.xls).

[32] Holderman, Mark. Supervising Engineer, Bay –Delta Office, California Department of Water Resources. Personal Communication.

Table 8.16 Estimated Non-Physical Barriers Program Costs by Cost Period

Costs by Period (mil. $)	Cost Period										Total Cost
	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	
Cost for 7 Barriers	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	491.4
Running Total	49.1	98.3	147.4	196.6	245.7	294.8	344.0	393.1	442.3	491.4	491.4

8.3.8 CM 8: Methylmercury

[Note to reviewers**: Cost estimates for this conservation measure will be developed once specific methods to reduce the methylation of mercury in BDCP habitat restoration areas have been determined and described.**]

8.3.9 CM 9: Non-Native Aquatic Vegetation Control

*[**Note to Reviewers:** At this point in time, cost estimates are presented for two levels of aquatic vegetation removal in order to support deliberations on selection of a preferred option. It is important to note that the preferred option could differ from the options shown below. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option.]*

This conservation measure provides for the control of Brazilian waterweed (*Egeria densa*), water hyacinth (*Eichhornia crassipes*), and other non-native submerged and floating aquatic vegetation (SAV and FAV) in BDCP tidal habitat restoration areas. To implement this conservation measure, the BDCP will apply existing methods used by DBWs *Egeria densa* and Water Hyacinth Control Programs, such as applying herbicides as specific as possible to these species, conducting mechanical removal, and/or using other methods of removal as dictated by site-specific conditions and intended outcome/goal. Application of herbicides or other means to control SAV/FAV will be timed to eliminate or minimize potential negative effects of SAV/FAV removal on covered species.

Non-native vegetation control costs vary greatly in the Delta, depending on location, plant density, time of year, method of eradication, and need for environmental monitoring. In recent years, environmental monitoring and regulatory compliance costs have comprised approximately 40 percent of total eradication costs, adding substantially to costs of eradication per acre (DBW 2006).[33] Between 2003 and 2005, DBW's aquatic vegetation removal program costs averaged about $2,500/acre (2009 dollars). However, budgetary estimates contained in the 2006 addendum to DBW's *Egeria densa* EIR suggest per acre costs as high as $4,500/acre.[34] For the BDCP cost analysis, a cost of $2,500/acre was assumed.

Low and high cost estimates are shown in Table 8.17. The low cost estimate assumed 5 percent of tidal habitat acreage will be treated annually.[35] The high cost estimate assumed 10 percent of

[33] Department of Boating and Waterways, "Ergeria densa Control Program (EDCP): Second Addendum to 2001 Environmental Impact Report with 5-year Program Review and Future Operations Plan, December 8, 2006.

[34] Ibid.

[35] Treated acreage is calculated as a percentage of the total tidal marsh footprint, including uplands acreage. Therefore, the amount of treated tidal and subtidal acreage, as a percentage of total restored tidal and subtidal acreage, would be higher than the percentages listed above.

tidal habitat acreage will be treated annually. Treatment was assumed to begin in the third year of the BDCP.

Table 8.17 BDCP Aquatic Vegetation Removal Acreages and Costs by Cost Period

Costs by Period (mil. $)	*Cost Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Option 1: Treat 5% of Tidal Marsh Footprint Acreage Annually											
Acres Treated Per Yr	194	648	1,061	1,398	1,681	1,965	2,248	2,532	2,532	2,532	
Total Treatment Cost	2.9	9.7	15.9	21.0	25.2	29.5	33.7	38.0	38.0	38.0	251.8
Running Total Cost	2.9	12.6	28.6	49.5	74.7	104.2	137.9	175.9	213.9	251.8	251.8
Option 2: Treat 10% of Tidal Marsh Footprint Acreage Annually											
Acres Treated Per Yr	389	1,297	2,121	2,795	3,362	3,929	4,496	5,063	5,063	5,063	
Total Treatment Cost	5.8	19.4	31.8	41.9	50.4	58.9	67.4	75.9	75.9	75.9	503.7
Running Total Cost	5.8	25.3	57.1	99.0	149.5	208.4	275.8	351.8	427.7	503.7	503.7

8.3.10 CM 10: Tidal Habitat Restoration

*[**Note to Reviewers**: At this point in time, cost estimates are presented for two tidal habitat restoration options in order to support deliberations on selection of a preferred option. It is important to note that the preferred option could differ from the options shown below. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option. Also note that the final cost estimate will not include tidal habitat in the East Delta ROA, however, the total acreage of habitat will be unchanged.]*

Tidal habitat restoration cost estimates were based on the extent and location of hypothetical tidal habitat restoration sites for the near-term (estimated Year 10), early long-term (estimated Year 15), and late long-term (estimated Year 40) time periods of the Plan shown in Table 8.18.[36] See Chapter 5, *Effects Analysis*, for a description of how hypothetical habitat restoration designs were developed. Estimated costs for tidal habitat restoration include the cost of land acquisition and the cost of tidal habitat construction. These costs were estimated as follows.

Table 8.18 Tidal Habitat Restoration Footprint Acreage

	Acres	*Running Total Acres*
Near Term (assumed PY 10)	14,000	14,000
Early Long Term (assumed PY 15)	11,000	25,000
Late Long Term (assumed PY 40)	40,000	65,000

Tidal Habitat Restoration Land Acquisition Costs

Land use classification data from DWR land use surveys and county parcel boundary data were used to determine the number of parcels and amount of acreage by land use classification that

[36] The acreage foot prints were derived from RMA modeling conducted for the BDCP effects analysis.

will need to be acquired within each tidal habitat restoration site footprint.[37] Publicly-owned parcels were not counted in the costing. Acreage within each tidal habitat restoration footprint was classified as: (1) native vegetation, (2) field crop, (3) truck crop, (4) orchard, (5) vineyard, (6) semi-agricultural, and (7) urban.

The amount of privately-held land that will be acquired in each cost period was estimated by linear interpolation of the near-term, early long-term, and late long-term acreages listed in Table 8.18. Land costs were based on the per acre fee title costs listed in Table 8.4. Transactional costs were calculated using the common assumptions in Tables 8.1 and 8.2. The details of these calculations are provided in Appendix XX. Estimated land acquisition costs over the term of the BDCP are summarized in Table 8.19.

Table 8.19 Tidal Habitat Land Acquisition Cost (mil. $)

	Land Purchase Cost Per Costing Period										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Total	71.7	71.7	151.0	130.3	130.3	130.3	130.3	130.3	0.0	0.0	946.1
Running Total	71.7	143.4	294.4	424.8	555.1	685.4	815.8	946.1	946.1	946.1	946.1

Tidal Habitat Construction Cost Scenarios

Tidal habitat restoration will involve a broad range of construction activities, as described in Chapter 3, *Conservation Strategy*. Mass grading and construction of temporary and permanent flood-protection levees will account for most of the construction cost. Low and high construction cost estimates were developed, which differ in terms of the extent of mass grading necessary. Two scenarios were assessed because the extent to which surface grading will be used to adjust the mix of intertidal (mainly marsh plain) and subtidal (mainly estuarine aquatic) habitat has not been determined. The estimated intertidal and subtidal habitat acreages for the low and high cost scenarios are summarized in Table 8.20. The acreages in Table 8.20 are based on the same hypothetical tidal habitat restoration footprint and phasing assumptions that were used for the effects analysis, with minor modifications in the West Delta ROA.[38]

Table 8.20 Tidal Habitat Restoration Area Estimates by Scenario

	Habitat Area (acres)			
	Tidal Marsh	**Subtidal**	**Other**	**Total**
Low Cost Scenario	14,500	33,000	17,500	65,000
High Cost Scenario	29,000	26,500	9,500	65,000

Note: The acreage footprints are derived from hydrodynamic modeling for a July 2002 base period. Tidal habitat is defined as the area between mean lower low water (MLLW) and mean higher high water (MHHW). Subtidal habitat is defined as the area below MLLW. Other habitat includes areas which are currently within intertidal elevations, but would be above high tides, based on the modeling predictions, once restoration is complete. The tidal ranges and associated acreages shown in the table do not account for long-term forecasts of sea level rise.

[37] Parcels were counted only if at least 10 percent of their acreage was included in the footprint in order to avoid counting parcels just touching the footprint or having very little acreage in it.

[38] Due to very substantial fill and grading requirements in the West Delta ROA under the original hypothetical footprint, the footprint assumed for the cost analysis was reconfigured slightly to avoid tidal habitat construction in the most subsided parts of the ROA.

Cost Assumptions for Mass Grading

*[**Note to Reviewers**: The final estimate will not include tidal habitat in the East Delta ROA. The total acreage of habitat, however, will be unchanged.]*

Significant areas within the ROAs have subsided to a degree that natural sedimentation processes alone will not increase intertidal elevations to levels necessary to support the establishment of vegetation. To establish suitable elevations for intertidal marsh restoration, fill will need to be placed (mechanically or hydraulically) in subsided areas or biomass accumulation (also referred to as subsidence reversal) will need to occur prior to levee breaching. Because the extent to which grading will be needed to achieve the desired mix of intertidal and subtidal habitat has not been determined, cost estimates were developed for two conceptual mass grading scenarios. For each scenario, fill settlement has been taken into account in the volume calculations as a function of fill height and approximate depth of underlying peat soils.[39]

The low cost grading scenario assumes 4.9 million cubic yards (MCY) of fill placement will be used to raise grades to suitable intertidal marsh elevations in parts of the West Delta ROA. The high cost grading scenario assumes an additional 13.7 MCY of grading and fill placement will be used to expand the intertidal area in the West Delta, Cache Slough, South Delta, and Cosumnes-Mokelumne ROAs.

Cost estimates were based on the following mass grading assumptions for each ROA.[40]

Suisun Marsh: The cost estimate assumed no mass grading will be required. Suisun Marsh has a relatively high potential for estuarine deposition to raise elevations from subtidal to intertidal compared to the Delta ROAs. In addition, because of the regional geomorphic setting of Suisun Marsh, the tide signal is not expected to be as compressed as modeled in the long term, resulting in a relatively high extent of intertidal habitat area created without fill placement.

West Delta: The low cost scenario assumed restoration areas on subsided West Delta islands would be filled with hydraulically-placed dredged material to create a mix of approximately 20 percent intertidal and 80 percent subtidal habitat in all except the most deeply subsided areas (deeper than approximately 9 feet below mean low low-water (MLLW). The high cost scenario assumed these same restoration areas will be filled to create 100 percent intertidal habitat, again with the exception of the most deeply subsided areas. Both cost scenarios assumed the Dutch Slough site mass grading will consist of land-based fill placement (from local borrow and the Ironhouse Sanitary parcel), per the current DWR restoration plan (PWA 2006). Both scenarios assumed existing artificial fill above intertidal elevations will be removed at no cost to the project. West Delta fill costs were based on estimated costs of placing dredged material and the planning-level cost estimate for Dutch Slough.

[39] PWA, 2002 and K Tillis, pers.comm.

[40] It should be noted that alternative methods for converting subtidal habitat to intertidal marsh, such as bioaccumulation (subsidence reversal) and more extensive dredged material fill placement, have not been included in the cost estimates. Bioaccumulation involves planting and controlled flooding of marsh vegetation (e.g., tules, cattails) to allow for the accumulation of organic material over time to increase surface elevations. Allowing bioaccumulation to occur over a period of 20-30 years prior to breaching could increase grades by approximately three feet relative to the tides, assuming an accretion rate of one foot every six years. Bioaccumulation is most applicable to late long term restoration actions because of the time needed to increase surface elevations. To use this approach, the rate of land acquisition set out in the BDCP would need to be accelerated to provide sufficient opportunities for bioaccumulation to occur.

Cache Slough, South Delta, and Cosumnes-Mokelumne: For these ROAs, the low cost scenario assumed no mass grading is required. The high cost scenario assumed some land-based cut and fill. To estimate the volume of fill required, it was assumed that lands with elevations up to one foot above mean high high-water (MHHW) will be lowered to the MHHW elevation. The cut material will then be placed in shallow subtidal areas to raise them up to the MLLW elevation. Additionally, mass grading costs for the Cache Slough ROA are based on the assumption that earthmoving will be phased over several decades, requiring interim stockpiling of fill material on one or more parcels. Cut and fill areas were broadly categorized based on anticipated haul distances, and the need for interim stockpiling. Unit costs for grading and fill were based on grading and fill costs for a sample of regional tidal marsh restoration projects.

Cost Assumptions for Flood Protection Levees

Flood protection levees will be necessary to protect adjacent developed and other lands that have not been protected for tidal habitat restoration. Levee cost estimates were based on a total of 44 miles of permanent levees along the upland edges of the ROAs, 32 miles of permanent levees on subsided areas in the interiors of the ROAs, and 50 miles of temporary levees that will need to be breached or removed as restoration progresses. Estimated levee heights and unit volumes for each type of levee, by ROA, are shown in Table 8.21.

The typical levee height for permanent levees was calculated as the difference between the FEMA 100-year flood elevation and a typical ground elevation, plus an allowance for settlement, freeboard and future sea level rise. Typical ground elevation was estimated by ROA and by levee type. Settlement was estimated for each levee type within an ROA as a function of levee height and approximate depth of underlying peat soils.[41] A crest width of 16 feet was assumed for all levees, with average side slopes of 5:1 and 2:1 (horizontal:vertical) on the outboard and inboard sides, respectively.

Unit costs were derived from per cubic yard costs based on similar constructed projects. Unit costs ranging from $5 to $30 per cubic yard, depending on anticipated soil strength and distance of fill material source, were applied. It was assumed that the fill necessary for levee construction will be obtained from sources within the ROA. For island levees, it was assumed that material will be imported from offsite locations by barge and conveyor system.

[41] PWA 2002 and K Tillis, pers.comm.

Table 8.21 Estimated Levee heights and unit volumes by ROA

ROA	*FEMA Base Flood Elevation (ft NAVD)*	*Temporary Levees*		*Permanent Levee (subsided areas)*		*Permanent Levee (upland edge)*	
		Total Height* (ft)	**Unit Volume (cy/lf)**	**Total Height* (ft)**	**Unit Volume (cy/lf)**	**Total Height* (ft)**	**Unit Volume (cy/lf)**
Cache Slough	17.0	19.8	62.4			12.1	26.3
Suisun Marsh	10.0	10.8	21.4	9.3	16.7	-	-
Cosumnes-Mokelumne	20.0	-	-	22.5	79.0	-	-
West Delta	9.0	-	-	18.0-26.0	53-105	-	-
East Delta	10.0	-	-	15.4	39.9	7.1	10.7
South Delta	14.0			20.2	64.9	10.7	21.2

* Total levee height includes allowance for settlement, future sea level rise, and freeboard.

Other Restoration Elements

A unit cost of $3,600 per acre was applied to the acreages shown in Table 8.20 to account for restoration elements other than mass grading and flood protection levees. This unit cost is based on costs for typical, large-scale tidal marsh restorations that have been completed (or are in final stages of design) in the San Francisco Bay: Napa Salt Ponds, South Bay Salt Ponds (multiple sites), Eden Landing Ecological Reserve, Bahia Wetlands, Petaluma Marsh, Cooley Landing, Outer Bair Island and Blacklock Marsh (Suisun Bay). Projects located in San Francisco Bay were used as analogues because of the lack of large-scale tidal habitat restoration projects within the Delta to serve as reference sites.

Contingency Costs

There are several challenges and limitations associated with estimating construction costs for the tidal habitat restoration. Consequently, estimates of construction costs and of the expected outcomes regarding the extent of habitat acreages created may ultimately be low or high. The uncertainties potentially affecting cost estimates are largely related to the following factors:

- Few, if any, examples of large-scale, planned tidal habitat restoration projects exist in the Delta to serve as reference sites.
- Flexible restoration footprints within the ROAs.
- Flexible sequencing of restoration projects.
- Future determinations regarding desired mix of intertidal marsh and subtidal habitat and therefore relative emphasis on using mass grading and fill to expand intertidal areas.
- Future evaluation of site specific features (e.g., utilities), conditions (e.g., weak soils, degraded levees), and adjacent land uses that may require additional design effort and construction costs.
- Future assessment of actual (versus modeled) changes to tide range over time due to phased restoration actions, geomorphic evolution, and sea level rise.

Each restoration site will have its own unique characteristics, causing actual construction costs to differ from the estimates set out in this chapter. Factors that may affect actual costs include:

relocation of existing utilities, improvements necessary for site access, and accommodation for a phased approach to construction. The precise cost of restoration projects will not be known until site-specific designs are completed. A 35 percent contingency was applied to estimated construction costs to account for these unknowns.

Total Tidal Habitat Construction Costs

Low and high construction cost estimates for tidal habitat restoration are summarized in Table 8.22.

Table 8.22 Total Construction Costs for Tidal Habitat Restoration

Cost Component	*Low Cost Estimate*	*High Cost Estimate*
Mass Grading Costs	$ 35,279,000	$ 234,012,000
Long-term Levee Costs	$ 333,312,000	$ 333,312,000
Temporary Levee Costs	$ 236,464,000	$ 236,464,000
Other Restoration Costs	$ 235,698,000	$ 239,140,000
Subtotal Construction Costs	**$ 840,753,000**	**$ 1,042,928,000**
Cost Uncertainty (15%)	$ 126,113,000	$ 156,439,000
Site Specific Factors (20%)	$ 168,151,000	$ 208,586,000
Total Construction Costs	**$ 1,135,017,000**	**$ 1,407,950,000**
Related Costs		
Permitting, Survey & Design (20%)	$ 227,003,000	$ 281,589,000
Construction Administration (7%)	$ 79,451,000	$ 98,557,000
Vegetation Establishment (3%)	$ 34,051,000	$ 42,239,000
Grand Total	**$ 1,475,522,000**	**$ 1,830,335,000**

Per Acre Tidal Habitat Construction Costs

Estimated construction costs per acre for each ROA are shown in Table 8.23. The variation in costs across the ROAs is due to differences in fill, mass grading, and levee construction requirements. The high construction costs estimated for the West Delta ROA are caused by the extensive mass grading required for tidal habitat creation in that region of the Delta.

Table 8.23 Estimated Per Acre Construction Costs for Tidal Habitat Restoration

ROA	*Tidal Habitat Construction Cost Per Acre*	
	Low Cost Estimate	**High Cost Estimate**
Cache Slough	$16,000	$26,000
Suisun Marsh	$12,000	$12,000
South Delta	$26,000	$30,000
Cosumnes-Mokelumne	$20,000	$20,000
East Delta	$32,000	$34,000
West Delta	$67,000	$84,000
Average for All ROAs*	$22,300	$27,700

*Average for all ROAs is an acreage-weighted average and therefore does not equal the simple average of ROA per acre costs.

Summary of Tidal Habitat Restoration Costs

Low and high total estimated costs for tidal marsh restoration over the 50-year term of the BDCP are summarized in Table 8.24.

Table 8.24 Total Estimated Costs of Tidal Habitat Restoration (mil. $)

	Total Cost for Tidal Marsh Habitat Creation Per Costing Period										*Total*
Low Cost	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Land Acquisition	71.7	71.7	151.0	130.3	130.3	130.3	130.3	130.3	0.0	0.0	946.1
Construction	137.1	137.1	305.3	179.2	179.2	179.2	179.2	179.2	-	-	1,475.5
Total	208.8	208.8	456.3	309.5	309.5	309.5	309.5	309.5	0	0	2421.6
Running Total	208.8	417.6	873.9	1183.4	1492.9	1802.4	2111.9	2421.4	2421.4	2421.4	2421.4
	Total Cost for Tidal Marsh Habitat Creation Per Costing Period										*Total*
High Cost	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Land Acquisition	71.7	71.7	151.0	130.3	130.3	130.3	130.3	130.3	0.0	0.0	946.1
Construction	160.1	160.1	444.3	213.2	213.2	213.2	213.2	213.2	0.0	0.0	1,830.3
Total	231.8	231.8	595.3	343.5	343.5	343.5	343.5	343.5	0	0	2776.4
Running Total	231.8	463.6	1058.9	1402.4	1745.9	2089.4	2432.9	2776.4	2776.4	2776.4	2776.4

8.3.11 CM 11: Channel Margin Habitat Enhancement

This conservation measure provides for the enhancement of 20 linear miles of channel margin habitat in the Delta.[42] For the cost analysis, it was assumed that channel margin habitat enhancement will entail creating low benches that support emergent vegetation and higher elevation benches that support riparian vegetation along existing levees. Large woody material (e.g., tree trunks and stumps) may be anchored into constructed low benches or in existing riprapped levees to provide similar habitat functions.

Channel margin enhancement cost estimates are based on conceptual design cross sections and budget-level cost estimates for 95 USACE bank stabilization project sites (approximately 76,000 linear feet) along the Sacramento River and its tributaries.[43] Only bank stabilization projects that included channel margin habitat enhancements for species that are covered under the BDCP were considered for the BDCP cost analysis.

Line item cost estimates for each project were obtained from USACE. Cost items included expenditures for: (1) soil cover, (2) instream woody material, (3) fascines, (4) landscape materials, and (5) wetlands construction. Across the 95 projects, the cost of channel margin enhancements averaged $538/LF (linear foot). This estimate includes the cost of planning, engineering and design (at 12 percent of construction cost), construction management (at 8

[42] This could increase to up to 40 linear miles if adaptive management results in the deobligation of funds from other conservation measures.
[43] U.S. Army Corps of Engineers, "Sacramento River Bank Protection Project: Alternatives Report, 80,000 LF," April 3, 2009.

percent of construction cost), and contingency (at 20 percent of construction cost). USACE assumed channel margin enhancement projects would not require land purchases or easements, though in some cases construction was assumed to require land-side access to target sites. The BDCP cost estimate adopted the same assumptions.

Table 8.25 shows the expected schedule and associated costs of channel margin enhancements over the term of the BDCP.

Table 8.25 Estimated Costs of Channel Margin Improvements by Cost Period

	Cost Period										
Miles/Costs by Period	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Totals***
Miles Completed in Cost Period	2.5	2.5	3.0	3.0	4.5	4.5	-	-	-	-	20.0
Running Total Miles	2.5	5.0	8.0	11.0	15.5	20.0	20.0	20.0	20.0	20.0	20.0
Costs (mil. $)	$7.1	$7.1	$8.5	$8.5	$12.8	$12.8	$0.0	$0.0	$0.0	$0.0	$56.8
Running Total Costs	$7.1	$14.2	$22.7	$31.2	$44.0	$56.8	$56.8	$56.8	$56.8	$56.8	$56.8

8.3.12 CM 12: Riparian Habitat Restoration

This conservation measure provides for the establishment of 5,000 acres of riparian forest and scrub within areas of restored tidal marsh, floodplain, and channel margin. Establishment of riparian habitat will rely on both natural recruitment and active planting. Non-native vegetation in riparian restoration areas will be controlled during the first three years of native riparian establishment. Assumptions used to estimate the costs of this conservation measure are as follows.

Natural Recruitment in Tidal Marsh Restoration Areas: Natural recruitment of riparian forest and scrub was assumed to occur above the tidal range from MHHW to MHHW + 2.5 ft at sites that support suitable soils. Natural recruitment was assumed to take place in up to 20 percent of areas with generally suitable soils, and in up to 40 percent of areas with more fluvial disturbance (e.g., portions of the Cosumnes-Mokelumne ROA), where there is more potential for fluvial inundation and scour to refresh soil surfaces.

Active Planting in Tidal Marsh Restoration Areas: Active planting of riparian forest and scrub was assumed to occur in areas adjacent to naturally recruited vegetation in order to increase riparian patch size and enhance riparian habitat quality. It was assumed that active planting acreage will equal 30 percent of natural recruitment acreage in each ROA. A plant density of 170 plants per acre was assumed, which is consistent with an "over-planting" approach designed to rapidly establish native riparian species and reduce the need for replanting. A 70 percent survivorship rate was assumed over the three-year establishment period. Active planting was estimated to cost $3,970 per acre, and includes management, field preparation, irrigation installation, and planting costs. The unit cost assumption is based on riparian establishment costs for comparable projects in the Central Valley. A 20 percent cost contingency was added to the estimate.

Management of Riparian Vegetation in Tidal Marsh Restoration Areas: Control of non-native vegetation during the three-year establishment period will be required. Control of non-native vegetation will take place in both natural recruitment and active planting areas. It was assumed that control will occur on 100 percent of active planting areas and 50 percent of natural recruitment areas. Annual control cost in areas of active planting was assumed to be $1,290 per acre. The unit cost assumption is based on non-native vegetation control costs for comparable projects in the Central Valley. Control of non-native vegetation in natural recruitment areas was assumed to cost 40 percent more than in active planting areas to account for more varied and difficult non-native control conditions. A 20 percent cost contingency was added to the estimate.

Active Planting in Floodplain and Channel Margin Restoration Areas: The amount of active planting acreage in floodplain and channel margin restoration areas was based on the difference between targeted riparian acreage and estimated tidal marsh riparian acreage for the near-term, early long-term, and late long-term periods of the BDCP. Establishment of riparian habitat within restored floodplain was assumed to occur primarily in the South Delta ROA along the San Joaquin, Old, and Middle Rivers. Natural recruitment in floodplain areas and along channel margins was not assumed to contribute to riparian target acreage because of the likelihood native species composition and density would not result in quality riparian habitat.[44] Active planting cost assumptions in floodplain and channel margin restoration areas are the same as for tidal marsh restoration areas.

Management of Riparian Vegetation in Floodplain and Channel Margin Restoration Areas: Non-native vegetation control costs per acre during the three-year establishment period in floodplain and channel margin restoration areas were assumed to be the same as for tidal marsh restoration areas.

Estimated riparian acreage and establishment costs over the term of the BDCP are summarized in Table 8.26.

Table 8.26 Estimated Costs of Riparian Habitat Restoration

Riparian Acres/Costs	*Cost Period*										*Total Acres/ Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Riparian Acreage											
Tidal Marsh - Natural Recruitment	77	77	110	200	200	200	200	200	200	200	1,664
Tidal Marsh - Active Planting	23	23	33	60	60	60	60	60	60	60	499
Floodplain - Active Planting	541	541	857	118	118	118	118	118	118	118	2,764
Channel Margin - Active Planting	9	9	0	8	8	8	8	8	8	8	73
Total	650	650	1,000	386	386	386	386	386	386	386	5,000
Riparian Establishment Costs (mil. $)											
Riparian Planting Cost	$2.7	$2.7	$4.2	$0.9	$0.9	$0.9	$0.9	$0.9	$0.9	$0.9	$15.9
Non-Native Control Cost	$2.3	$2.9	$4.2	$2.1	$1.5	$1.5	$1.5	$1.5	$1.5	$1.5	$20.6
Total	$5.1	$5.6	$8.4	$3.0	$2.4	$2.4	$2.4	$2.4	$2.4	$2.4	$36.5
Running Total	$5.1	$10.7	$19.1	$22.1	$24.5	$26.9	$29.3	$31.7	$34.1	$36.5	$36.5

[44] Some funds for active planting in floodplain and channel margin restoration areas could be shifted to other conservation measures if subsequent monitoring shows that natural recruitment in these areas creates good riparian habitat.

8.3.13 CM 13: Seasonally Inundated Floodplain Restoration

*[**Note to Reviewers**: At this point in time, cost estimates are presented for two floodplain restoration cost sharing options in order to support deliberations on selection of a preferred option. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option.]*

This conservation measure provides for the creation of 10,000 acres of seasonally inundated floodplain habitat along the San Joaquin River downstream of Vernalis and along Old and/or Middle rivers. The locations identified in this analysis were used solely to estimate costs. The BDCP floodplain restoration conservation measures provide flexibility for restoration actions to occur along any major channel in the north, east, and south Delta. For cost estimation, it was assumed that floodplain habitat will be created by setting back existing levees, approximately 1,000 feet on each side of a channel. For areas along the San Joaquin River between Vernalis and French Camp Slough, it was assumed that 7,000 acres of floodplain habitat will be created through the relocation of approximately 29 miles of existing levees. It was assumed an additional 3,000 acres of floodplain habitat will be created along Old and/or Middle rivers by moving approximately 12 miles of existing levees.

The assumed schedule of setback levee construction and floodplain habitat creation over the term of the BDCP is shown in Table 8.27.

Table 8.27 Estimated Miles of Setback Levees and Acres of Created Floodplain Habitat by Cost Period

Miles or Acres of Floodplain Habitat Creation	*Cost Period*										*Total Miles or Acres*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
San Joaquin R.	-	0.9	2.0	5.2	5.2	5.2	5.2	5.2			28.9
Old/Middle R.	-	0.4	0.9	2.2	2.2	2.2	2.2	2.2			12.4
Total Miles	-	1.3	2.9	7.4	7.4	7.4	7.4	7.4	-	-	41.3
Running Total	-	1.3	4.2	11.6	19.0	26.4	33.8	41.3	41.3	41.3	41.3
Flood Plain Created (Ac)	-	300	700	1800	1800	1800	1800	1800	-	-	10,000
Running Total	-	300	1,000	2,800	4,600	6,400	8,200	10,000	10,000	10,000	10,000

Setback levees for both project and non-project levees[45] were assumed to be constructed to the PL84-99 (Delta Specific) Standard. Levees along the San Joaquin River were assumed to already meet this standard, while levees along Old and Middle rivers were assumed to be non-project levees that do not meet this standard. The average levee height was assumed to be 20 feet, with a 5:1 interior slope, a 2:1 exterior slope, and a 16-foot wide crest. It was also assumed a graded, sloping bench to provide opportunities for both passive and active establishment of riparian vegetation will be added to the water-side of the levee.

[45] Project levees are part of the Sacramento Flood Control Project, which was completed by the U.S. Army Corps of Engineers in 1960. Non-project levees are not part of a federal flood control project. Non-project levees are maintained by local districts with financial assistance from the State.

Floodplain development costs were grouped as follows: (1) land acquisition costs for floodplain habitat and setback levee footprint; (2) planning, design, engineering, and permitting costs; (3) construction management costs; (4) construction costs; and (5) contingency costs.

The amount and cost of land needed for floodplain development are summarized in Table 8.28. It was assumed floodplain creation will entail both fee title and easement purchases. Graded benches and other habitat features on the water-side of the setback levees are expected to render most of the created floodplain unsuitable for agricultural production. It was therefore assumed 80 percent of the land will be acquired through fee purchases and 20 percent through conservation easements. Fee title and easement purchase costs are based on the land values for the South Delta ROA listed in Table 8.4[46] Real estate transaction costs were assumed to be the same for easement and fee title purchases and are based on the cost assumptions listed in Table 8.2.[47] A 20 percent cost contingency was added to the land cost estimate.

Table 8.28 Flood Plain Habitat Land Acquisition Costs

	Cost Period										*Total*
Acres/Costs by Period	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	*Acres/ Costs*
Flood Plain Created (Ac)	-	300	700	1800	1800	1800	1800	1800	-	-	10,000
Total Floodplain Habitat (Ac)	-	300	1,000	2,800	4,600	6,400	8,200	10,000	10,000	10,000	10,000
Land Costs (mil $)	$0	$7	$17	$44	$44	$44	$44	$44	$0	$0	$245

Levee construction cost estimates for setback levees were taken from Betchart (2008). Cost estimates were updated to 2009 dollars using USACE's Civil Works Construction Cost Index for levees and floodwalls. It was assumed upgrading existing levees to the PL84-99 (Delta Specific) standard will cost from $1.5 to $2.1 million per mile. It was assumed setting back levees will cost $2.3 million per mile, while creating the water-side benches for habitat development will cost between $1.2 million and $2.3 million per mile.[48] Based on these estimates, the construction costs used for the cost analysis were assumed to be $2.1 million per mile to upgrade non-project levees to the PL84-99 standard, $2.3 million per mile to convert levees to setback levees, and $2.3 million per mile to construct the water-side bench.[49] The unit cost estimate assumed necessary fill will be obtained locally. If fill needs to be imported, costs per mile will increase. The above unit costs include allowances for mobilization (10 percent), surveys, design, construction management and administration (30 percent), and contingency (10 percent).

Estimated setback levee construction costs over the term of the BDCP are summarized in Table 8.29.

[46] Per the common assumption for estimating conservation easement costs.

[47] Due diligence costs and pre-acquisition survey costs were estimated using the common assumptions described in Section 8.2.1. The average number of riparian parcels per river mile, acres per parcel, and parcel perimeter were calculated using parcel-level GIS data for the target river reaches. The assumptions used to calculate the due diligence costs and pre-acquisition survey costs are further described in Appendix XX.

[48] The cost ranges cited here are in 2009 dollars. The cost estimates reported in Betchart (2008) were developed by the Delta Risk Management Strategy (DRMS)/URS Levee Optimization workgroup. The estimates are based on a very basic estimating system using assumed material quantities and unit prices and are considered to be first-order planning level estimates. Actual costs for constructing levee setbacks would be subject to substantial variation based on local conditions, availability of fill material, and changes in other construction assumptions.

[49] Channel margin enhancements for USACE bank erosion projects discussed in Section 8.2.3, which would be similar to the water-side enhancements envisioned for floodplain setback levees, had an average cost of $2.8 million per mile. The lower cost estimate used here is based on the expectation of some economies of scale associated with setback levee construction.

Table 8.29 Estimated Costs for Setback Levees for Floodplain Habitat

	Cost Period										
Cost by Period (mil. $)	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Total Cost***
San Joaquin R.	0.0	8.0	18.7	48.2	48.2	48.2	48.2	48.2	0.0	0.0	267.6
Old/Middle R.	0.0	5.0	11.7	30.0	30.0	30.0	30.0	30.0	0.0	0.0	166.5
Total Levee Cost	$0.0	13.0	30.4	78.1	78.1	78.1	78.1	78.1	0.0	0.0	434.1

Estimated costs for land acquisition and setback levee construction over the term of the BDCP are summarized in Table 8.30.

Table 8.30 Estimated Costs for Land and Setback Levees for Floodplain Habitat

	Cost by Period (mil. $)										***Total***
Cost Item	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Land Acquisition	0.0	6.3	14.7	37.7	37.7	37.7	37.7	37.7	0.0	0.0	209.5
Setback Levees	0.0	13.0	30.4	78.1	78.1	78.1	78.1	78.1	0.0	0.0	434.1
Total Cost	0.0	19.3	45.0	115.8	115.8	115.8	115.8	115.8	0.0	0.0	643.5
Running Total	0.0	19.3	64.4	180.2	296.0	411.9	527.7	643.5	643.5	643.5	643.5

Low and High Cost Share Estimates

*[**Note to Reviewers:** cost estimates are presented for two floodplain restoration cost sharing options in order to support deliberations on selection of a preferred option. Once the selection of a preferred option has been made, Chapter 8 will be revised to present the cost estimate for just that option.]*

It was assumed some of the costs of floodplain creation will be funded by the State's flood management program, with BDCP providing the remaining share of those costs. The low cost estimate assumed the BDCP will pay for half the incremental levee setback costs and all the incremental habitat development costs and half the land acquisition costs. The high cost estimate assumed the BDCP will pay for incremental levee setback and habitat development costs and all land acquisition costs, while the flood management program will pay for incremental levee costs to raise levees to the P.L.84-99 (Delta Specific) standard. The low and high cost share estimates are approximately 50 and 75 percent, respectively, of the costs listed in Table 8.30. Low and high cost share estimates over the term of the BDCP are summarized in Table 8.31.

Table 8.31 Low and High Cost Sharing Estimates for Floodplain Habitat Creation

	BDCP Floodplain Habitat Costs Per Period (mil. $)										***Total***
Cost Estimate	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Low Estimate	0.0	9.7	32.2	90.1	148.0	205.9	263.9	321.8	321.8	321.8	321.8
High Estimate	0.0	14.5	48.3	135.1	222.0	308.9	395.8	482.7	482.7	482.7	482.7

8.3.14 CM 14: Fremont Weir/Yolo Bypass Habitat Improvements

This conservation measure provides for the implementation of nine physical modifications within the Yolo bypass to enhance floodplain habitat for spawning and rearing splittail and

rearing habitat of juvenile Sacramento River salmonids, as described in Chapter 3, *Conservation Strategy*. The nine modifications are:

1. **Fremont Weir Elevation Reduction.** Approximately 900 feet of the Fremont Weir will be removed and soil beneath it will be excavated to an elevation of 17.5 feet (NAVD88). The remaining notch will be fitted with operable "inundation gates" that will allow controlled flow into the Yolo Bypass when the Sacramento River stage at the weir exceeds 17.5 feet. An "inundation channel" will be excavated from the Sacramento River to the new inundation gates and from the inundation gates to the Tule Canal to convey water from the Sacramento River, through the gates, and to the Tule Canal. A guidance structure in the Sacramento River in the vicinity of the inundation channel may be constructed, if needed, to encourage the passage of juvenile salmonids migrating down the Sacramento River into the Bypass. Infrastructure associated with operations of and access to Fremont Weir gates may include electrical connectivity, gravel road and parking lot improvements, and a bridge over the gates. In addition, levee improvements may be needed to ensure that channel deepening adjacent to existing levees do not undermine the levees. If necessary, lands will be acquired, in fee-title and through conservation or flood easements.

2. **Deep Fish Passage Channel.** A small section of the Fremont Weir will be removed and the soil beneath it will be excavated to an elevation of 11.5 feet (NAVD88). The remaining notch will be fitted with operable "fish passage gates" that will allow controlled flow into the Yolo Bypass when the Sacramento River stage is between 11.5 and 17.5 feet (NAVD88). A deeper "fish passage channel" will be excavated to convey water from the Sacramento River to the new fish passage gates, and from the fish passage gates to the Tule Canal to convey water from the Sacramento River, through the gates, and to the Tule Canal.

3. **Yolo Bypass Modification.** Grading, removal of existing berms, levees, and water control structures, construction of berms or levees, re-working of agricultural delivery channels, and earthwork or construction of structures to reduce Tule Canal/Toe Drain channel capacities will occur to the extent necessary to improve the distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass.

4. **Fremont Weir Fish Ladder Replacement.** The existing Fremont Weir Denil fish ladder will be removed and replaced with new experimental fish passage facilities designed to allow for the effective passage of adult salmonids from the Yolo Bypass past the Fremont Weir and into the Sacramento River when the river overtops the weir.

5. **Experimental Sturgeon Ramps.** Experimental ramps will be constructed at the Fremont Weir to allow for the effective passage of adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir and into the Sacramento River when the river overtops the weir by approximately 3 feet.

6. **Stilling Basin Modification.** Modifications will be made to the existing Fremont Weir stilling basin to ensure that the basin drains sufficiently into the deep fish passage channel.

7. **Sacramento Weir Improvements.** Improvements will be made to the Sacramento Weir structure to reduce leakage and therefore reduce attraction of fish from the Yolo Bypass to the weir. This action may require excavation of a channel to convey water from the Sacramento River to the Sacramento Weir and from the Sacramento Weir to the Tule Canal/Toe Drain, construction of new gates at a portion of the weir, and minor modifications to the stilling basin of the weir to ensure proper basin drainage.

8. **Tule Canal/Toe Drain Improvements.** Three existing structures at the northern end of the Tule Canal will be replaced by bridges or other structures to allow fish passage. Lisbon Weir will be redesigned to improve fish passage while maintaining or improving water capture efficiency for irrigation.

9. **Lower Putah Creek Improvements.** Lower Putah Creek will be realigned to improve upstream and downstream passage of Chinook salmon and steelhead in Putah Creek.

Estimated Construction Costs

*[**Note to Reviewers:** Estimated construction costs are preliminary and subject to revision. Order-of-magnitude design, project management, modeling, environmental documentation, permitting, and construction costs were estimated by DWR engineering staff and consultants using preliminary design concepts, rough estimates of material quantities, and unit prices for comparable projects. Specific designs for weir and bypass modifications are yet to be developed. A 50 percent contingency was added to all construction cost estimates to account for the high degree of cost uncertainty in the estimates.]*

Modifications 1-3: Estimated costs address removal of weir sections, mass excavation and hauling of spoils (2.63 MCY), installation of sheet piling, installation of pre-stressed concrete piles, construction of a new reinforced concrete base slab, installation of a hydraulic gate system (6000 cfs capacity) and associated controls, connection to the power grid, construction of a new operations building and parking lot, and installation of security fencing. Estimated construction costs total $153 million, excluding contingency. Design costs were assumed to be 10 percent of construction cost, or $15.3 million. Agency coordination, project management, modeling, environmental documentation, and permitting costs were estimated as a lump sum cost of $40 million. Contingency on design and construction costs is $84.2 million. It was assumed these modifications would be completed between years 6 and 10 of the BDCP.

Modifications 4 - 6: Estimated costs address removal of the Denil fish ladder's existing wood baffles and filing the baffle slots with concrete, re-constructing a small channel from the Denil fish ladder to the Sacramento River (approx. 200 ft) and lining it with riprap, demolishing and removing four 100 foot sections of the Fremont Weir, constructing four experimental sturgeon ramps, and excavating and grading existing stilling basin to ensure proper drainage into the deep fish passage channel. Estimated construction costs total $5.4 million, excluding contingency. Design costs were assumed to be 10 percent of construction cost, or $0.5 million. Agency coordination, project management, modeling, environmental documentation, and permitting

costs were estimated as a lump sum cost of $1.8 million. Contingency on design and construction costs is $2.9 million. It was assumed these modifications would be completed between years 6 and 10 of the BDCP.

Modifications 7-9: Estimated costs address modifications to the Sacramento Weir to reduce fish stranding, improve fish passage, and improve weir apron drainage, Tule Canal/Toe Drain improvements, and realignment of lower Putah Creek to improve fish passage. Estimated construction costs total $18.3 million. Design costs were assumed to be 10 percent of construction cost, or $1.8 million. Agency coordination, project management, modeling, environmental documentation, and permitting costs were estimated as a lump sum cost of $40 million. Contingency on design and construction costs is $10.1 million. It was assumed modification 7 would be completed between years 6 and 10 and modifications 8 and 9 between years 1 and 5 of the BDCP.

Estimated Costs for Flowage and Levee Easements

*[**Note to Reviewers:** Estimated costs for flowage and levee easements are preliminary and subject to revision. A preliminary low and high cost estimate are presented, which differ in their assumptions of the amount of acreage in the bypass that would require new easements or modification to existing easements. The low cost estimate assumes new flowage easements would be required for 21,500 acres within the eastern part of the bypass. The high cost estimate assumes western tributary flows would cause land within the central and western part of the bypass to also be affected. The high cost estimate assumes new flowage easements would be required for up to 48,000 acres.]*

Flowage easement costs were assumed to be a function of incremental changes in flood frequency and duration. Bypass acreage was categorized as minimally, moderately, or significantly impacted by incremental flows caused by the weir and other modifications to the bypass. Flowage easements on minimally impacted acreage were assumed to cost 12.5 percent of fee value. Flowage easements on moderately impacted acreage were assumed to cost 25 percent of fee value. Flowage easements on significantly impacted acreage were assumed to cost 37.5 percent of fee value. Fee value assumptions for Yolo Bypass are shown in Table 8.4. Transaction costs were assumed to be 10 percent of fee value.[50] A 20 percent contingency was added to the estimate. It was assumed half the easements would be acquired between years 1 and 5 and half between years 6 and 10 of the BDCP.

Flowage Easements Low Cost Estimate: The low cost estimate assumed new flowage easements will be required for 21,500 acres within the eastern part of the bypass.[51] It assumed one-third of this acreage will be minimally impacted, one-third moderately impacted, and one-third significantly impacted. The average easement cost across all land use categories was estimated at $2,500 per acre, including transaction and contingency costs.[52] The total cost for flowage easements on impacted acreage is $53.8 million.

[50] This is based on taking an average of transaction costs calculated for land acquisition for tidal marsh and floodplain habitat described in sections 8.3.10 and 8.3.13.

[51] This is based on the estimated extent of flooded acreage given a flow of 6000 cfs over Fremont Weir, per Table 2 of *Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass*, Updated April 2009.

[52] The acreage-weighted average fee value across all land use categories is $10,157 per acre, including transaction and contingency costs.

Flowage Easements High Cost Estimate*:* The high cost estimate assumed western tributary flows will cause land within the central and western part of the bypass to be affected. The high cost estimate assumed new flowage easements will be required for up to 48,000 acres.[53] It assumed 42.5 percent of this acreage will be minimally impacted, 42.5 percent moderately impacted, and 15 percent significantly impacted.[54] The average easement cost across all land use categories was estimated at $2,200 per acre, including transaction and contingency costs. The total cost for flowage easements on impacted acreage is $105.6 million.

Levee Easement Cost Estimate: The cost estimate includes a lump sum allowance of $5 million for levee easements that may be required to offset land encroachments for levee widening and other levee modifications to address potential scour and underseepage issues.

Low and high cost estimates for CM 14 over the term of the BDCP are summarized in Table 8.32.[55]

Table 8.32 Estimated Costs for Fremont Weir/Yolo Bypass Improvements (mil. $)

	Cost Per Period										*Total*
Low Cost	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Items 1-3	0.0	293.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.0
Items 4-6	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
Items 7-9	22.1	48.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.3
Flowage Easements	26.9	26.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.8
Levee Easements	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Total	51.4	381.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	432.7
Running Total	51.4	432.7	432.7	432.7	432.7	432.7	432.7	432.7	432.7	432.7	432.7
	Cost Per Period										*Total*
High Cost	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	***Cost***
Items 1-3	0.0	293.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.0
Items 4-6	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
Items 7-9	22.1	48.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.3
Flowage Easements	52.8	52.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	105.6
Levee Easements	2.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Total	77.4	407.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	484.6
Running Total	77.4	484.6	484.6	484.6	484.6	484.6	484.6	484.6	484.6	484.6	484.6

*[**Note to Reviewers:** Costs for fencing and gates not yet estimated for CMs 15-18.]*

[53] The estimated extent of flooded acreage under very high Fremont Weir flows, per Table 3 of *Technical Study #2: Evaluation of North Delta Migration Corridors: Yolo Bypass*, Updated April 2009, is used as a proxy of the amount of potentially impacted acreage.

[54] Percentages were calculated by assuming the same distribution of impacted acreage within the eastern part of the bypass as the low cost estimate, and that half the additional 26,500 acres impacted within the central and western parts of the bypass would be minimally impacted, and half would be moderately impacted.

[55] Monitoring costs for Fremont Weir/Yolo Bypass improvements are included in the Monitoring and Research Program cost estimate.

8.3.15 CM 15: Restore Non-Tidal Freshwater Marsh

This conservation measure provides for the restoration of 400 acres of nontidal freshwater marsh within Conservation Zones 2 and 4 (Figure 3.1). Restored habitat will be distributed in patches of at least 25 acres and associated with occupied giant garter snake habitat within the proposed 1,000-acre giant garter snake preserves designed to enhance the Caldoni Marsh/White Slough and the Yolo Basin/Willow Slough giant garter snake populations. Costs were estimated for land acquisition, habitat creation, and a backup water supply.

It was assumed 200 acres of agricultural land within Conservation Zone 4 would be acquired by year 5 of the Plan and an additional 200 acres of agricultural land within Conservation Zone 2 would be acquired by year 10 of the Plan. Land costs in Conservation Zone 2 were based on the 2009 average value of crop land for south Sutter, western Placer, Solano, and Yolo counties, as reported by the California Society of Farm Managers and Rural Appraisers.[56] Land costs in Conservation Zone 4 were based on the 2009 average value of crop land for the Lodi region of San Joaquin County, as reported by the California Society of Farm Managers and Rural Appraisers.[57] Because acquired lands will be dedicated solely to the creation of nontidal freshwater marsh, land acquisition costs were based on fee-title rather than easement land acquisition. Transaction costs equal to 10% of the fee-title cost and a 20% contingency were also assumed.

Nontidal freshwater marsh habitat construction costs were based on costs for comparable restoration projects occurring in and around the Delta.[58] Construction of nontidal freshwater marsh habitat, including permitting, project management, monitoring, grading, seeding, and other planting was estimated to cost between $4,500 and $8,000 per acre. The average cost per acre is based on two-thirds of the acreage being aquatic habitat and one-third being upland habitat. Two wells for backup water supply were also assumed. Each well was assumed to cost between $125,000 and $150,000. A 20% contingency was applied to all construction cost estimates.

Low and high estimated costs for CM 15 over the term of the BDCP are summarized in Table 8.33.

[56] California Society of Farm Managers and Rural Appraisers (CSFMRA), "2009 California Trends in Agricultural Land and Lease Values." South Sutter, western Placer, Solano, and Yolo counties comprise Region 1 in the 2009 CSFMRA report.

[57] Ibid.

[58] Matt Gause, Resource Ecologist, Westervelt Ecological Services. Pers. Comm., June 28, 2010.

Table 8.33 Estimated Costs to Restore Non-Tidal Freshwater Marsh (mil. $)

Low Cost Estimate	*Cost Period*										*Total Cost*
	1-5	*6-10*	*11-15*	*16-20*	*21-25*	*26-30*	*31-35*	*36-40*	*41-45*	*46-50*	
Land Acquisition	3.43	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.24
Planning & Construction	1.23	1.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.46
Total	4.66	3.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.70
Running Total	4.66	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
High Cost Estimate	***Cost Period***										***Total Cost***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Acquisition	3.43	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.24
Planning & Construction	2.10	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.20
Total	5.53	3.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.44
Running Total	5.53	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44

8.3.16 CM 16: Restore Vernal Pool Complex Terrain

This conservation measure provides for the restoration of 200 acres of vernal pool complex habitat within Conservation Zones 1, 8, and/or 11 (Figure 3.5). Costs were estimated for land acquisition, habitat creation, and on-going weed management during the establishment period for the vernal pool complex terrain.

Land acquisition costs were based on the land assembly schedule shown in Table 8.34. Land costs were based on the 2009 average value of rangeland for south Sutter, western Placer, Solano, and Yolo counties, as reported by the California Society of Farm Managers and Rural Appraisers.[59] Because acquired lands will be dedicated solely to the creation of vernal pool complex terrain, land assembly costs were based on fee-title rather than easement land acquisition. Transaction costs equal to 10% of the fee-title cost and a 20% contingency were also assumed.

Vernal pool habitat construction costs were based on costs for comparable restoration projects occurring in and around the Delta.[60] Construction of vernal pool terrain, including permitting, project management, monitoring, grading, seeding, and other planting was estimated to cost between $25,000 and $40,000 per acre of pool built. Fifteen percent of the acreage was assumed to be constructed vernal pools. The remaining 85% was assumed to be surrounding grassland habitat. Grassland restoration was assumed to cost $400 per acre for grading, disking, and seeding. Seed costs were estimated between $600 and $1,000 per acre.[61] A 20% contingency was applied to all construction cost estimates.

Weed management is expected to be required for several years following seeding. Costs will depend on whether chemical herbicides can be applied. With chemical herbicides, it was assumed 10% of the acreage would require weed management every other year for the first six

[59] Ibid.

[60] Matt Gause, Resource Ecologist, Westervelt Ecological Services. Pers. Comm., June 28, 2010.

[61] Ibid.

years, at an average cost of $150 per acre.[62] In the absence of chemical herbicides, it was assumed 20% of the acreage would require weed management every year for the first five years, at an average cost of $500 per acre.[63]

Low and high estimated costs for CM 16 over the term of the BDCP are summarized in Table 8.35.

Table 8.34 Land Acquisition Schedule for Vernal Pool Complex Terrain (mil. $)

Land Assembly by CZ	*Acres Acquired by Period*										*Total Acreage*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	40		22								62
8	27			22							49
11	20	29	20	20							89
Total	87	29	42	42	0	0	0	0	0	0	200
Running Total	87	116	158	200	200	200	200	200	200	200	200

Table 8.35 Estimated Costs to Restore Vernal Pool Complex Terrain Restoration (mil. $)

Low Cost Estimate	*Cost Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Acquisition	0.35	0.12	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.81
Construction	0.48	0.16	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	1.10
Weed Control	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Total	0.84	0.28	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	1.93
Running Total	0.84	1.12	1.52	1.93	1.93	1.93	1.93	1.93	1.93	1.93	1.93
High Cost Estimate	*Cost Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Acquisition	0.35	0.12	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.81
Construction	0.75	0.25	0.36	0.36	0.00	0.00	0.00	0.00	0.00	0.00	1.73
Weed Control	0.05	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.12
Total	1.16	0.39	0.56	0.56	0.00	0.00	0.00	0.00	0.00	0.00	2.66
Running Total	1.16	1.54	2.10	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66

8.3.17 CM 17: Restore Grassland Communities

This conservation measure provides for the restoration of 2,000 acres of grassland habitat within Conservation Zones 1, 8, and/or 11 (Figure 3.5). Costs were estimated for land acquisition, habitat creation, and on-going weed management during the establishment period.

[62] Ibid.
[63] Ibid.

Land acquisition costs were based on the land assembly schedule shown in Table 8.36. Land costs were based on the 2009 average value of rangeland for south Sutter, western Placer, Solano, and Yolo counties, as reported by the California Society of Farm Managers and Rural Appraisers.[64] Because acquired lands will be dedicated solely to the creation and protection of grassland habitat, land assembly costs are based on fee-title rather than easement land acquisition. Transaction costs equal to 10% of the fee-title cost and a 20% contingency were also assumed.

Grassland habitat construction costs were based on costs for comparable restoration projects occurring in and around the Delta.[65] Grassland restoration was assumed to cost $400 per acre for grading, disking, and seeding. Seed costs were estimated between $600 and $1,000 per acre.

Weed management is expected to be required for four years following seeding. Costs for weed management were estimated to range between $200 and $400 per acre.[66]

Low and high estimated costs for CM 16 over the term of the BDCP are summarized in Table 8.35.

Table 8.36 Land Acquisition Schedule for Grassland Habitat

Land Assembly by CZ	*Acres Acquired by Period*										*Total Acreage*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	250	250	125	125	125	125					1,000
8		250									250
11	250		125	125	125	125					750
Total	500	500	250	250	250	250					2,000
Running Total	500	1,000	1,250	1,500	1,750	2,000	2,000	2,000	2,000	2,000	2,000

[64] California Society of Farm Managers and Rural Appraisers (CSFMRA), "2009 California Trends in Agricultural Land and Lease Values." South Sutter, western Placer, Solano, and Yolo counties comprise Region 1 in the 2009 CSFMRA report.

[65] Matt Gause, Resource Ecologist, Westervelt Ecological Services. Pers. Comm., June 28, 2010.

[6666] Herbicide choice and type of weeds can greatly affect price. If the sites can be pre-treated for weeds prior to planting using a combination of cultural and chemical control methods the costs for future weed control may be reduced by half.

Table 8.37 Estimated Costs to Restore Grassland Habitat Restoration (mil. $)

Low Cost Estimate	*Cost per Period*										*Total Cost*
	1-5	*6-10*	*11-15*	*16-20*	*21-25*	*26-30*	*31-35*	*36-40*	*41-45*	*46-50*	
Land Assembly	2.03	2.03	1.01	1.01	1.01	1.01	0.00	0.00	0.00	0.00	8.12
Construction	0.60	0.60	0.30	0.30	0.30	0.30	0.00	0.00	0.00	0.00	2.40
Weed Control	0.48	0.48	0.24	0.24	0.24	0.24	0.00	0.00	0.00	0.00	1.92
Total	3.11	3.11	1.55	1.55	1.55	1.55	0.00	0.00	0.00	0.00	12.44
Running Total	3.11	6.22	7.77	9.33	10.88	12.44	12.44	12.44	12.44	12.44	12.44
High Cost Estimate	*Cost per Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Assembly	2.03	2.03	1.01	1.01	1.01	1.01	0.00	0.00	0.00	0.00	8.12
Construction	0.84	0.84	0.42	0.42	0.42	0.42	0.00	0.00	0.00	0.00	3.36
Weed Control	0.96	0.96	0.48	0.48	0.48	0.48	0.00	0.00	0.00	0.00	3.84
Total	3.83	3.83	1.91	1.91	1.91	1.91	0.00	0.00	0.00	0.00	15.32
Running Total	3.83	7.66	9.57	11.49	13.40	15.32	15.32	15.32	15.32	15.32	15.32

8.3.18 CM 18: Preserve Natural Communities

This conservation measure provides for the establishment of a preserve system to protect and enhance areas of existing natural communities and covered species habitat, protect and maintain occurrences of selected plant species with very limited distributions, provide sites suitable for restoration of natural communities and covered species habitat, and provide habitat connectivity among the various BDCP conservation land units in the preserve system. Estimated costs are based on a preserve system including 300 acres of vernal pool complex terrain, 400 acres of seasonal alkali wetland complex, 8,000 acres of grassland habitat, and 32,640 acres of protected agricultural land.[67] Costs were estimated for land acquisition, habitat creation, and on-going weed management during the establishment period.

Land acquisition costs were based on the land acquisition schedule shown in Table 8.38. Acreage-weighted average land values were calculated using the common assumptions land values in Table 8.5. Land acquired for vernal pool complexes, seasonal wetland complexes, and grassland habitat will be dedicated to these purposes and therefore were assumed to be acquired by fee-title rather than easement. Much of the farm land in the preserve will remain in agricultural production. The cost analysis assumed 70% of this acreage will be acquired through easement and 30% through fee-title. Average easement costs were assumed to be 60% of fee-title costs, per the common assumptions. Transaction costs equal to 10% of the fee-title cost and a 20% contingency were also assumed.

[67] The preserve system will also include 400 acres of non-tidal freshwater marsh. The costs for acquiring the land and constructing the non-tidal freshwater marsh habitat are counted under CM 15.

Table 8.38 Land Acquisition Schedule for CM 18 Preserve System

Vernal Pool Complex Terrain											
Conservation Zone	**Acres Acquired by Period**										**Total Acreage**
	1-5	***6-10***	***11-15***	***16-20***	***21-25***	***26-30***	***31-35***	***36-40***	***41-45***	***46-50***	
1	44	23	31	16							114
8	43		31	17							91
11	44	20	31								95
Total	131	43	93	33	0	0	0	0	0	0	300
Running Total	131	174	267	300	300	300	300	300	300	300	300
Alkali Seasonal Wetland Complex											
Conservation Zone	***Acres Acquired by Period***										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	10		89	50							149
8	5	8	89								102
11	10		89	50							149
Total	25	8	267	100	0	0	0	0	0	0	400
Running Total	25	33	300	400	400	400	400	400	400	400	400
Grassland											
Conservation Zone	***Acres Acquired by Period***										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	500		443	500	750	744	900	1,000			4,837
8	1,000		307								1,307
11	500		250	500	250	256	100				1,856
Total	2,000	0	1,000	1,000	1,000	1,000	1,000	1,000	0	0	8,000
Running Total	2,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	8,000	8,000	8,000
Agricultural Lands (70% easement, 30% fee-title)											
Conservation Zone	***Acres Acquired by Period***										***Total Acreage***
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
1	473	481	308	308	309	309	309	308			2,805
2	1,720	1,752	1,123	1,123	1,123	1,123	1,123	1,123			10,210
4	1,654	1,684	1,079	1,079	1,079	1,080	1,080	1,080			9,815
7	1,653	1,683	1,079	1,079	1,079	1,079	1,079	1,079			9,810
Total	5,500	5,600	3,589	3,589	3,590	3,591	3,591	3,590	0	0	32,640
Running Total	5,500	11,100	14,689	18,278	21,868	25,459	29,050	32,640	32,640	32,640	32,640

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The same assumptions used to estimate costs of habitat construction and weed management for vernal pool complex terrain and grassland habitat for CMs 16 and 17 were used for CM 18. No construction costs were assumed for existing alkali seasonal wetlands and protected agricultural lands brought into the preserve system under CM 18.

Low and high estimated costs for CM 18 over the term of the BDCP are summarized in Table 8.39.

Table 8.39 Estimated Costs to Establish CM 18 Land Preserve System (mil. $)

Low Cost Estimate	*Cost per Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Assembly	62.97	52.70	40.41	39.27	38.83	38.84	38.89	38.92	0.00	0.00	350.84
Construction	0.72	0.24	0.51	0.18	0.00	0.00	0.00	0.00	0.00	0.00	1.66
Weed Control	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Total	63.70	52.94	40.93	39.46	38.83	38.84	38.89	38.92	0.00	0.00	352.51
Running Total	63.70	116.64	157.58	197.03	235.86	274.70	313.59	352.51	352.51	352.51	352.51
High Cost Estimate	*Cost per Period*										*Total Cost*
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	
Land Assembly	62.97	52.70	40.41	39.27	38.83	38.84	38.89	38.92	0.00	0.00	350.84
Construction	1.13	0.37	0.80	0.28	0.00	0.00	0.00	0.00	0.00	0.00	2.59
Weed Control	0.08	0.03	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.18
Total	64.18	53.10	41.27	39.58	38.83	38.84	38.89	38.92	0.00	0.00	353.61
Running Total	64.18	117.28	158.55	198.13	236.95	275.79	314.69	353.61	353.61	353.61	353.61

8.3.19 CM 19: Enhance and Manage Preserved Habitats

*[**Note to Reviewers:** This cost estimate for managing preserves may be revised based on additional sources of habitat management costs. FWS refuge management costs will continue to provide the basis for the estimated cost of managing tidal wetlands. Management costs for terrestrial habitats and non-tidal wetland habitats may be revised and based on management costs of nearby terrestrial HCPs (e.g., San Joaquin County, East Contra Costa County).]*

This conservation measure provides for the development and implementation of management plans for all conservation lands. This management will provide for the maintenance of the habitat functions of protected existing habitat and restored habitats described in CMs 10, 11, 12, 13, 15, 16, 17, 18, and 19. Habitat management costs for BDCP conservation lands were based on operating budgets for western U.S. National Wildlife Refuges (NWR) managed by USFWS (USFWS, 2007). Data on operating budgets and acreage under management were used to estimate unit costs for habitat management. Estimation details are provided in Appendix XX.

Total acreage under management, average unit management cost, and total management costs over the term of the BDCP are shown in Table 8.40. Habitat acreage was assumed to come under management in the period following the one in which existing habitat was acquired or new habitat restored. Tidal marsh, floodplain, and terrestrial/non-tidal wetlands acreage were treated as separate management units and separate unit cost assumptions were applied to these acreages. Unit costs shown in the table are averages across all habitat types.

Table 8.40 Total Estimated Costs for Habitat Reserves Management and Maintenance

Cost for Marsh Habitat Management Per Costing Period (mil. $)										
Plan Period	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
	Habitat Acres Under Management									
Tidal Marsh	0	7,000	14,000	24,999	32,999	40,999	48,999	56,999	65,000	65,000
Floodplain	0	0	348	1,160	3,248	5,336	7,424	9,512	11,600	11,600
Terrestrial	0	8,443	14,823	20,064	25,078	29,918	34,759	39,350	43,940	43,940
Total	0	15,443	29,171	46,223	61,325	76,253	91,182	105,861	120,540	120,540
	Average Cost Per Acre Under Management									
Avg Unit Cost/Acre/Yr	$0	$111	$83	$58	$48	$40	$35	$31	$28	$28
	Total Cost (Mil. $)									
Cost Per Year	$0	$111	$83	$58	$48	$40	$35	$31	$28	$28
Cost Per Period	$0	$111	$83	$58	$48	$40	$35	$31	$28	$28
Running Total	$0	$111	$83	$58	$48	$40	$35	$31	$28	$28

8.4 Plan Administration Cost Estimate

The costs associated with the administration of the BDCP reflect all of the expenditures that will be reasonably necessary for the BDCP Management Entity to effectively oversee the implementation of the BDCP throughout the term of the Plan. Program administration costs include expenditures related to employees, facilities, equipment, vehicles, and associated overhead necessary to support the BDCP Management Entity. Associated overhead costs include employee benefits, insurance, legal and financial assistance, and travel. For the purpose of the cost analysis, the BDCP Management Entity is assumed to be an independent entity located in Sacramento, California. This assumption provides a conservative basis from which to estimate program administration costs. Administrative costs that may be incurred by entities other than the BDCP Management Entity (e.g., supporting entities – see Chapter 7, *Implementation Structure*) are not included in the program administration cost estimate.

Staff and Related Costs

The staffing plan used to estimate labor costs for program administration is shown in Table 8.38. Salary assumptions for staffed positions are listed in Table 8.39. Estimated costs for employee salaries and benefits were based on the common assumptions listed in section 8.2. Annual allowances for travel and training were also calculated (see Appendix XX for details).

Allocation of staff and related costs to support different administrative functions is shown for each staff position in Table 8.41.

***[Note to Reviewers:** Staffing estimates are likely to be revised as the governance plan continues to be refined.]*

Table 8.41 Staffed Positions and Number of Employees for BDCP Program Administration

Staffing Levels	*Avg Annual FTEs Per Cost Period*									
Position	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**
Program Manager	1	1	1	1	1	1	1	1	1	1
Deputy Program Manager	1	1	1	1	1	1	1	1	1	1
Program Counsel	1	1	1	1	1	1	1	1	1	1
Habitat Restoration Program Manager	1	1	1	1	1	1	1	1	1	1
Other Stressors Program Manager	1	1	1	1	1	1	1	1	1	1
Monitoring/Research Program Manager	1	1	1	1	1	1	1	1	1	1
IT/Database/GIS Management	1	1	1	1	1	1	1	1	1	1
GIS Specialist	1	1	1	1	1	1	1	1	1	1
Budget Analyst	1	1	1	1	1	1	1	1	1	1
Land Acquisition Specialist	2	3	3	3	2	2	1	1	1	1
Contracts Officer	1	1	1	1	1	1	1	1	1	1
Regulatory Specialist	1	1	1	1	1	1	1	1	1	1
Public Outreach Program Manager	1	1	1	1	1	1	1	1	1	1
Admin - Secretary	2	2	2	2	2	2	2	2	2	2
Clerks	3	3	3	3	3	3	3	3	3	3
Civil Engineer	1	1	1	1	1	1	1	1	1	1
Staff Scientist	2	3	3	3	3	3	3	3	3	3
Water Operations Specialist	2	2	2	2	2	2	2	2	2	2
Habitat Restoration Project Manager	1	2	3	3	3	3	2	2	1	1
Other Stressors Project Manager	2	2	2	2	1	1	1	1	1	1
Terrestrial Preserve Manager	1	1	2	2	2	2	2	2	2	2
Technical Specialist	5	10	10	10	10	10	8	6	5	4
Laborer	2	4	4	6	6	6	6	6	6	6
Total FTE Positions	35	45	47	49	47	47	43	41	39	38

Table 8.42. Staff Salary Assumptions for BDCP Implementing Entity

Position	Annual FTE Salary*	Resources Agency Reference Position	Percent of Cost Allocated to Function			
			Program Admin.	Habitat Restor.	Reserve Mgt.	Monitoring Research
Program Manager	$115,000	C.E.A. III, DFG, Resources Management & Policy Division	100%	0%	0%	0%
Deputy Program Manager	$106,000	C.E.A. II, DFG, Bay Delta Region	100%	0%	0%	0%
Program Counsel	$113,000	Staff Counsel III-Supervisor, DFG	100%	0%	0%	0%
Habitat Restoration Program Manager	$86,000	Environmental Program Manager I – Supervisory, Habitat Conservation Branch, DFG	15%	75%	10%	0%
Other Stressors Program Manager	$86,000	Environmental Program Manager I – Supervisory, Habitat Conservation Branch, DFG	15%	20%	40%	25%
Monitoring/ Research Program Manager	$86,000	Environmental Program Manager I – Supervisory, Habitat Conservation Branch, DFG	15%	0%	0%	85%
IT/Database/GIS Management	$76,000	Research Manager II - Geographic Information Systems, DFG	100%	0%	0%	0%
GIS Specialist	$65,000	Supervising Biologist, Water Branch, DFG	100%	0%	0%	0%
Budget Analyst	$60,000	Associate Budget Analyst, Administration Division, DFG	100%	0%	0%	0%
Land Acquisition Specialist	$77,000	Sr Land Agent– Specialist, DFG	100%	0%	0%	0%
Contracts Officer	$71,000	Staff Services Manager I, DFG	100%	0%	0%	0%
Regulatory Specialist	$59,000	Associate Governmental Program Analyst, DFG	100%	0%	0%	0%
Public Outreach Program Manager	$61,000	Information Officer I – Specialist, DFG	100%	0%	0%	0%
Admin – Secretary	$40,000	Executive Assistant, Resources Management & Policy Division, DFG	50%	0%	50%	0%
Clerks	$33,000	Account Clerk II, DFG	100%	0%	0%	0%
Civil Engineer	$82,000	Associate Civil Engineer, DFG	15%	70%	15%	0%
Staff Scientist	$71,000	Staff Env Scientist, Habitat Conservation Branch, DFG	15%	20%	15%	50%
Water Operations Specialist	$77,000	Operations Research Spec III, DWR Bay Delta Office	100%	0%	0%	0%
Habitat Restoration Project Manager	$71,000	Staff Env Scientist, Habitat Conservation Branch, DFG	15%	70%	0%	15%
Other Stressors Project Manager	$71,000	Staff Env Scientist, Habitat Conservation Branch, DFG	15%	70%	0%	15%
Terrestrial Preserve Manager	$71,000	Staff Env Scientist, Habitat Conservation Branch, DFG	15%	0%	85%	0%

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Table 8.42 Staff Salary Assumptions for BDCP Implementing Entity (continued)

Position	*Annual FTE Salary**	*Resources Agency Reference Position*	*Percent of Cost Allocated to Function*			
			Program Admin.	**Habitat Restor.**	**Reserve Mgt.**	**Monitoring Research**
Technical Specialist	$46,000	Fish Habitat Specialist, Bay Delta Region, DFG	25%	25%	25%	25%
Laborer	$42,000	Laborer - Tractor Operator, Bay Delta Region, Region 3, DFG	0%	25%	50%	25%

Notes:
* Salary estimates based on proposed salaries for 2008-09 for corresponding positions within the Resources Agency, as reported by the California Department of Finance (www.dof.ca.gov/budget/historical/2008-09/salaries_and_wages/index.htm).
A benefits multiplier of 1.35 is applied to salary amounts shown in the table to account for paid leave, health, retirement and other benefits is not reflected in the salary amounts shown in the table.

Office Space and Related Costs

Office space and related costs include the office rental costs, utilities, general office equipment, employee-assigned office equipment, GIS hardware and software, and public outreach materials. Cost assumptions for each of these items are as follows:

Office Space and Utilities: An office space requirement of 250 square feet per FTE employee was assumed. Field labors and other out-of-office employees were excluded from the determination of office space requirement. Unfurnished office space was assumed to cost $2.50/sf/month, including utilities.[68]

General Office Equipment: General office equipment includes copy machines, telephone systems, printers, fax machines, and specialized equipment such as digital cameras, trunked radio systems, and publications and subscriptions. It also includes common area office furniture. Annual costs were estimated by amortizing the purchase cost of each type of equipment or furniture over its useful life.[69] Some items were assumed to include annual service contract costs (see Appendix XX for details).

Employee-Assigned Office Equipment: Employee-assigned office equipment includes cubicle office furniture, computers, cell phones, and office supplies. Annual costs were estimated by multiplying the number of full-time equivalent (FTE) staff positions by the amortized cost of equipment. Some items were assumed to include annual service contract costs. See Appendix XX for specific employee-assigned equipment cost assumptions.

GIS Hardware and Software: This category includes a dedicated geographic information system (GIS)/database server, tablet personal computer, plotter, GPS unit, GIS software, and related computer software. Annual costs are based on the estimated purchase cost for each item amortized over its useful life. Some items were assumed to include annual service contract costs. See Appendix XX for specific GIS equipment cost assumptions.

[68] The rental rate assumption is approximately 125 percent of current office rental rates if downtown Sacramento. The 25 percent premium is added to account for the currently depressed commercial real estate market in Sacramento.

[69] This is equivalent to assuming general office equipment and furniture is leased by the Management Entity.

Public Outreach Costs: This category includes an annual allowance for printed material, public meetings and focus groups, including costs for design, layout, printing, postage, web services, and facilities rental. Annual public outreach costs were assumed to vary over the term of the BDCP. See Appendix XX for specific public outreach cost assumptions.

Vehicle and Related Costs

Vehicle costs include the costs for owned and rented vehicles and as well as allowances for fuel, maintenance, and insurance. Vehicle costs were allocated to different Management Entity functions according to the percentages in Table 8.40. Owned vehicle annual costs were based on the vehicle's estimated purchase cost amortized over its useful life plus an annual allowance for fuel, maintenance, and insurance. Annual costs for rented vehicles were based on a daily rental rate multiplied by the number of rental days per year per 1,000 acres of habitat under management. See Appendix XX for the specific vehicle quantity and cost assumptions.

Table 8.43. Vehicle Types and Cost Allocation Percentages

Management Entity Vehicles	*Percent of Cost Allocated to Function*			
	Program Admin.	**Habitat Restor.**	**Reserve Mgt.**	**Monitoring Research**
Owned Vehicles				
Passenger Cars	50%	0%	25%	25%
4WD Trucks	0%	33%	33%	33%
Boats	0%	33%	33%	33%
ATVs & Trailers	0%	33%	33%	33%
Rented Vehicles				
Large Tractor	0%	0%	75%	25%
Small Tractor	0%	0%	75%	25%
Dump Truck	0%	0%	75%	25%
Fire Truck	0%	0%	100%	0%

Legal, Accounting, and Insurance Costs

*[**Note to Reviewers:** Insurance requirements for the management entity are under review. Estimates below will be updated once this review is completed.]*

Insurance requirements for the BDCP Management Entity were assumed to include directors and officers insurance, general liability insurance, and professional liability insurance. Liability insurance was assumed to total $20,000 per year, or $100,000 every five years.[70] The Management Entity was assumed to require outside legal and accounting assistance throughout the term of the BDCP. Annual legal assistance costs were calculated by multiplying an hourly rate by required hours of assistance. Required legal assistance was assumed to vary over the term of the BDCP. Accounting assistance costs were based on a lump sum allowance for auditing and other financial services. See Appendix XX for specific legal and accounting assistance cost assumptions.

[70] Vehicle and employee health/disability/workers compensation insurance costs are calculated separately from liability insurance costs. Vehicle insurance costs are included in the vehicle cost estimate, while employee insurance costs are captured by the benefits multiplier applied to wage and salary costs.

Total Estimated Costs for Program Administration

Estimated Management Entity costs over the term of the BDCP are summarized in Table 8.41.

Table 8.44. Estimated Management Entity Costs Over 50-Year Term of BDCP

BDCP Implementing Entity Costs (mil.$)	*Cost Period*										
	1-5	**6-10**	**11-15**	**16-20**	**21-25**	**26-30**	**31-35**	**36-40**	**41-45**	**46-50**	**Total**
Staff Costs*	$15.7	$19.3	$20.3	$20.9	$19.9	$19.9	$18.2	$17.6	$16.8	$16.5	$185.0
Office Costs**	$2.9	$3.3	$2.9	$2.7	$2.6	$2.4	$2.2	$2.0	$1.9	$1.9	$24.8
Vehicles***	$0.5	$0.9	$1.0	$1.1	$1.3	$1.4	$1.4	$1.4	$1.4	$1.3	$11.5
Outside Services****	$1.9	$1.9	$1.9	$1.0	$1.0	$0.5	$0.5	$0.5	$0.5	$0.5	$10.5
Liability Insurance	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$1.0
Total Costs	$21.1	$25.5	$26.2	$25.9	$24.9	$24.2	$22.4	$21.6	$20.7	$20.3	$232.8
Running Total	$21.1	$46.6	$72.7	$98.6	$123.5	$147.7	$170.1	$191.8	$212.5	$232.8	$232.8

*Includes employee benefits and incidentals.
**Includes costs for office space, general office equip., employee-assigned office equip., specialized office equip., and public outreach expenditures.
***Includes costs for owned and rented vehicles.
****Includes cost for outside accounting and legal services.

8.5 Avoidance and Minimization Measures Cost Estimate

*[**Note to Reviewers:** A cost estimate for this part of the BDCP is still being developed.]*

8.6 Monitoring and Research Program Cost Estimate

*[**Note to Reviewers:** A cost estimate for this part of the BDCP is still being developed.]*

8.7 Adaptive Management Program Cost Estimate

*[**Note to Reviewers:** A cost estimate for this part of the BDCP is still being developed.]*

8.8 Program Cost Summaries and Tables

***[Note to Reviewers:** Summary tables are not included in this draft.]*

8.9 Funding Sources and Assurances

***[Note to Reviewers:** Funding Sources and Assurances are not included with this draft. This section will be completed following completion of the cost analysis and the development of the funding plan. It should be emphasized that the PREs have not committed to pay for any BDCP costs beyond the conveyance component, and substantial public and other sources of funding are expected to contribute to the cost of implementing the elements of the Plan.]*

8.10 Net BDCP Costs

[Note to Reviewers: *This section will compare total to net costs of BDCP implementation. Total costs are the sum of costs for all plan components expected to be incurred over the 50-year planning period. Net costs recognize that some of these costs might be incurred even if the Plan were not put into operation. This will be the last step in the cost analysis and cannot be completed until the analyses of total costs for all conservation measures and related activities are completed.]*

Technical Appendix for Cost Estimation

[Note to Reviewers: *The technical appendix will provide more detailed information on data sources, assumptions, and cost models used to estimate expected BDCP costs.]*