

APPENDIXN

National Economic Development (NED) Analysis of Alternatives

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Acronyms

AF	acre-foot or acre-feet
NED	National Economic Development
Reclamation	Bureau of Reclamation
Unit	San Luis Unit
Westlands	Westlands Water District

National Economic Development (NED) Analysis of Alternatives

The objective of the National Economic Development (NED) account analysis is to determine the change in net value of the nation's output of goods and services that would result from implementing each project alternative. Beneficial and adverse effects are evaluated in monetary terms and are measured in terms of changes in national income. The NED account describes the National Environmental Policy Act human environment and identifies beneficial and adverse effects on the economy. Beneficial effects in the NED account are (1) increases in the economic value of the national output of goods and services from a plan, (2) the value of output resulting from external economies caused by a plan, and (3) the value associated with the use of otherwise unemployed or under-employed labor resources. Adverse effects in the NED account are the opportunity costs of resources used in implementing a plan. These adverse effects include (1) implementation outlays, (2) associated costs, and (3) other direct costs. Specific guidelines, standards, and procedures used in the NED analysis are provided in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resources Council 1983).

Effects to the NED account resulting from various action alternative features are discussed below.

N1 NED BENEFITS

Contributions to NED are measured as increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the project area and the rest of the nation. Contributions to NED include increases in the net value of goods and services that are marketed, as well as those that may not be marketed.

NED benefits generated from the agricultural production of an alternative are measured as the increased value of agricultural output of the nation plus any cost savings that occur in maintaining a given level of output. Such benefits include reductions in production costs and associated costs; reduction in damage costs from flooding, erosion, sedimentation, inadequate drainage, or inadequate water supply; and the value of increased production of crops.

N1.1 Provision of Drainage Service

The benefits of the action alternatives are estimated relative to the No Action Alternative and are based on providing drainage service to drainage-impaired lands within the San Luis Unit service area. These benefits fall into three categories:

- Increased net revenues that are a result of continuing to farm those drainage-impaired lands that would otherwise have to be removed from agricultural production due to inadequate drainage
- Increased net revenues resulting from changing from a salinity- and water-restricted crop mix to a more revenue intensive crop mix on drainage-impaired lands
- Reduced costs of irrigation management practices by providing drainage service to drainage-impaired lands

The first category of benefits is the result of reclaiming drainage-impaired lands that would otherwise be removed from agricultural production without the provision of adequate drainage

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service. It is estimated that under the No Action Alternative, the drainage capacity of 65,000 acres would be impaired to the point that the land could no longer sustain irrigated agriculture. Under all of the action alternatives that do not incorporate land retirement, it is assumed that these 65,000 acres would be part of the land that would receive drainage service. For those action alternatives that include land retirement, an adjustment to the area of voluntary land retirement is necessary to avoid double counting the lands retired under the No Action Alternative. This adjustment is shown in Table N-1. The increased net farm revenue used to estimate the benefit of avoiding land retirement is \$147.74/acre/year for Westlands Water District (Westlands) and \$161.17/acre/year for the Northerly Area.

The second category of benefits is the result of farmers being able to grow a much broader selection of crops rather than being restricted to raising only salt-tolerant crops. These lands, which are drainage-impaired under the No Action Alternative, are estimated to generate an additional \$94.67/acre/year in Westlands and \$149.27/acre/year in the Northerly Area. As indicated above, the benefit estimated for lands changing from a drainage-impaired to a drained condition requires an adjustment to account for the 65,000 acres of the land retired under the No Action Alternative to avoid double counting the benefit of those lands. The adjusted land area for this second category of benefit is also shown in Table N-1.

The first two types of benefits described above are based on strategies used under the No Action Alternative to keep lands with limited natural drainage and high soil salinities under agricultural production. The last benefit category is the result of a reduction in production costs that occurs as farmers are relieved from increasingly restrictive irrigation management practices required to keep farming drainage-impaired lands even as salts continue to accumulate in the root zone of the soil. This reduced cost is estimated to be \$6.80/acre/year in Westlands and \$7.18/acre/year in the Northerly Area. However, these values are included in the increased net farm revenue indicated for the two benefit categories described above. Therefore, an estimate of NED benefits was not prepared or shown separately in Table N-1. Analysis and results of the action alternatives are described later in this section.

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Table N-1
Acres of Land Identified as Drainage-Impaired, Drained, or Retired
Changes Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Westlands					
DRAINAGE-IMPAIRED AREA (acres)	298,000	298,000	298,000	298,000	298,000
Existing Retired - Drainage Impairment	44,106	44,106	44,106	44,106	44,106
Remaining Drainage-Impaired Land	253,894	253,894	253,894	253,894	253,894
DRAINAGE-IMPAIRED LAND REMOVED FROM AGRICULTURAL PRODUCTION (acres)					
Voluntary Land Retirement	0	0	38,486	139,850	253,894
Additional Land Retired for New Facilities	7,864	5,964	5,984	1,044	0
Total Land Retired for Action Alts.	7,864	5,964	44,470	140,894	253,894
LANDS RETIRED UNDER NO ACTION - DRAINED UNDER ACTION ALTERNATIVES (acres)					
Lands Retired Under No Action	65,000	65,000	65,000	65,000	65,000
Voluntary Land Retirement	0	0	38,486	139,850	253,894
Benefited Area (retired to drained)	65,000	65,000	26,514	0	0
DRAINAGE-IMPAIRED LAND UNDER NO ACTION CONVERTED TO DRAINED LAND (acres)					
Remaining Drainage-Impaired Land	253,894	253,894	253,894	253,894	253,894
Total Land Retired for Action Alts.	7,864	5,964	44,470	140,894	253,894
Retired to Drained Land Adjustment	65,000	65,000	26,514	0	0
Benefited Area (impaired to drained)	181,030	182,930	182,910	113,000	0
Northerly Area					
DRAINAGE-IMPAIRED AREA (acres)	81,000	81,000	81,000	81,000	81,000
Existing Retired - Drainage Impairment	0	0	0	0	0
Remaining-Drainage Impaired Land	81,000	81,000	81,000	81,000	81,000
DRAINAGE-IMPAIRED LAND REMOVED FROM AGRICULTURAL PRODUCTION (acres)					
Voluntary Land Retirement	0	0	10,000	10,000	10,000
Additional Land Retired for New Facilities	5,827	3,897	4,467	4,467	4,467
Total Land Retired for Action Alts.	5,827	3,897	14,467	14,467	14,467
LANDS RETIRED UNDER NO ACTION - DRAINED UNDER ACTION ALTERNATIVES (acres)					
Lands Retired Under No Action	0	0	0	0	0
Benefited Area (retired to drained)	0	0	0	0	0
DRAINAGE-IMPAIRED LAND UNDER NO ACTION CONVERTED TO DRAINED LAND (acres)					
Remaining Drainage-Impaired Land	81,000	81,000	81,000	81,000	81,000
Total Land Retired for Action Alts.	5,827	3,897	14,467	14,467	14,467
Retired to Drained Land Adjustment	0	0	0	0	0
Benefited Area (impaired to drained)	75,173	77,103	66,533	66,533	66,533

Notes:

Values represent the number of acres in each category, relative to No Action.
Values rounded to nearest \$1,000. Totals may not add due to rounding.

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N1.1.1 Avoided Cost of Involuntary Land Retirement

The first category of benefits provided by drainage service alternatives is the increase in net farm revenues as a result of sustaining agricultural production on lands that would otherwise be retired because of inadequate drainage. Westlands has implemented a plan to retire 65,000 acres of drainage-impaired land. Under the No Action Alternative, this land is assumed to remain out of production for the 50-year planning horizon. The annual benefit per acre is estimated as the avoided loss of net farm revenue from lands removed from agricultural production. Based on prices, yields, and production costs developed for the PFR Addendum (Reclamation 2004a), the net revenue loss would average \$161.17/acre/year in the Northerly Area and \$147.74/acre/year in Westlands (the difference is due to different crop mixes on the affected lands). Table N-2 summarizes the changes in net income resulting from involuntary land retirement.

It is assumed that for the drainage disposal alternatives without land retirement, the 65,000 acres that would be retired under No Action would be provided with drainage service. In other words, these lands would have on-farm tile drains installed and connected to the collection, treatment, and disposal systems. Under this assumption, the estimated benefit for these lands is based on changing them from a retired status with essentially no net farm revenue to fully drained land having no drainage- or irrigation-related restrictions on the crop mix grown. However, for alternatives that include voluntary land retirement, it is assumed that some or all of the 65,000 acres retired under No Action would be included in the lands retired voluntarily. Based on this assumption, an adjustment is necessary to ensure that these lands are not included when estimating the benefits of changing land from drainage impaired to fully drained, therefore overestimating the benefits of those alternatives that include voluntary land retirement.

For the In-Valley/Groundwater Quality Land Retirement Alternative, only 38,486 acres are estimated to be retired voluntarily. The difference between the 65,000 acres that would be retired under No Action and the voluntarily retired land (26,514 acres) is assumed to generate a benefit as the result of receiving drainage service. An adjustment to drained land is not necessary for the In-Valley/Water Needs Land Retirement Alternative and the In-Valley/Drainage-Impaired Land Retirement Alternative because the total amount of land retired under these alternatives exceeds the 65,000 acres retired under No Action. However, a reduction of 65,000 acres to the land retired under the In-Valley/Drainage-Impaired Land Retirement Alternative is needed to prevent overestimating the amount of land that would change from drainage impaired to retired.

N1.1.2 Cropping Patterns Changes

The second category of benefits projected to occur over the long run as a result of the provision of drainage service is the increase in net revenues associated with changes in cropping patterns. With adequate drainage conditions, crops are projected to shift toward a more revenue intensive crop mix. The gain in net revenue depends on how the mix of crops changes. For this analysis, an estimate is made of the average crop evapotranspiration and applied water that would most likely occur under adequate drainage conditions. In Westlands, the weighted increase in net revenue expected from the crop mix change is \$94.67 per acre. For the Northerly Area, with slightly lower estimated natural drainage on its most impaired lands, the projected change in crop mix results in a weighted increase in net revenue of \$149.27 per acre. These estimates are used to assess the potential net revenue gained as a result of improving drainage conditions by providing drainage service on drainage-impaired lands. This analysis only represents a typical or average

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situation, wherein individual growers would make their decisions based on specific site and market conditions.

Table N-2 displays estimates of the aggregate gain in net revenue from farming, using the crop shifts described above. The expected crop mix with drainage service provided is assumed to be similar to overall crop mix in the San Luis Unit, with the exception that the most sensitive crops (orchards and vineyards) would not be planted in areas affected by shallow groundwater. The crops for the No Action Alternative (no drainage service provided) are assumed to be a mix of cotton, grains, and rotational fallow.

Prices and yields are based on Fresno County Agricultural Commissioner annual reports. Production costs were derived from the most recent crop budgets prepared by the University of California Cooperative Extension (various years). These assumptions are developed according to Bureau of Reclamation guidelines (Reclamation 2004b) for estimating costs and benefits of water projects.

N1.1.3 Avoided Irrigation Management Costs

To maintain agricultural production on drainage-impaired lands without artificial drainage, a high level of irrigation management is required. The required level of management depends on the estimated rate of natural drainage. Poorly drained lands with a low rate of natural drainage require higher levels of irrigation management to remain in production. As long as irrigation management methods can help keep aggregate deep percolation of applied irrigation water equal to or less than natural drainage, and if the deep percolation provides an acceptable leaching fraction, then long-term root zone equilibrium can be maintained. Several considerations are important for managing irrigated crop production under poor drainage conditions:

- Even if irrigation can be managed to hold deep percolation equal to natural drainage, salts would continue to accumulate in the shallow groundwater. These salts would also continue to migrate into deeper groundwater over time. Only artificial drainage that removes and disposes of salts can improve the long-term salt balance that includes both root zone and groundwater salt loads.
- Very careful irrigation management is required, which means that both seasonal application efficiency and distribution uniformity of irrigation water must be high. The cost of irrigation hardware and management is significantly higher to irrigate poorly drained soils than well-drained soils.
- Lands for which revenues cannot support the higher irrigation and management costs would go out of production.
- The continued accumulation of salts in the shallow groundwater makes irrigating poorly drained soils relatively risky. Small changes in the overall water and salt balance (for example, reducing groundwater pumping that provided some portion of the natural drainage, or a change in the salinity of applied water) can result in a fairly rapid deterioration of root zone conditions.
- To keep deep percolation within the limits provided by natural drainage, the cropping pattern generally needs to be restricted to lower- evapotranspiration crops. Small grains (e.g., wheat and barley) may need to play a larger role in the crop mix. Sugar beets and some forage crops

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can tolerate the saltier soil conditions, but their relatively high water uses may result in more deep percolation than allowed by drainage conditions.

- The net result of higher soil salinity and restricted deep percolation is a crop mix that excludes both salt-sensitive crops and high water-using crops. Small grains, salt-tolerant row crops, and a mixture of cotton with grains and/or row crops are the most feasible cropping systems. When natural drainage is very restrictive (e.g., less than 0.25 foot/year), rotational fallowing may be required to allow the shallow groundwater to subside. Again, careful irrigation management is needed to avoid excessive salinization of the soil.

Providing drainage service to drainage-impaired lands eliminates the requirement for such a high level of irrigation management, and the associated costs. Irrigation management costs avoided as a result of providing drainage service are included as a project benefit. Avoided irrigation management costs are estimated to be \$6.80 per acre for Westlands and \$7.18 per acre for the Northerly Area districts. As indicated earlier, these avoided irrigation management costs are incorporated in the increased net revenue values shown in Table N-2 and are not listed separately as a benefit.

Table N-2
Changes in Agricultural Productivity of Project Lands
Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater r Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Westlands					
LAND RETIRED UNDER NO ACTION – DRAINED UNDER ACTION ALTERNATIVES					
Acres	65,000	65,000	26,514	0	0
Increased Net Revenue (\$/ac/yr)	\$147.74	\$147.74	\$147.74	\$147.74	\$147.74
Benefit Subtotal (\$)	\$9,603,000	\$9,603,000	\$3,917,000	\$0	\$0
LAND RETIRED UNDER NO ACTION – RETIRED UNDER ACTION ALTERNATIVES					
Acres	0	0	38,486	65,000	65,000
Increased Net Revenue (\$/ac/yr)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Benefit Subtotal (\$)	\$0	\$0	\$0	\$0	\$0
DRAINAGE-IMPAIRED LAND UNDER NO ACTION – DRAINED UNDER ACTION ALTERNATIVES					
Acres	181,030	182,930	182,910	113,000	0
Increased Net Revenue (\$/ac/yr)	\$94.67	\$94.67	\$94.67	\$94.67	\$94.67
Benefit Subtotal (\$)	\$17,138,000	\$17,318,000	\$17,316,000	\$10,698,000	\$0
NET CHANGE IN AGRICULTURAL PRODUCTIVITY – WESTLANDS					
Drainage Benefit – Westlands	\$26,741,000	\$26,921,000	\$21,233,000	\$10,698,000	\$0

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Table N-2 (continued)
Changes in Agricultural Productivity of Project Lands
Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Northerly Area					
LAND RETIRED UNDER NO ACTION – DRAINED UNDER ACTION ALTERNATIVES					
Acres	0	0	0	0	0
Increased Net Revenue (\$/ac/yr)	\$161.17	\$161.17	\$161.17	\$161.17	\$161.17
Benefit Subtotal (\$)	\$0	\$0	\$0	\$0	\$0
LAND RETIRED UNDER NO ACTION – RETIRED UNDER ACTION ALTERNATIVES					
Acres	0	0	0	0	0
Increased Net Revenue (\$/ac/yr)	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Benefit Subtotal (\$)	\$0	\$0	\$0	\$0	\$0
DRAINAGE-IMPAIRED LAND UNDER NO ACTION – DRAINED UNDER ACTION ALTERNATIVES					
Acres	75,173	77,103	66,533	66,533	66,533
Increased Net Revenue (\$/ac/yr)	\$149.27	\$149.27	\$149.27	\$149.27	\$149.27
Benefit Subtotal (\$)	\$11,221,000	\$11,509,000	\$9,931,000	\$9,931,000	\$9,931,000
NET CHANGE IN AGRICULTURAL PRODUCTIVITY – NORTHERLY AREA					
Drainage Benefit – Northerly Area	\$11,221,000	\$11,509,000	\$9,931,000	\$9,931,000	\$9,931,000
Benefit Total (\$1,000)	\$37,962,000	\$38,430,000	\$31,164,000	\$20,629,000	\$9,931,000

Notes:

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2 NED COSTS

Project components or features, whether structural or nonstructural, require the use of various resources. NED costs are the opportunity costs of using these resources. Opportunity costs are a measure of the highest valued alternative use that would be foregone as a result of using a particular resource. When determining the value of NED costs, both public and private uses of the various resources required in a project alternative should be considered.

N2.1 Economic Costs vs. Financial or Accounting Costs

As indicated above, NED costs are the opportunity, or economic, costs of resources used in a project alternative. Financial or accounting costs are a measure of the actual cash outlays made to acquire the resources necessary to implement the project. In cases where financial costs reflect the full economic value of a particular resource to society, they can and should be used to determine NED costs. However, financial costs are often different from, and unrelated to, economic costs. Many financial costs do not reflect the true opportunity cost of a resource.

Market prices (i.e., the price that a particular commodity will fetch in the marketplace) are used to quantify the financial cost of a particular commodity or resource. When market prices do not accurately reflect the true opportunity cost of a resource to society, it is necessary to use other or

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additional means to estimate NED costs. In some cases, financial costs don't include all of the opportunity costs of a resource. Other times, actual cash outlays made to acquire a resource have no relationship to the opportunity costs of the resource. Economic costs may exceed financial costs when uncompensated or unmitigated losses occur as a result of the installation, operation, maintenance, and replacement of project measures. An example of such losses might be the degradation of water or air quality resulting from the construction and operation of a coal-fired electrical power plant. The true opportunity cost to society of using these resources is not captured in the accounting or financial costs of the power plant.

On the other hand, in some instances the financial costs paid by an entity exceed the actual increased value of production (especially when measured for the entire nation). For example, assume that one company buys another company. Unless one of the companies possesses a technological or management process that either increases the total output (or decreases the total production cost) of the new combined company, the actual financial transaction is very likely to exceed the actual increase in net revenue. When this transaction is viewed from a national perspective, the financial transaction is irrelevant to the total output of the nation. The amount that is relevant to the entire nation is the net change in total output minus the net change in total production costs of the combined company compared to the net revenues of the two separate companies before they were combined (assuming that the output of the rest of the nation remains the same).

The *Principles and Guidelines* (U.S. Water Resources Council 1983) identifies three separate categories to use in measuring and analyzing NED costs: implementation outlays, associated costs, and other direct costs. These cost categories are discussed and estimated in the sections below.

N2.2 Implementation Costs of Project Features

The NED costs of implementation outlays include the costs incurred by the responsible Federal entity and, where appropriate, contributed by other Federal or non-Federal entities to construct, operate, and maintain a project in accordance with sound engineering and environmental principles and place it in operation. These costs include remaining postauthorization planning and design costs; construction costs; construction contingency costs; administrative services costs; fish and wildlife habitat mitigation costs; relocation costs; historical and archaeological salvage costs; land, water, and mineral rights costs; and operation, maintenance, and replacement costs.

N2.2.1 Treatment and Disposal Costs

Treatment and disposal costs include postauthorization planning and design costs, construction costs, construction contingency costs, administrative service costs, as well as operation, maintenance, and replacement costs.

Specific treatment and disposal facilities include facilities funded by the Federal government, as well as those funded by non-Federal entities. Federally funded facilities consist of the drainage collection system, conveyance system, regional reuse facilities, evaporation basins, reverse osmosis treatment facilities, biological selenium treatment facilities, and fish and wildlife mitigation facilities. Facilities funded by non-Federal entities include on-farm tile drains,

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drainwater recycling facilities, seepage reduction measures, shallow groundwater management measures, and on-farm irrigation efficiency improvements. Construction costs, interest during construction costs, and annual operation, maintenance, and replacement costs are expressed as annual equivalent costs using the FY2005 Federal discount rate of 5.625 percent over a 50-year project life. Annual treatment and disposal costs are shown in Table N-3.

N2.2.2 Fish and Wildlife Mitigation Costs

Normally, the cost of mitigating for the loss of fish and wildlife habitat would also be included in the estimate of NED costs. However, information is insufficient regarding specific mitigation protocols to allow a reasonable design and cost estimate of mitigation features. Some general information is available for estimating and designing a variety of mitigation facilities, including wetland areas and ponds, to mitigate for the construction of evaporation basins in the In-Valley Alternatives. However, specific details regarding the type and quantity of mitigation features have not been identified.

Some project features may have certain mitigation considerations included in their designs and, therefore, some mitigation costs may be integrated into the design cost of those particular features. For example, design specifications for evaporation basins require that the shape of containment berms have a specific slope and that the depth of the ponds be such that they are less likely to attract waterfowl. The cost of features that have these types of criteria integrated into their design is not separated into what is commonly considered mitigation.

The annual equivalent Federal project costs shown in Table N-3 do not match the values in Table 2.12-1 of the EIS because the values shown in Table N-3 reflect the cost of lost agricultural production from those lands used for project facilities while the values shown in Table 2.12-1 reflect the financial cost of purchasing those lands (see Section N2.1 above).

Table N-3
Annual Equivalent Costs of Drainage Service (Treatment, Disposal, and Mitigation)
Changes Relative to the No Action Alternative (\$1,000)

Subarea	In-Valley Disposal	Out-of- Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Northerly Area & Westlands Combined					
FEDERAL PROJECT COSTS					
Alternative Specific					
Conveyance System	1,597	17,430	1,501	1,302	130
Evaporation Basins	6,898	0	6,149	4,850	2,387
Reverse Osmosis Facilities	5,138	0	4,684	3,688	1,822
Selenium Treatment	3,591	0	3,189	2,458	1,281
Subtotal	17,224	17,430	15,523	12,298	5,620
Common Federal Costs					
Drainage Collection System	11,194	11,072	9,530	5,351	167
Regional Reuse Facilities	4,621	4,633	4,038	3,685	2,047

Table N-3 (continued)
Annual Equivalent Costs of Drainage Service (Treatment, Disposal & Mitigation)
Changes Relative to the No Action Alternative (\$1,000)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
DMC Collection/Reuse	104	103	105	106	106
Subtotal	15,919	15,807	13,673	9,142	2,320
FEDERAL COST SUBTOTAL	33,144	33,238	29,197	21,440	7,940
NON-FEDERAL COSTS					
Drainage Reduction Costs					
Drainwater Recycling	3,229	3,192	2,799	1,920	832
Seepage Reduction	519	520	518	517	517
Shallow GW Mgt	662	666	558	311	9
Irrigation Improvements	768	768	768	768	768
Subtotal	5,178	5,147	4,642	3,516	2,126
On-farm Tile Drains	3,279	3,291	3,004	2,442	498
NON-FEDERAL COST SUBTOTAL	8,457	8,437	7,647	5,958	2,625
TOTAL TREATMENT & DISPOSAL	\$41,601	\$41,675	\$36,843	\$27,398	\$10,565
Mitigation Costs	n/a	n/a	n/a	n/a	n/a
Total Cost	\$	\$	\$	\$	\$

Notes:

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2.2.3 Cost of Reducing Deep Percolation in Nondrainage-Impaired lands

Increased irrigation management could allow full crop production, but at a significant cost and within limits. Water use estimates for the drainage-impaired area in Westlands indicate that seasonal application efficiency is already well over 80 percent. Increasing efficiency higher than this level is expensive and may be impractical, especially given the imperative to leach salts from the root zone.

Lands in Westlands upslope areas and in the Northerly Area that are not drainage impaired are not currently at as high a level of irrigation efficiency as drainage-impaired lands. For these areas, the costs and benefits of two levels of improvements were assessed as part of SLDFR Plan Formulation (see PFR Addendum [Reclamation 2004a]). Based on that assessment, all of the drainage service alternatives were assumed to implement a moderate reduction in deep percolation on these lands. The costs of the irrigation system improvements were based on estimates in an update to the irrigation cost and performance study prepared for Reclamation under the San Joaquin Valley Drainage Program and the San Luis Unit Drainage Program (CH2M Hill 1994). Irrigation system performance estimates were compiled from studies performed at California State Polytechnic University. The costs were derived by estimating the level of irrigation efficiency and distribution uniformity needed to reduce deep percolation by the

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target amount of 0.1 foot/acre, on average. Costs associated with higher levels of management are expressed as annual equivalents, including amortized capital costs of irrigation system hardware and operation and maintenance costs. Costs are estimated to be \$0.9 million/year in the Northerly Area and \$1.72 million/year in Westlands as shown in Table N-4.

Table N-4
Additional Irrigation Management Costs
Changes Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Westlands					
Upslope Unimpaired Area (ac)	253,000	253,000	253,000	253,000	253,000
Irrigation Mgt. Costs (\$/acre)	\$6.80	\$6.80	\$6.80	\$6.80	\$6.80
Benefit Subtotal (\$)	\$1,720,000	\$1,720,000	\$1,720,000	\$1,720,000	\$1,720,000
Northerly Area					
Upslope Unimpaired Area (ac)	126,000	126,000	126,000	126,000	126,000
Irrigation Mgt. Costs (\$/acre)	\$7.18	\$7.18	\$7.18	\$7.18	\$7.18
Benefit Subtotal (\$)	\$905,000	\$905,000	\$905,000	\$905,000	\$905,000
Benefit Total	\$2,625,000	\$2,625,000	\$2,625,000	\$2,625,000	\$2,625,000

Notes:

Irrigation improvements on all Northerly Area lands and on Westlands lands outside the drainage-impaired area are assumed in all action alternatives to reduce percolation to the regional aquifer. The costs of the improvements are shown in this table.

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2.2.4 Land Retirement Costs

Another category of costs incurred by some of the action alternatives is the removal of lands from agricultural production, or voluntary land retirement. As mentioned above, the NED cost of land retirement is the net farm income forgone as a result of retiring land rather than keeping it in irrigated agricultural production – not the actual cash outlay, or financial cost, of purchasing land to retire. The financial cost of land retirement is a transfer payment. A transfer payment is essentially a payment from one economic sector of the nation (Federal government) to another (current owners of drainage-impaired land) without any corresponding production or expectation of production. The analysis of alternatives formulated to provide the San Luis Unit with drainage service includes two types of land retirement scenarios: (1) retiring land for the purpose of constructing project facilities on it and (2) retiring land to avoid providing drainage service for particular land parcels.

N2.2.4.1 Project Facilities

The first example of land retirement, which occurs in all of the action alternatives, is the purchase of lands required for project facilities, such as reuse areas, evaporation basins, and water storage, treatment, or conveyance facilities. The net revenue from these lands is lost as they are removed from agricultural production and used as sites for project facilities. The change in net farm revenue that occurs when drainage-impaired land is retired is estimated to be

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\$53.07/acre/year in Westlands and \$11.90/acre/year for land in the Northerly Area (the difference is due to different crop mixes on the affected lands). These values are based on prices, yields, and production costs developed for the PFR Addendum (Reclamation 2004a). The estimated NED cost of lands retired for project facilities is provided in Table N-5.

Table N-5
Cost of Ag Production Losses from Land Purchased for Project Facilities
Changes Relative to the No Action Alternative (million \$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Westlands					
Purchased for Project Facilities (ac)	7,864	5,964	5,984	1,044	0
Change in Net Revenue (\$/ac/yr)	\$53.07	\$53.07	\$53.07	\$53.07	\$53.07
Cost Subtotal	\$417,000	\$316,000	\$318,000	\$55,000	\$0
Northerly Area					
Purchased for Project Facilities (ac)	5,827	3,897	4,467	4,467	4,467
Change in Net Revenue (\$/ac/yr)	\$11.90	\$11.90	\$11.90	\$11.90	\$11.90
Cost Subtotal	\$69,000	\$46,000	\$53,000	\$53,000	\$53,000
Total Cost	\$486,000	\$362,000	\$371,000	\$108,000	\$53,000

Notes:

Estimates shown are annual figures as of the end of the 50-year planning horizon.

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2.2.4.2 Voluntary Land Retirement

Another reason to retire land is to avoid the cost of providing drainage service to specific drainage-impaired lands. Such land retirement is a feature of the Land Retirement Alternatives. The NED cost per acre of retiring land to avoid providing drainage service to that same land is the same as the cost estimated for project facilities. Table N-6 summarizes the changes in net farm income resulting from voluntary land retirement activities.

Table N-6
Cost of Ag Production Losses from Voluntary Land Retirement
Changes Relative to the No Action Alternative (million \$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Westlands					
Voluntary Retired Land (acres)	0	0	38,486	139,850	253,894
Avoided Land Retirement Under No Action	0	0	-38,486	-65,000	-65,000
Adjusted Net Retired Land	0	0	0	74,850	188,894
Change in Net Revenue (\$/acre/year)	\$53.07	\$53.07	\$53.07	\$53.07	\$53.07
Cost Subtotal	\$0	\$0	\$0	\$3,972,000	\$10,025,000

National Economic Development (NED) Analysis of Alternatives

Table N-6 (continued)
Cost of Ag Production Losses from Voluntary Land Retirement
Changes Relative to the No Action Alternative (million \$/year in 2050)

Subarea	In-Valley Disposal	Out-of- Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Northerly Area					
Additional Retired Land (acres)	0	0	10,000	10,000	10,000
Change in Net Revenue (\$/acre/year)	\$11.90	\$11.90	\$11.90	\$11.90	\$11.90
Cost Subtotal	\$0	\$0	\$119,000	\$119,000	\$119,000
Total Cost	\$0	\$0	\$119,000	\$4,091,000	\$10,144,000

Notes:

Avoided losses increase over time as drainage is installed. Estimates shown are annual figures as of the end of planning horizon. Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

In addition to the loss of net revenue that occurs as land is taken out of production agriculture, an additional cost of the land retirement program is the result of management and administrative activities required to manage the alternative uses of retired lands. Specific activities assumed to be part of the land management program are dryland farming, land fallowing, and grazing. One-third of all voluntary retired land is assumed to be in one of these three program activities. Administrative and management costs of the land retirement program are assigned only to those lands retired to avoid having to provide drainage service. Annual administrative and management costs of the land retirement program are estimated to be \$42.60/acre. Lands retired to provide sites for project facilities are not assigned administrative and management costs. Administrative and management costs of the land retirement program are shown in Table N-7.

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Table N-7
Administration and Management Costs of Voluntary Land Retirement
Changes Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Westlands					
Land Retirement Program Acres	0	0	38,486	139,850	253,894
Admin & Mgt Cost (\$/acre)	\$42.60	\$42.60	\$42.60	\$42.60	\$42.60
Cost Subtotal	\$0	\$0	\$1,640,000	\$5,958,000	\$10,816,000
Northerly Area					
Retired Voluntarily (acres)	0	0	10,000	10,000	10,000
Admin & Mgt Cost (\$/acre)	\$42.60	\$42.60	\$42.60	\$42.60	\$42.60
Cost Subtotal	\$0	\$0	\$426,000	\$426,000	\$426,000
Cost Total	\$0	\$0	\$2,066,000	\$6,384,000	\$11,242,000

Notes:

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2.2.5 Cost of Supplemental Water Purchases

There is currently a shortage of water available to irrigate all of the land located within the San Luis Unit. It is estimated that under the No Action Alternative, about 96,000 acre-feet (AF)/year of water is necessary to provide a full irrigation supply for the Unit. The result of providing drainage service to drainage-impaired lands within the Unit increases the amount of water that will be needed to irrigate all land suitable for unrestricted agricultural production. It is estimated that under all of the action alternatives, except for the In-Valley/Water Needs Land Retirement Alternative and the In-Valley/Drainage-Impaired Area Land Retirement Alternative, additional water will need to be acquired to irrigate Unit lands that will have sufficient drainage service. The additional cost of acquiring additional irrigation water each year is a cost that needs to be accounted for in the NED analysis. The differences (compared to No Action) in required water supply and the associated cost differences of acquiring additional irrigation water for each alternative are shown in Table N-8.

The additional water needed to irrigate all Unit lands with sufficient drainage service was limited to 130,000 AF/year, based on annual water purchases by Westlands from 2002 to 2004. Limiting the amount of water purchased in any one year to 130,000 AF means that the action alternatives that do not include voluntary land retirement will still not have a full water supply for all of the lands with adequate drainage service. Therefore, an additional adjustment was made to estimate the net NED benefits for the In-Valley Disposal Alternative and the Out-of-Valley Disposal Alternatives. NED benefits were adjusted by assuming that some land would need to be involuntarily retired or fallowed due to an inadequate water supply. An estimate of the land retired or fallowed, as well as the corresponding reduction of NED benefits for each action alternative, is shown in Table N-8.

National Economic Development (NED) Analysis of Alternatives

Table N-8
Cost of Additional Water Supply for Land Retired Voluntarily
Changes Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Westlands					
No Action Estimate					
Additional Water Required (AF)	96,215	96,215	96,215	96,215	96,215
Water Price (\$/AF)	\$119.59	\$119.59	\$119.59	\$119.59	\$119.59
Value of Acquired Water	\$11,507,000	\$11,507,000	\$11,507,000	\$11,507,000	\$11,507,000
Estimates of Action Alternatives					
Additional Water Required (AF)	130,000	130,000	130,000	15,733	-296,900
Water Price (\$/AF)	\$125.00	\$125.00	\$125.00	\$106.72	\$56.70
Value of Acquired Water	\$16,250,000	\$16,250,000	\$16,250,000	\$1,679,000	-\$16,833,000
Cost of Supplemental Water	\$4,743,000	\$4,743,000	\$4,743,000	-\$9,828,000	-\$28,340,000
UPSLOPE LAND DRAINED UNDER NO ACTION – RETIRED/FALLOWED UNDER ACTION ALTERNATIVES					
Acres	11,984	13,298	0	0	0
Decreased Net Revenue (\$/acre/year)	\$147.74	\$147.74	\$147.74	\$147.74	\$147.74
Insufficient Water Cost (\$)	\$1,770,000	\$1,965,000	\$0	\$0	\$0
Cost Total	\$6,513,000	\$6,708,000	\$4,743,000	-\$9,828,000	-\$28,340,000

Notes:

Values represent additional costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N2.3 Cost Summary

NED costs estimated for each alternative are listed in Table N-9. All cost estimates shown are based on comparing the costs incurred under each of the action alternatives to those estimated under the No Action Alternative.

National Economic Development (NED) Analysis of Alternatives

Table N-9
Summary of NED Costs
Changes Relative to the No Action Alternative (million \$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Westlands					
Irrigation Mgt Cost-Unimpaired Lands	\$1,720,000	\$1,720,000	\$1,720,000	\$1,720,000	\$1,720,000
Ag Losses – Facilities	417,000	316,000	318,000	55,000	0
Ag Losses – Land Retirement	0	0	0	3,972,000	10,024,000
Land Retirement Admin Costs	0	0	1,640,000	5,958,000	10,816,000
Cost Subtotal	\$2,137,000	\$2,036,000	\$3,678,000	\$11,705,000	\$22,560,000
Northerly Area					
Irrig Mgt Cost-Unimpaired Lands	905,000	905,000	905,000	905,000	905,000
Ag Losses – Facilities	69,000	46,000	53,000	53,000	53,000
Ag Losses – Land Retirement	0	0	119,000	119,000	119,000
Land Retirement Admin Costs	0	0	426,000	426,000	426,000
Cost Subtotal	\$974,000	\$951,000	\$1,503,000	\$1,503,000	\$1,503,000
Northerly Area & Westlands Combined					
Treatment & Disposal Costs	\$41,601,000	\$41,675,000	\$36,843,000	\$27,398,000	\$10,565,000
Suppl. Water Purchases/Sales	4,743,000	4,743,000	4,743,000	-9,828,000	-28,340,000
Upslope Land Retirement	1,770,000	1,965,000	0	0	0
Cost Subtotal	\$48,314,000	\$48,333,000	\$41,586,000	\$17,570,000	-\$17,775,000
Total Costs	\$51,225,000	\$51,370,000	\$46,767,000	\$30,778,000	\$6,288,000

Notes:

Values represent NED costs relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N3 NET NED BENEFITS

The *Principles and Guidelines* (U.S. Water Resources Council 1983) states that the alternative that reasonably maximizes net NED benefits, consistent with the Federal objective, is identified as the NED plan. Net NED benefits are calculated by subtracting NED costs from NED benefits. As shown in Table N-10, only one of the action alternatives analyzed generates more NED benefits than the No Action Alternative. The action alternative that generates the maximum net NED benefit is the In-Valley/Drainage-Impaired Area Land Retirement Alternative. However, the question of whether the In-Valley/Drainage-Impaired Area Land Retirement Alternative is consistent with the Federal objective is debatable, since the Federal objective is to provide drainage service to drainage-impaired lands in the San Luis Unit.

Appendix N

National Economic Development (NED) Analysis of Alternatives

Table N-10
Benefit/Cost Summary
Changes Relative to the No Action Alternative (\$/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Groundwater Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage- Impaired Area Land Retirement
Total NED Benefit	\$37,962,000	\$38,430,000	\$31,164,000	\$20,629,000	\$9,931,000
Total NED Cost	51,225,000	51,370,000	46,767,000	30,778,000	6,288,000
Net NED Benefit	-\$13,263,000	-\$12,940,000	-\$15,603,000	-\$10,149,000	\$3,643,000

Notes:

Values represent net NED benefits relative to No Action.

Values rounded to nearest \$1,000. Totals may not add due to rounding.

N4 REFERENCES

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APPENDIXO

Mitigation Cost Estimates

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Table O-5 Costs for Mitigation Measures for Ocean Disposal Alternative

Table O-6 Costs for Mitigation Measures for Delta-Chipps Island Disposal Alternative

Table O-7 Costs for Mitigation Measures for Delta-Carquinez Straits Disposal Alternative

Appendix O Mitigation Cost Estimates

This appendix provides appraisal-level costs for the mitigation measures described in Section 20. Total appraisal-level costs are provided for each of the seven action alternatives. The mitigation costs are based on the features of the alternatives as presented in Tables 2.13-1 and 19-1. These cost estimates are for comparative purposes only and do not represent commitments by Reclamation to conduct any of the described mitigation actions. Actual mitigation would be determined following site-specific surveys and selection of a preferred alternative.

The following assumptions have been made concerning the outcome of site surveys and the terrestrial and aquatic habitat types present at the facility sites:

- Costs for site-specific botanic/biologic surveys are based on two biologists being able to survey an area of 600 acres/day or 4 linear miles/day and include other direct costs.
- For the In-Valley Disposal Alternatives, 50 percent of the temporary right-of-way (ROW) in agricultural areas is restored. For the Ocean and Delta Disposal Alternatives, all annual grassland area in temporary ROW is restored. Site restoration costs include hydroseeding at \$2,000/acre, erosion control mix at \$400/acre (agricultural lands), or native plant mix at \$700/acre (annual grassland).
- Twenty-five percent of agricultural lands are deemed San Joaquin kit fox habitat by the U.S. Fish and Wildlife Service (Service). Mitigation bank credits are \$15,000/acre for San Joaquin kit fox habitat, \$15,000/acre for California red-legged frog habitat, \$15,000/acre for California tiger salamander habitat, or \$20,000/acre for multi-species credits (i.e., San Joaquin kit fox and California tiger salamander habitat).
- One hundred percent of annual grassland is deemed San Joaquin kit fox habitat (foraging habitat) and California tiger salamander habitat (aestivation habitat). Fifty percent of annual grassland is deemed California red-legged frog habitat.
- One hundred percent of sensitive aquatic wetland habitat is deemed habitat for the California red-legged frog.
- For every acre of habitat that is permanently impacted, the Service requires purchase of bank credits for 3 acres. For every acre that is temporarily impacted, the Service requires purchase of bank credits for 1.1 acres.
- Mitigation bank credits are \$70,000/acre for sensitive aquatic wetland habitat. This habitat does not contain vernal pools. For the Ocean Disposal Alternative and the Delta Disposal Alternatives, it is assumed that 5 percent of the sensitive aquatic wetland habitat is permanently impacted.
- For the Ocean Disposal Alternative, the riparian foothills mitigation bank credits are \$50,000/acre, and oak woodland mitigation bank credits are \$25,000/acre.
- Creation of evaporation basin mitigation habitat costs \$20,000/acre.

Table O-1
Costs for Mitigation Measures for
In-Valley Disposal Alternative

Affected Resource	Mitigation Measures	Appraisal-Level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	150
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (645 acres of temporary ROW)	3,500
	Mitigation bank credits for permanent lost habitat (3,550 acres)	40,000
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement	Insignificant cost for this alternative
	Design measures to minimize evaporation basin use by waterfowl and shorebirds	Included in design and operating costs
	Develop and implement <i>Adaptive Operation and Monitoring Plans</i> for migrating and nesting waterbirds and other wildlife	
	Create evaporation basin mitigation habitat (approximately 1,436 acres)	29,000
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Consult with appropriate authorities and approved surveys for special-status species	Up to 850 depending on species
	Implement avoidance measures, construction BMPs, and conservation measures	Included in construction and design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀ and recommended Rule 4550 Conservation Management Practices	Included in construction costs
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		74,250

Table O-2
Costs for Mitigation Measures for
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource	Mitigation Measures	Appraisal-Level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	150
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (645 acres of temporary ROW)	3,500
	Mitigation bank credits for permanent lost habitat (3,150 acres)	35,500
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement	Insignificant cost for this alternative
	Design measures to minimize evaporation basin use by waterfowl and shorebirds Develop and implement <i>Adaptive Operation and Monitoring Plans</i> for migrating and nesting waterbirds and other wildlife	Included in design and operating costs
	Create evaporation basin mitigation habitat (approximately 1,242 acres)	25,000
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Consultation with appropriate authorities and approved surveys for special-status species	Up to 850 depending on species
	Implementing avoidance measures, construction BMPs and conservation measures	Included in construction and design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀	Included in construction costs
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		65,750

Table O-3
Costs for Mitigation Measures for
In-Valley/Water Needs Land Retirement Alternative

Affected Resource	Mitigation Measures	Appraisal-Level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	100
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (645 acres of temporary ROW)	3,500
	Mitigation bank credits for permanent lost habitat (2,410 acres)	27,000
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement	Insignificant cost for this alternative
	Design measures to minimize evaporation basin use by waterfowl and shorebirds Develop and implement <i>Adaptive Operation and Monitoring Plans</i> for migrating and nesting waterbirds and other wildlife	Included in design and operating costs
	Create evaporation basin mitigation habitat (approximately 926 acres)	18,500
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Consultation with appropriate authorities and approved surveys for special-status species	Up to 850 depending on species
	Implementing avoidance measures, construction BMPs and conservation measures	Included in construction and design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀	Included in construction costs
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		50,700

Table O-4
Costs for Mitigation Measures for
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource	Mitigation Measures	Appraisal-level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	50
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (10 acres of temporary ROW)	50
	Mitigation bank credits for permanent lost habitat (1,274 acres)	14,500
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement	Insignificant cost for this alternative
	Design measures to minimize evaporation basin use by waterfowl and shorebirds Develop and implement <i>Adaptive Operation and Monitoring Plans</i> for migrating and nesting waterbirds and other wildlife	Included in design and operating costs
	Create evaporation basin mitigation habitat (approximately 548 acres)	11,000
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Consultation with appropriate authorities and approved surveys for special-status species	Up to 850 depending on species
	Implementing avoidance measures, construction BMPs and conservation measures	Included in construction and design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀	Included in construction costs
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		27,200

Table O-5
Costs for Mitigation Measures for
Ocean Disposal Alternative

Affected Resource	Mitigation Measures	Appraisal-Level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	200
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (1,980 acres of temporary ROW)	22,000
	Mitigation bank credits for permanent lost habitat (830 acres)	33,000
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement Maintain or restore affected channels/wetland areas at pipeline and aqueduct crossings	Included in construction costs
	Mitigation bank credits for temporary lost habitat (55 acres)	5,000
	Mitigation bank credits for permanent lost habitat	700
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Conduct preconstruction species-focused biological and botanical surveys using established or approved protocols	Up to 950 depending on species
	Use approved construction techniques and scheduling to avoid impacts to tidewater goby during construction of the outfall	Included in construction costs
<u>Geology and Seismicity</u>	Perform detailed engineering geologic investigations along the conveyance routes to identify potential problem areas for appropriate slope stability design	Included in design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀ and recommended Rule 4550 Conservation Management Practices	Included in construction costs
<u>Water Resources</u>	Obtain NPDES permit for discharge to the ocean at a distance of 1.4 miles off Point Estero (includes mitigation for benthic impacts)	2,000
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		64,600

Table O-6
Costs for Mitigation Measures for
Delta-Chipps Island Disposal Alternative

Affected Resource	Mitigation Measures	Appraisal-level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	200
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (1,600 acres of temporary ROW)	11,000
	Mitigation bank credits for permanent lost habitat (988 acres)	20,500
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement Maintain or restore affected channels/wetland areas at pipeline and aqueduct crossings	Included in construction costs
	Mitigation bank credits for temporary lost habitat (73 acres)	7,000
	Mitigation bank credits for permanent lost habitat	1,000
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Conduct preconstruction species-focused biological and botanical surveys using established or approved protocols	Up to 950 depending on species
	Use approved construction techniques and scheduling to avoid impacts to aquatic species during construction of the underwater outfall	Included in construction costs
<u>Geology and Seismicity</u>	Perform detailed engineering geologic investigations along the conveyance routes to identify potential problem areas for appropriate slope stability design	Included in design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀ and recommended Rule 4550 Conservation Management Practices	Included in construction costs
<u>Water Resources</u>	Obtain NPDES permit for discharge to the Delta 1 mile from the shoreline at Mallard Slough	2,000
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		43,400

Table O-7
Costs for Mitigation Measures for
Delta-Carquinez Strait Disposal Alternative

Affected Resource	Mitigation Measures	Appraisal-Level Costs (\$1,000)
<u>Biological Resources:</u> Terrestrial Resources	Site-specific botanic/biologic surveys at all proposed facility sites	200
	Modify initial impact sites and designs, as necessary, to avoid/minimize impacts to native or natural habitats	Included in design costs
	Mitigation bank credits for temporary lost habitat and site restoration (1,750 acres of temporary ROW)	13,500
	Mitigation bank credits for permanent lost habitat (1,040 acres)	24,000
<u>Biological Resources:</u> Aquatic & Wetland Resources	For jurisdictional wetland areas, establish appropriate avoidance measures, construction BMPs, restoration monitoring procedures and include in CWA Section 404 permit and CDFG Streambed Alteration Agreement Maintain or restore affected channels/wetland areas at pipeline and aqueduct crossings	Included in construction costs
	Mitigation bank credits for temporary lost habitat	11,000
	Mitigation bank credits for permanent lost habitat	1,500
<u>Biological Resources:</u> State and Federally Listed Special-Status Species	Conduct preconstruction species-focused biological and botanical surveys using established or approved protocols	Up to 950 depending on species
	Use approved construction techniques and scheduling to avoid impacts to aquatic species during construction of the underwater outfall	Included in construction costs
<u>Geology and Seismicity</u>	Perform detailed engineering geologic investigations along the conveyance routes to identify potential problem areas for appropriate slope stability design	Included in design costs
<u>Air Resources</u>	Implement SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of PM ₁₀ and recommended Rule 4550 Conservation Management Practices	Included in construction costs
<u>Water Resources</u>	Obtain NPDES permit for discharge to the Delta 1 mile from the shoreline at the City of Crockett	2,000
<u>Cultural Resources</u>	Prepare a Class III survey Programmatic Agreement and Historic Property Management Plan	750
	Incorporate avoidance measures during the planning process, and conduct periodic review	Included in design and operating costs
TOTAL APPRAISAL-LEVEL COSTS		53,900

