SECTIONONE

PURPOSE OF AND NEED FOR ACTION

This section of the San Luis Drainage Feature Re-evaluation Environmental Impact Statement (SLDFR EIS) identifies the purpose of and need for the proposed Federal action, describes the historical context for the evaluation of alternative solutions for providing drainage service to the San Luis Unit (the Unit), summarizes the drainage quantity estimates, defines the project area, identifies related projects and activities, and concludes with the decisions to be made by the U.S. Department of the Interior (Interior).

1.1 PURPOSE OF AND NEED FOR ACTION

The project purpose is to provide agricultural drainage service to the San Luis Unit and the general area, of which lands served by the Unit are a part, that achieves long-term, sustainable salt and water balance in the root zone of irrigated lands. Drainage service is defined as managing the regional shallow groundwater table by collecting and disposing of shallow groundwater from the root zone and/or reducing contributions of water to the shallow groundwater table through land retirement. A long-term sustainable salt and water balance is needed to ensure sustainable agriculture in the Unit and the region.

In order to meet this overall purpose and need, the Bureau of Reclamation (Reclamation) used four related project objectives to develop the alternatives evaluated in this EIS:

- Drainage service will consist of measures and facilities to provide a complete drainage solution, from production through disposal, and avoid a partial solution or a solution with undefined components.
- Drainage service must be technically proven and cost-effective.
- Drainage service must be provided in a timely manner.
- Drainage service should minimize adverse environmental effects and risks.

The proposed Federal action is to provide drainage service to the San Luis Unit. This proposed action would meet the needs of the Unit for drainage service, fulfill the requirements of the February 2000 Court Order, and be completed under the authority of Public Law 86-488. The Re-evaluation is being conducted pursuant to Public Law 86-488, which authorized the Unit.

To plan this proposed action, Reclamation has determined a reasonable future drainage output from the Unit and used the best available information to determine the quality of any drainwater produced. All of the action alternatives use the determined values of drainage output and drainwater quality in the design of all features and in the analysis of environmental effects.

1.2 HISTORICAL PERSPECTIVE

Planning for drainage facilities to serve the San Joaquin Valley has occurred since the mid-1950s. Drainage facilities were discussed when Reclamation studied the feasibility of water supply development for the Unit. In the 1957 California Water Plan, the California Department of Water Resources (DWR) also planned for drainage facilities from near the Buena Vista lakebed in Tulare Basin to the Sacramento-San Joaquin River Delta (the Delta). Figure 1-1 provides an overview of historical and future events for San Joaquin Valley drainage planning.

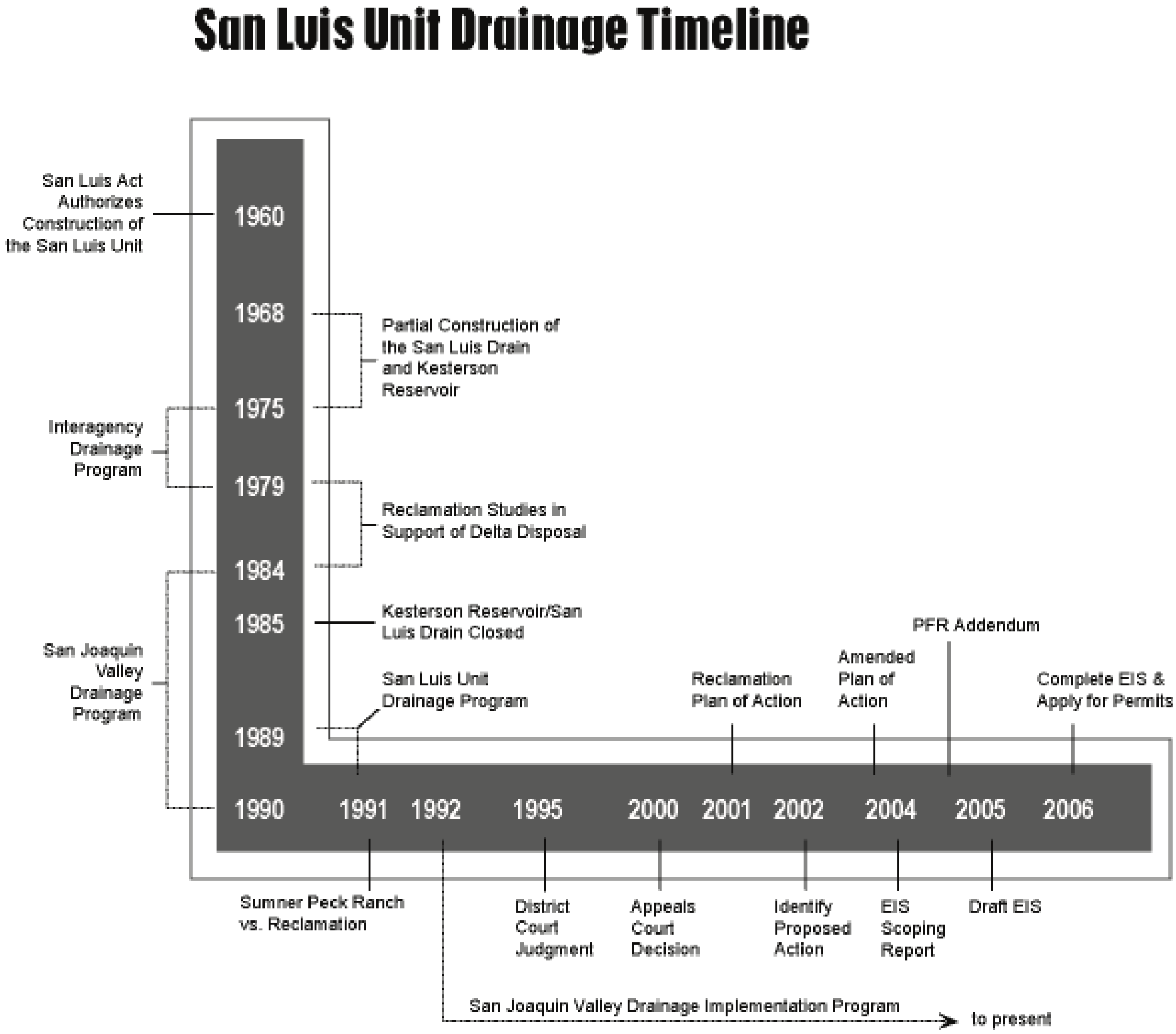


Figure 1-1 San Luis Unit Drainage Timeline

In 1960, Congress enacted Public Law 86-488 (San Luis Act) authorizing construction of the San Luis Unit of the Central Valley Project (CVP). Also in 1960, California voters approved the Burns-Porter Act authorizing the State Water Project. Both of these Acts included facilities to remove drainwater from the San Joaquin Valley.

In the early 1960s, the plan for the construction of the San Luis Interceptor Drain (the Drain) changed from an unlined ditch to a concrete-lined canal. In 1968, Reclamation began construction of the Drain and the first stage of Kesterson Reservoir. Kesterson Reservoir became part of a wildlife refuge through a joint agreement between Reclamation and the U.S. Fish and Wildlife Service (Service). The primary purpose of the reservoir was to regulate flow to support completion of the Drain to the Delta. By 1975, an 82-mile segment of the Drain (ending at Kesterson Reservoir) was completed, and subsequently 120 miles of collector drains were constructed in a 42,000-acre area of the northeast portion of Westlands Water District (Westlands).

Between 1975 and 1979, the San Joaquin Valley Interagency Drainage Program, a joint effort between Reclamation, DWR, and the State Water Resources Control Board (State Board), was formed to find an economically, environmentally, and politically acceptable solution to San Joaquin Valley drainage problems. This group recommended that a drain be completed to the Delta, terminating near Chipps Island. The State declined to participate in a master drain and, based on the San Joaquin Valley Interagency Drainage Program's recommendation, Reclamation initiated a special study to fulfill the requirements for a discharge permit from the State Board for a Federal-only drain.

In 1983, discovery of embryonic deformities of aquatic birds at Kesterson Reservoir significantly changed the approach to drainage solutions in San Joaquin Valley. Because of the high selenium (Se) levels found in the drainwater and its effects at Kesterson Reservoir, the San Luis Unit Special Study was suspended. In 1985, following a Nuisance and Abatement Order issued by the State Board, discharges to Kesterson Reservoir were halted, and feeder drains leading to the Drain were plugged.

In response to the Kesterson problems, the SJVDP was formed by the governor of California and the Secretary of the Interior. This joint Federal/State effort was established to develop solutions to drainage and drainage-related problems. While the initial efforts looked at all possible solutions, a policy decision in 1987 limited studies, to in-valley drainage management measures based on a recommendation from a citizen's advisory committee consisting of water users, environmental advocates, and public interests. The SJVDP's final report (SJVDP 1990) recommended an In-Valley solution that included source reduction, drainage reuse, land retirement, evaporation basins, groundwater management, San Joaquin River discharge, and institutional changes. This plan provided a strategy for managing salts through 2040 and stated that eventually salts may need to be removed from the San Joaquin Valley.

While the SJVDP was preparing its recommendations, a 1986 Federal court order settled a lawsuit among Westlands, Reclamation, and various classes of landowners and water users in Westlands. Named after one of the parties to the lawsuit, the Barcellos Judgment addressed, among other things, the supply of water to Westlands and the provision of drainage service to Westlands. It directed Reclamation to develop, adopt, and submit to Westlands a plan for drainage service facilities by the end of 1991, leading to preparation of the San Luis Unit Drainage Program Plan Formulation Report and the related Draft EIS.

Several landowners subsequently sued Interior, seeking completion of the master drain to the Delta. These lawsuits were partially consolidated in 1992 to address the common allegation that Interior was required by law to construct drainage service facilities from certain lands in the Unit. In 1995, the district court issued a partial judgment stating that the San Luis Act established a mandatory duty to provide drainage. The judgment ordered Interior to promptly prepare, file, and pursue an application for a discharge permit with the State Board to complete the San Luis Drain to the Delta. Interior appealed this judgment.

In February 2000, the U.S. Court of Appeals concluded that Interior must provide drainage service but held that Interior had the discretion to meet the court order with a plan other than the interceptor drain solution. In accordance with the court order, Reclamation developed a Plan of Action (April 2001; Reclamation 2001a) outlining its proposed efforts to provide prompt drainage service considering a variety of options.

- The first phase of the Re-evaluation, consistent with the Plan of Action, was the process of identifying a list of preliminary alternatives that met the court's order to provide prompt drainage service to the Unit. The result of the first phase was the *Preliminary Alternatives Report (PAR), San Luis Unit Drainage Feature Re-evaluation*, which was published in December 2001 (Reclamation 2001b). The alternatives described in the PAR meet the court order and use proven technology.
- The second phase of the Re-evaluation was the preparation of the *Plan Formulation Report (PFR), San Luis Drainage Feature Re-evaluation*, which included the determination of the lands that require drainage service; the anticipated quantity and quality of drainwater for which Reclamation will need to provide service; the formulation, evaluation, and screening of the preliminary alternatives; the description of the final set of alternative plans; and the selection of the proposed action. The PFR was published in December 2002 (Reclamation 2002).
- The third phase of the Re-evaluation will refine the components of the proposed action, provide additional engineering detail, and complete the environmental review of the proposed action and alternatives. The product of this phase is an EIS and a Record of Decision.

The 2002 PFR identified the In-Valley Disposal Alternative as the preferred alternative to provide drainage service. The In-Valley Disposal Alternative was compared to No Action and the three Out-of-Valley Alternatives and was selected in 2002 based on cost, implementation, and other environmental information available in 2002.

Land retirement was considered in the 2002 PFR but was excluded as a primary drainage reduction component of the Federal drainage service alternatives under consideration at that time because it did not meet the project purpose of "providing drainage service." Land retirement is a measure that removes land from irrigated agricultural production, reducing the need for drainage service on remaining lands. However, as a result of public and stakeholder input, Reclamation determined that it would broaden the scope of analysis to include large-scale land retirement as a component of some of the action alternatives.

On February 5, 2004, Reclamation submitted to the Court an *Amended Plan of Action for Drainage to the San Luis Unit*. The Amended Plan of Action states that Reclamation will continue to refine and evaluate all five alternatives described in the PFR for inclusion in the EIS. Additionally, Reclamation will formulate alternative(s) that use land retirement as a method to control drainage need, by comparing costs, benefits, and impacts for alternatives with different amounts of land retirement.

1.3 DRAINAGE SERVICE NEED

Drainage service is needed to achieve a long-term, sustainable salt and water balance in the root zone of irrigated lands in the San Luis Unit and adjacent areas. The Federal action to supply drainage services is required by Public Law 86-488 and the February 2000 Court Order.

To adequately design the facilities required for providing drainage service, Reclamation developed an estimate of the quantity and quality of the drainwater requiring disposal. Reclamation evaluated three factors affecting drainage quantity and quality:

- Which lands will ultimately need drainage to maintain arability of the soil
- The subsurface water that will need to be drained off the fields to maintain arability of the soil
- What reasonable on-farm and in-district drainwater reduction actions could be implemented to reduce the rate at which shallow groundwater would reach the root zone

1.3.1 Areas Needing Drainage

The drainage study area is located in the western San Joaquin Valley and consists primarily of the lands lying within the boundary of the CVP's San Luis Unit, as shown on Figure 1-2. The Unit, as defined by the authorized service area, encompasses the entire Westlands, Broadview, Panoche, and Pacheco Water Districts and the southern portion of the San Luis Water District. Lands immediately adjacent to the Unit, in the Grassland Drainage Area (GDA), have also been included.

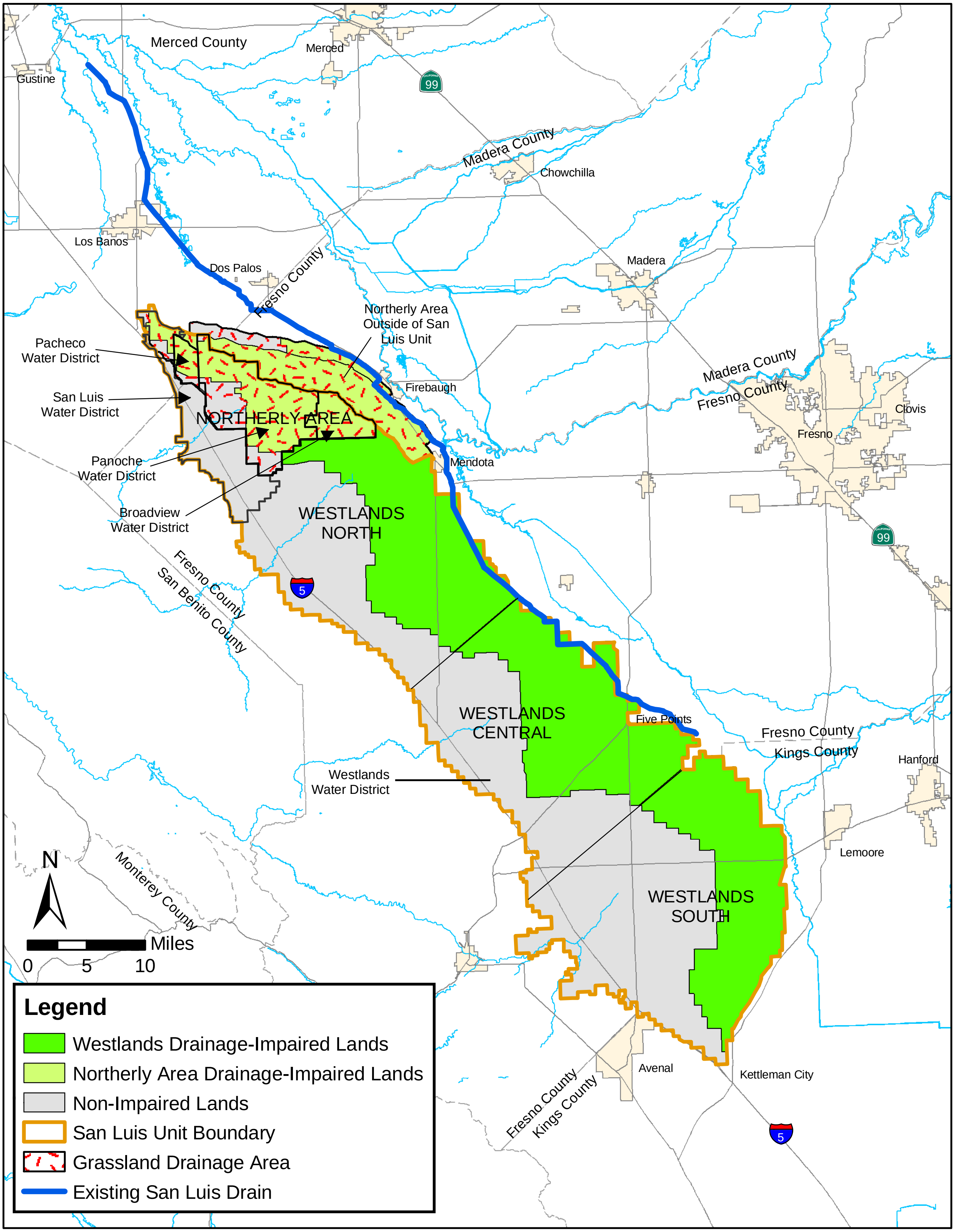
For this EIS, the drainage study area has been subdivided into the Westlands Water District and the Northerly Area. Similar to the approach taken in the PFR (Reclamation 2002), the lands within Westlands have been broken down into three subareas (north, central, and south). These subareas have significantly different water quality characteristics that may allow for better planning for treatment and/or disposal of drainwater. The Northerly Area includes all of the GDA. A tabulation of the area included within the drainage study area is shown in Table 1-1 and on Figure 1-2.

The entire drainage study area (including the lands to the north and outside of the Unit) totals approximately 730,000 acres. Of these 730,000 acres, approximately 379,000 acres would be drainage-impaired and constitute the drainage service area for the 50-year planning horizon. The areas needing drainage service were estimated from previous projections and information collected as part of the PFR. Table 1-2 summarizes the areas needing drainage service for both the Northerly Area and Westlands, resulting in a total drainage service area of 379,000 acres for the entire study area.

Table 1-1
Drainage Study Area

District	Area (acres)
Westlands Water District	604,000
Northern San Luis Unit Districts	85,600
Northerly Area Outside of San Luis Unit	40,400
Total	**730,000**

Note: All areas are based on acreage reported by the water districts except the San Luis Water District, which was calculated using Arc GIS.



San Luis Drainage Feature Re-evaluation	Drainage Study Area	Figure 1-2
17324004		

Table 1-2
Area Needing Drainage Service

District	Area (acres)
Westlands North	102,000
Westlands Central	104,000
Westlands South	92,000
Subtotal (Westlands Water District)[1]	298,000
Northern San Luis Unit Districts	45,000
Northerly Area Outside of San Luis Unit	36,000
Subtotal (Northerly Area)	81,000
Total	**379,000**

[1]The areas needing drainage service were revised for the PFR Addendum based on land retirement actions that occurred since the publication of the PFR in December 2002, but they are not revised for this EIS because the baseline for existing conditions is 2001. The retired lands (44,106 acres) are included as part of the action alternatives (Section 2.3.3).

The alternative disposal designs are based on the drainage flow generated by those areas with drainage systems installed within the drainage-impaired lands. It is reasonable to expect that not all of the land owners within the drainage service area would install on-farm drainage systems. Some farmers would elect not to install drains based on localized conditions and economic considerations. Therefore, Reclamation estimates that only two-thirds of the area in the drainage service area would actually have subsurface drainage systems installed (254,000 acres). Analysis of the drainwater flows and water table elevations indicates that arability of the entire 379,000-acre drainage service area is maintained with this condition (URS 2002).

1.3.2 Drainwater Quantity and Quality

Under the No Action and Action Alternatives, drainage production assumes that existing CVP and local surface- and groundwater supplies would continue to be available according to existing contracts, supply constraints, Reclamation policy, and groundwater pumping practices. In addition to the CVP supplies, some of the districts would use additional local surface- and groundwater sources of supply.

Appendix C of this EIS details the modeling assumptions and results to determine the quantity and quality of drainwater for the Out-of-Valley and In-Valley Disposal Alternatives.

Based on modeling of the groundwater conditions and agricultural productivity, Reclamation identified the lands that would require drainage service, the rate at which farmers would install tile drains to collect drainwater, and the rate that water would need to be drained from the fields to maintain arability.

Reclamation then evaluated the potential drainwater reduction actions that could be implemented on-farm, in-district, or with regional facilities. Reclamation determined that regional drainwater reuse facilities would be a cost-effective measure for reducing the volume of drainwater for treatment and disposal and should be included in all alternatives. Reuse facilities irrigate salt-tolerant crops with unblended drainwater.

To determine the quantity and quality of drainwater the collection and reuse systems would receive from farms and water districts (and therefore the size of the facilities), Reclamation identified additional drainwater reduction actions that would be more cost-effective than drainwater collection, reuse, treatment, and disposal. That is, Reclamation identified the drainwater reduction measures where the cost of reducing an acre-foot of drainwater would be less than the cost of collecting, reusing, treating, managing, and disposing that acre-foot of drainwater. To size the drainwater collection, reuse, treatment, and disposal facilities, Reclamation assumed that farmers and/or water districts would implement those actions that would be cost-effective. Farmers and water districts would have flexibility to select other measures to reduce drainwater.

Reclamation found four drainwater reduction measures to be cost-effective: drainwater recycling, shallow groundwater management, seepage reduction, and irrigation system improvements.

- **Drainwater Recycling.** Blending of drainwater, either at the farm or district level, with freshwater supplies up to a salinity level that is still acceptable for use on commercial crops.
- **Shallow Groundwater Management.** Managing groundwater levels in tile drainage systems to partially utilize the shallow groundwater to meet crop needs.
- **Seepage Reduction.** Lining or piping of existing unlined irrigation conveyance and distribution facilities to reduce seepage losses into the groundwater. This option tends to reduce recharge to the shallow aquifer, thereby reducing the quantity and/or postponing the need for artificial drainage.
- **Irrigation System Improvements.** These on-farm improvements reduce deep percolation of irrigation water to shallow ground water. Improvements for nondrainage-impaired land in Westlands and land in the Northerly Area were found to be cost effective. Examples of irrigation system improvements include drip irrigation, hand-move or linear-move sprinklers, and shorter furrow lengths.

In addition, Reclamation determined that the storage capacity of the groundwater aquifer beneath the reuse facilities could be used to regulate the seasonal variations in drainwater flows.

Based on this analysis, Reclamation developed drainage quantities and flow rates in the PFR (Reclamation 2002) and revised them in the PFR Addendum (Reclamation 2004b). The total area needing drainage service is reduced by land retirement programs and actions. Land retirement is defined as the removal of lands from irrigated agricultural production by purchase or lease for other purposes or land uses. Land retirement assumptions for No Action, the original four action alternatives (In-Valley, Ocean, Delta-Chipps Island, and Delta-Carquinez Strait Disposal), and three additional In-Valley/Land Retirement Alternatives are described in Section 2.2.1.2.

The estimates of land retirement acreage for all of the alternatives range from 44,106 to 308,000 acres for the seven action alternatives and up to 109,106 acres for the No Action Alternative.

Table 1-3 shows the estimated drainwater quantity for the various alternatives based on appraisal-level designs. The maximum estimated flow of drainwater produced is about 97,000 acre-feet (AF)/year. Different alternatives contain features that reduce this amount. Final drainwater flows for treatment and disposal range from 8,100 AF/year to 21,000 AF/year, depending on the amount of land retirement in the alternative.

Table 1-3
Drainwater Reduction

	In-Valley Disposal Alternative	Land Retirement Alternatives*			Out-of-Valley (Ocean and Delta) Alternatives
		In-Valley/ Groundwater Quality	In-Valley/ Water Needs	In-Valley Drainage-Impaired Area	
Drainage Flow without Reduction (AF/year)	97,000	85,000	63,000	36,000	97,000
Drainage Flow with Drainwater Reduction Activities (drainwater recycling, shallow groundwater management, and seepage reduction) (AF/year)	70,000	61,000	45,000	27,000	70,000
Drainage Flow with Drainwater Reduction and Regional Reuse Facilities (AF/year)	21,000	18,500	14,000	8,100	21,000
Average Design Flow with Drainwater Reduction and Regional Reuse Facilities (cfs)	29	26	19	11	29

cfs = cubic feet per second
*Alternatives are described in Section 2.3.3.

1.4 RELATED PROJECTS AND ACTIVITIES

Related projects are those that would directly affect drainwater quality and quantity or are programs attempting to address drainage needs. Those identified here are the Grassland Bypass Project: the San Joaquin Valley Drainage Implementation Project (SJVDIP), including ongoing studies and pilot projects by Reclamation, DWR, and others; the San Luis Unit long-term water service contract renewal; two land retirement programs; and the Westside Regional Drainage Plan. See Section 4, the affected environment and/or cumulative effects sections of the resource analyses, and Appendix L for relevant regulatory environment and compliance requirements.

1.4.1 Grassland Bypass Project

The Grassland Area Farmers established the Grassland Drainage Area and a regional drainage entity to collect subsurface drainwater from 97,400 acres and use a portion of Reclamation's San Luis Drain to convey the water to its current terminus at Mud Slough, through September 2009. Constructed and funded portions of the project are included in the No Action Alternative for this Re-evaluation. Future components of the Grassland Bypass Project have been incorporated into the action alternatives evaluated in this EIS, specifically expanded reuse, treatment, and disposal components.

1.4.2 San Joaquin Valley Drainage Program and Ongoing Studies

The SJVDP produced its Rainbow Report in September 1990. Since then, several of the recommendations for action have been implemented but not on a scale large enough to address the drainage management and disposal needs in the San Luis Unit. Recommendations in the plan are consistent with features included in the In-Valley Disposal Alternative.

Reclamation, DWR, and other SJVDIP agencies are pursuing new technologies through pilot projects, involving selenium treatment, enhanced solar evaporation, and marketing of salts. See Appendix B, Pilot Studies, for an update on investigations underway by Reclamation specifically for the SLDFR. The action alternatives herein reflect the latest proven technologies for drainage management on a large scale, and these alternatives can be modified prior to construction should other methods prove feasible. Any modifications would be evaluated for appropriate National Environmental Policy Act (NEPA) compliance.

1.4.3 San Luis Unit Long-Term Contract Renewal

Reclamation's proposed renewal of long-term water service contracts for the CVP San Luis Unit Contractors, which include the Cities of Avenal, Coalinga, and Huron; Pacheco, Panoche, San Luis, and Westlands Water Districts; and the California Department of Fish and Game, is currently under environmental review with issuance of a Draft EIS in November 2004 (Reclamation 2004c). The proposed contracts are for the delivery of up to 1,399,048 AF of CVP water per year. Reclamation proposes to renew municipal and industrial water service contracts for a period of 40 years and agricultural only or agriculture and municipal and industrial water service contracts for a period of 25 years. The purpose of this Federal action is to renew the Unit long-term water service contracts consistent with Reclamation authority and all applicable state and federal laws, including the Central Valley Project Improvement Act (CVPIA). Project alternatives evaluated in the Draft EIS include the terms and conditions of the long-term contracts and tiered water pricing (Reclamation 2004c).

The Draft EIS discusses each contractor's individual CVP allocation and the status of existing interim and long-term contracts (Chapter 3). South-of-Delta CVP agricultural deliveries have been significantly changed by implementation of three Federal statutes (the Endangered Species Act, the CVPIA, and the Clean Water Act). Water used by these contractors has been rededicated to other purposes, and reliability of water supplies has approached 50-55 percent on average. Renewal of the Unit's long-term contracts is being carried out in parallel with the implementation of the CVPIA (Reclamation 2004c).

1.4.4 Land Retirement Programs

The objective of Reclamation's CVPIA Land Retirement Program is to reduce the volume of subsurface drainwater through a voluntary program of purchases of land, water, and other property interests from willing sellers who receive CVP water allocations. Land retirement eliminates the application of irrigation water, which reduces the amount of subsurface drainage resulting on the affected property. See Section 2.2.1.2 for additional discussion of acreages planned for retirement.

In addition, Westlands is engaged in land retirement due to litigation and water supply constraints. Drainage-impacted land is being retired on a voluntary basis under three settlement agreements discussed in Section 2.2.1.2. Acreage includes both temporary and permanent retirement. Approximately 100,000 acres may be purchased from individual landowners, and irrigated agriculture would cease. The affected lands would be put to other beneficial uses such as wildlife habitat, dryland farming, or related economic development activities (SJRECWA et al. 2003).

1.4.5 Westside Regional Drainage Plan

The Westside Regional Drainage Plan, to provide drainage relief in portions of the San Luis Unit, represents a collaborative effort among the following stakeholders: San Joaquin River Exchange Contractors Water Authority, Panoche Water District, Westlands Water District, and Broadview Water District. Key elements of the Plan include adaptive management to perfect the final drainage management strategy, land retirement of up to 200,000 acres, groundwater management, source control, regional reuse, treatment, and salt disposal. The Plan calls for identification of sound and effective projects to manage drainage and an accelerated implementation schedule to comply with impending regulatory constraints. The Plan establishes a phased approach to establishing drainage service, including a list of specific actions to occur under Phase I from 2003 to 2009 (SJRECWA et al. 2003).

1.5 DECISIONS TO BE MADE

Reclamation will identify the Preferred Alternative in the Final EIS but will decide in the Record of Decision (ROD) which alternative to implement. No decision will be made until the environmental review process is complete. Specific environmental commitments may be made in the ROD to mitigate identified environmental effects. Following completion of the Final EIS, the ROD will state the action to be implemented and discuss factors leading to the decision.

SECTIONTWO
ALTERNATIVES

Section 2 describes the project area and the components of the No Action and seven action alternatives, including a summary of the cost estimates and assumptions made to develop the costs. It includes a discussion of other alternatives considered but eliminated from further analysis in this EIS. Section 2 concludes with a comparison of the alternatives' environmental effects and a discussion of Reclamation's preferred alternative and the environmentally preferred alternative.

2.1 PROJECT AREA

The geographic scope of the analysis (project area) consists of the drainage study area and other areas affected by disposal alternative features such as conveyance, treatment facilities, and discharge locations. The project area extends beyond the San Joaquin Valley west to the Pacific Ocean as far south as Point Estero and northwest to the Delta in northern and central California. The project area is shown on Figure 2.1-1. Features of the action alternatives are located in nine counties: Fresno, Kings, Merced, Alameda, Contra Costa, San Joaquin, Stanislaus, Kern, and San Luis Obispo.

2.2 NO ACTION ALTERNATIVE

The No Action Alternative defines conditions in the project area through the 50-year planning time frame if drainage service is not provided to the San Luis Unit and related areas (as described in Section 1.3). It represents existing conditions for drainage management in 2001[1] with individual farmers and districts making limited changes in management in the absence of Federal drainage service. These changes would be "the future without the project." No Action

[1] This year is consistent with the publication of the Notice of Intent to prepare an EIS.

includes only regional treatment, conveyance, and disposal facilities that existed in 2001 or are authorized, funded projects.

2.2.1 Description

Under No Action, without Federal drainage service, farmers and districts would not be able to discharge drainwater to receiving waters (sloughs, rivers, bays, or ocean) from drainage-impaired lands except where such discharges are currently permitted (e.g., the Grassland Bypass Project). This restriction means that 379,000 acres projected to need drainage service (see Table 1-2) would not have that service available, and farmers would pursue individual actions related to (1) drainage control and reuse and (2) cropping practices. Water districts and landowners would continue to address drainage problems within institutional, regulatory, and financial constraints currently in effect and reasonably foreseeable.

Key characteristics and assumptions for the No Action Alternative are the following drainage and land management activities.

2.2.1.1 Drainage Production

Drainage-impaired lands are estimated at 379,000 acres, including 298,000 acres in Westlands and 81,000 acres in the Northerly Area. However, much of this acreage would not be producing drainage in the absence of drainage service. Only the Grassland Drainage Area (GDA) would produce drainage for disposal through 2009 (with the Grassland Bypass Project). Under the current Use Agreement, expiring December 31, 2009, the Grassland Area Farmers must meet their selenium (Se) load requirements within 20 percent of the target or pay a fine. If the target is exceeded by more than 20 percent, the Use Agreement can be terminated and allow no further discharges.

The following components of the GDA's proposed In-Valley Treatment/Drainage Reuse Facility would occur with or without drainage service from Reclamation and are included under No Action.

- Four-thousand acres of land are proposed for planting with salt-tolerant crops. Twenty-two hundred acres have already been planted, and another 500 acres are in the process of being planted. Subsurface drainage systems have been installed on a total of 900 planted acres (an additional 300 acres have subsurface drainage but are not planted).
- Without additional funding, the remainder of the 4,000 acres could not be planted, and no additional subsurface drainage systems would be installed.
- In its current condition, the reuse facility can reduce drainage discharge needs by 7,200 AF (8,100 AF applied, 900 AF discharged).

Under the No Action Alternative, the GDA would be prevented from discharging drainwater after 2009.

San Luis Drainage Feature Re-evaluation	Project Area	Figure 2.1-1
17324004		

The remaining components of the GDA's In-Valley Treatment/Drainage Reuse Facility are not included under No Action because of the uncertainties associated with their design, operation, and funding. These remaining components include additional land acquisition (2,000 acres), additional subsurface drainage systems (for 4,800 acres), and the treatment facility/disposal units. Designs may not be completed until 2006, and the facility is planned to be operational by 2009 if funding can be obtained.[2]

No other treatment facilities beyond small-scale pilot projects and existing reuse facilities (e.g., Integrated Farm Drainage Management projects such as Red Rock Ranch) are assumed to be operational in the drainage study area under No Action.

2.2.1.2 Lands Not in Agricultural Production

Land Retirement

Land retirement is defined as the removal of lands from irrigated agricultural production by purchase or lease for other purposes or land uses. Under No Action, Reclamation assumes 109,106 acres would be retired based on the following:

1. CVPIA Land Retirement – Up to 7,000 acres of lands are included to be retired within the study area under the existing CVPIA land retirement program (2,091 acres retired to date).
2. Westlands Settlement Agreement (*Sagouspe v. Westlands Water District*) – A settlement agreement among various classes of water users within Westlands calls for temporary retirement of land. An estimated 65,000 acres of land would be retired under this settlement agreement. Because the agreement would allow these lands to come back into production if and when Reclamation provides drainage service, Reclamation assumed these lands would be retired under the No Action Alternative (i.e., potentially all or in part under the In-Valley/Land Retirement Alternatives but not under the four Disposal Alternatives).[3]
3. Britz Settlement (*Sumner Peck Ranch, Inc., et al. v. Bureau of Reclamation, et al.*) – An additional 3,006 acres in Westlands are being retired permanently under a settlement agreement dated September 3, 2002, between the United States, Westlands, and the Britz group of plaintiffs in the Sumner Peck lawsuit.
4. An additional 34,100 acres from the Sumner Peck Ranch et al. settlement of December 2002 would be retired.

In summary, 44,106 acres of permanently retired lands would be increased by 65,000 acres if drainage service is not provided to Westlands, for a total of 109,106 acres.

---

[2] It is assumed that the Grassland Area Farmers would participate in the SLDFR proposed action, consistent with their *Long-Term Drainage Management Plan for the Grassland Drainage Area* (Grassland Area Farmers and Delta-Mendota Water Authority 1998), as long as they can meet their Waste Discharge Requirements (WDRs) in 2009. Therefore, the not-yet-funded parts of the GDA facilities are included as a component in the In-Valley Disposal Alternative (Section 2.4).

[3] These lands could use groundwater (subject to safe yield limitations) or other purchased water to irrigate crops. They would not receive water from Westlands. In 2003, approximately 25 percent of the land was irrigated.

Land Fallowing

On an annual basis, 5 to 10 percent of the total cultivated acreage is often fallowed for soil fertility, normal crop rotation, and economic purposes, and this practice would continue under No Action. This fallowing acreage is in addition to the land retirement described above.

2.2.1.3 On-Farm, In-District Activities

The following management activities by individual farmers and/or districts for drainage-impaired land are assumed to occur under No Action:

- **On-farm/in-district use of existing drainage control/reuse measures** would continue, including 30,000 acres with drainage systems installed in the San Luis Unit (30,000 acres in the Northerly Area) and an additional 18,000 acres outside of the Unit. Existing drains (including plugged drains) in Westlands on 5,000 acres would not be operational due to lack of drainage service. In summary, a total of 48,000 acres would continue to be drained in the GDA and none in Westlands; no additional drains would be installed.
- **Some on-farm irrigation system improvements** would occur within Westlands to continue to manage perched water and crop practices in the absence of drainage service. Efforts to develop tilewater treatment and disposal technologies would continue. However, it is assumed that no new on-farm tile systems, collection facilities, or land disposal actions would be implemented. Limited use of existing facilities for on-farm drainwater recycling would occur.
- **Irrigation practices** remain similar to current efficiency levels. As the drainage problem expands and farmers adjust irrigation practices to high water table conditions, water use efficiency in these areas may increase but not substantially over existing conditions which are already highly efficient. Overall, irrigation practices would be expected to respond to economic conditions and would be consistent with efficiency assumptions in the *California Water Plan* (DWR 1993). (See Section 12 of this EIS for a discussion of these economic conditions and anticipated changes in agricultural practices.)
- **Any water that fallowing frees up in drainage-impaired areas would be reallocated to unaffected areas**. Water conserved because of improved irrigation efficiency, changes in cropping pattern, increased contribution to evapotranspiration (ET) from groundwater, or possible reductions in irrigated acreage would be available within the respective district to meet internal needs. The reallocated water would likely result in less groundwater pumping, as the quantity applied per acre would not increase beyond crop requirements.
- **Other drainwater reduction measures** are anticipated to be used at current or increased levels under No Action with no drainage service and include seepage reduction, drainwater recycling, shallow groundwater pumping, and shallow groundwater management. These measures are defined in Section C1.1.4 of Appendix C.

2.3 COMMON ELEMENTS TO ALL ACTION ALTERNATIVES

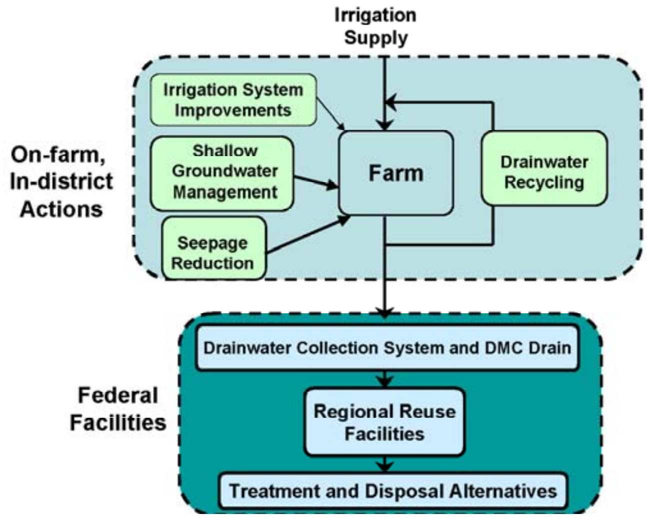


Figure 2.3-1 Common Elements to All Disposal Alternatives

The quantity of drainwater requiring treatment and/or disposal can be reduced by implementing drainwater reduction measures. Several factors were considered in estimating the design drainwater quantity and quality for each disposal alternative. A cost-effectiveness analysis yielded the reasonable drainwater reduction measures that could be implemented within the drainage area and that are common to all disposal alternatives. These drainwater reduction activities are shown on Figure 2.3-1 and are briefly described below. A more detailed description of each of these actions, including the cost-effectiveness analysis, is included in Appendix C, Section C1.1.4.

The quantity of drainwater after drainage reduction measures is estimated conservatively (i.e., higher) for this EIS to ensure that effects on the physical environment are not understated. As the SLDFR Feasibility Study progresses, the volume of drainwater requiring treatment and disposal is expected to be reduced further. As drainwater volumes are reduced, the treatment and disposal facilities can be scaled back in size from the estimates provided herein.

2.3.1 On-Farm, In-District Activities

The on-farm, in-district drainwater reduction activities (such as those described under the No Action Alternative) are not components of the drainage service alternatives that Reclamation would implement. Rather, they represent the assumptions Reclamation has made regarding the conditions of the area to be served and the reasonable actions that districts could implement in the future once drainage service is provided. Although drainwater reduction measures other than the ones selected could be implemented, they were either not cost effective compared to the disposal facilities, or it was assumed that they would not be implemented due to the uncertainty of the measure's effectiveness. Farmers would also install subsurface tile drains on drainage-impaired lands. In addition, irrigation system improvements for Westlands nondrainage-impaired land and lands in the Northerly Area were found to be cost-effective (see PFR Addendum, Section 3.3.10.3).

2.3.2 Federal Facilities

The following facilities are included in all of the Federal action alternatives. However, the area included or the volume of drainwater managed varies with each alternative. The facilities would be designed to comply with all applicable Federal and State regulations.

2.3.2.1 Collection System

Reclamation would construct a **closed collection system** to collect and convey drainwater from on-farm subsurface tile drains to the 16 **regional reuse facilities**—within each of four drainage service areas (Northerly Area, Westlands North, Westlands Central, and Westlands South).

A closed collection system includes drain sumps and pipelines. Drain sumps would be placed at the lowest corner of the quarter sections of land or at some other low point on the quarter section lines. Farmers would pump drainwater from their drains into the sumps, and pipelines would convey drainwater from the sumps to the reuse areas. The drainwater in the sumps would be at or below the ground surface, except at a few sumps where the level is no higher than 5 feet above the ground surface. Drainwater in the pipelines would flow to the reuse facilities by gravity to the fullest extent possible. Where the farmland requiring drainage is below the reuse areas, pumps would be used to convey the water to the reuse areas in pressurized pipelines. The minimum pipeline depth would be 3 feet underground, and the pipe materials would be high-density polyethylene (HDPE) as much as practical.

2.3.2.2 Firebaugh Sumps

Shallow high-Se groundwater enters the unlined Delta-Mendota Canal through nearby underground drains and six sumps near Firebaugh. This high-Se groundwater is diluted somewhat by the canal water and is used for irrigation downstream, posing a risk of adverse environmental effects.

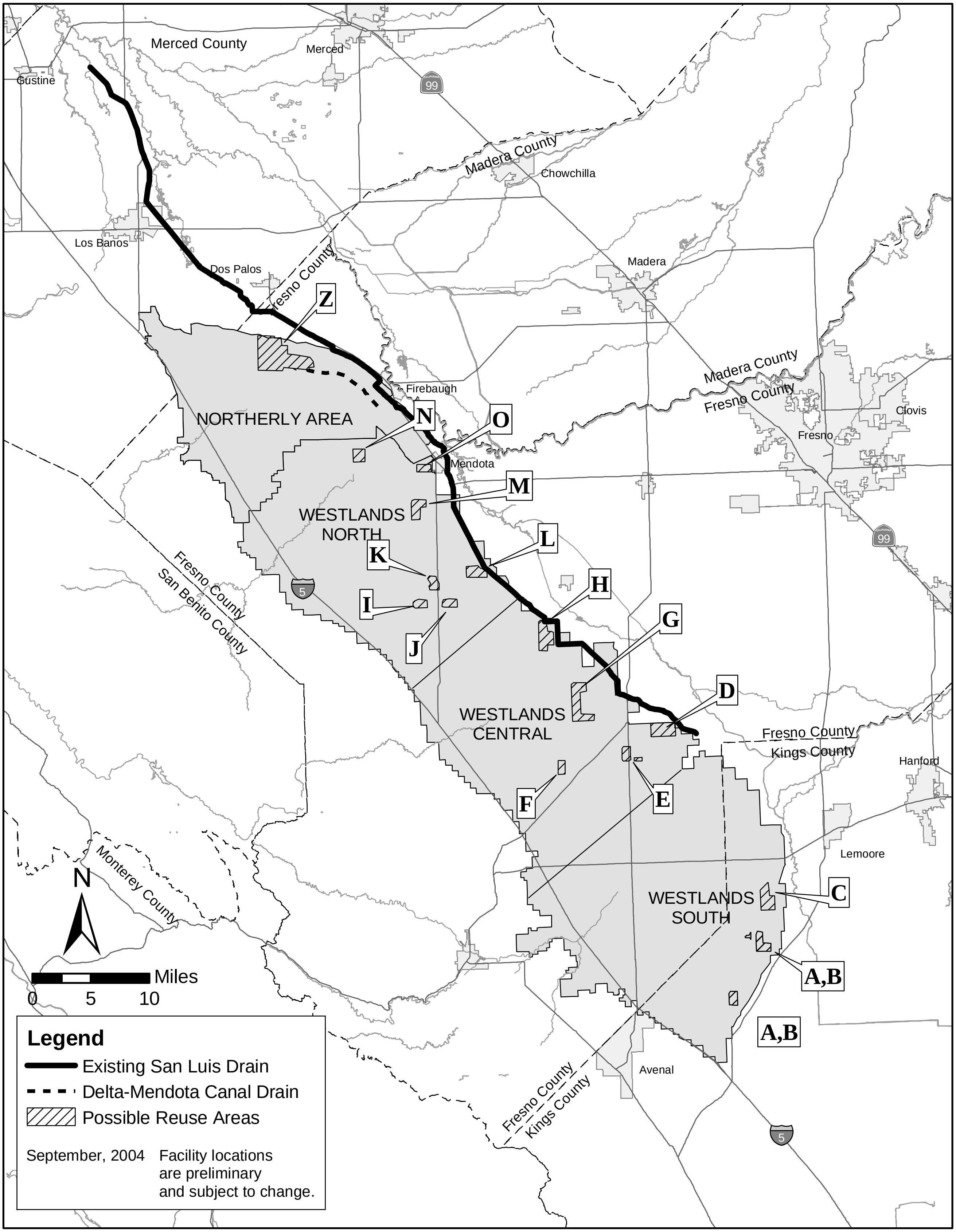
The proposed separate Delta-Mendota Canal Drain is designed to intercept this groundwater at the existing Firebaugh sumps and convey it to the Northerly Reuse Area for reuse, treatment, and disposal (approximately 1,100 AF/year). The drain consists of two pipelines. The upstream pipeline would convey drainwater 300 feet from Sump A, over the canal, and into the adjoining reuse area. The other 39,700-foot-long buried pipeline would collect drainwater from the other five sumps and convey it along the southwestern side of the canal to the southeastern corner of the reuse area, immediately after crossing the canal.

This drain collects more than shallow groundwater; it also collects precipitation that percolates through the ground to the underlying drains. The additional infiltration affects the quantity of drainwater flows. The pipeline capacity allows the infiltrating water to remain in the ground for no more than 2 months before discharging to the reuse area.

Figure 2.3-2 shows the four drainage service areas, the proposed Firebaugh Sumps/Delta-Mendota Canal Drain, and the potential reuse areas.

2.3.2.3 Reuse Facilities

The drainwater would irrigate salt-tolerant crops on lands near or surrounding up to 16 **regional reuse facilities**. At the reuse facilities, subsurface tile drains would be installed to collect the reused drainwater. Each reuse facility would also be an underground regulating reservoir to control the flow of reused drainwater to downstream features. The reused drainwater would be conveyed via pipeline or canal to treatment and/or disposal facilities. In the early years of operation, the water quality of the reused drainwater would be the same as the water quality of the perched aquifer beneath the reuse facility. The water quality of the water table under the



San Luis Drainage Feature Re-evaluation	Potential Areas for Reuse Facilities	Figure 2.3-2
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_3-2_Potential_Areas_for_Reuse_Facilities.mxd Date: 8/26/2004 3:52:11 PM Name: dhwrigh0 reuse areas is expected to gradually decline during long-term use, as do all aquifers underlying irrigated farmlands.

Drainage quantity and lands required for reuse vary with each alternative. Between 7,500 and 19,000 acres would be needed to accommodate the expected drainage volume of 26,830 to 69,645 AF/year. The final selection and sizing of reuse sites would be refined based upon the service area providing drainwater to each reuse site, field verification and investigation, and review by affected parties.

Reuse Area Operation Description

The reuse areas would consist of lands that have been or are currently irrigated, and have been judged suitable for irrigation with water having a total dissolved solids (TDS) concentration of 10,000 milligrams per liter (mg/L) or less. The initial screening criteria for reuse areas included an emphasis on using existing retired lands and locating reuse areas to minimize collection system costs. Lands that met the initial screening criteria were then evaluated in the field by professional soil scientists and drainage engineers. Common soil characteristics include fine or very fine textured surface soils and active root zones usually underlain by fine, fine loamy, and fine silty substrata. Coarser substrata textures occur deep in some profiles. Soil salinity is currently at moderate to rather high levels, and soil salinity levels at most reuse areas would rise somewhat following irrigation with reuse waters. The soils contain a small amount of residual lime and gypsum, especially in subsurface layers. Other characteristics are described in the following paragraphs.

Crops. Reuse area crops would consist mostly of salt-tolerant perennial pasture grasses, including Bermuda grass, Jose tall wheatgrass, Rio wildrye, and alkali sacaton. Legumes, such as salt-tolerant alfalfa and narrowleaf birdsfoot trefoil, may be used in the pasture mixes in some of the less saline reuse areas. Smaller acreages of annual crops would include barley, canola, and other salt-tolerant grains or forage mixes. Tree varieties recommended by the local resource conservation district would also be used in appropriate areas.

Salt-tolerant grasses and grains would be harvested for hay, silage, and/or greenchopped for local livestock producers. The value of the hay and other products is expected to be significantly less than alfalfa products because the total digestible nutrient levels of these grasses are lower. Sheep grazing would also be used to harvest the grasses. Limited acreages of canola may be harvested.

Water Use. The reuse area cropping patterns should consume about 3.4 AF of water per acre. When effective rainfall and a 27 percent leaching fraction are considered, a 4 AF/acre annual water application would be required to maintain the grasses. About 1.1 AF/acre of water would pass through the root zone as deep percolation and be collected in the subsurface drains. Wells would be available to pump groundwater to supplement reuse water during high ET periods and for blending with high TDS or boron waters. In some cases, low salinity project surface water supplies may be used to establish young grasses or trees.

Infrastructure Improvements. In addition to the subsurface drainage system (described below), on-farm infrastructure improvements would include installation and/or enhancement of delivery pipelines and distribution pipe risers. The maximum irrigation run on gravity irrigated fields would be about 1,280 feet, with some fields having runs of about 640 feet. Irrigation systems at all fields would be capable of connecting to portable (hand-move) impact sprinkler systems. Pipeline capacities would match furrow length, field slope, and soil infiltration rates. For maximum flexibility every irrigation system would have access to project water, wellwater, tailwater, and reuse water.

Irrigation Management. Climate- and soil-based irrigation scheduling would be continual. Irrigation events would be monitored on site at all times. During the peak irrigation season, fields may be irrigated as often as every 2 weeks. One goal of the irrigation management program would be to eliminate standing tailwater. An underground tailwater collection, conveyance, and redistribution system would be installed as needed on each reuse area. Any tailwater collected from higher fields would be conveyed and used on lower fields. Tailwater from the lowest fields would be pumped back to higher fields.

The reuse areas could also selectively bypass drainwater inflows or mix the inflows with water from higher quality sources. Water exceeding a TDS of 10,000 mg/L or boron content of more than 20 mg/L would either be blended with groundwater or surface water, or could be bypassed to the low end of the reuse area where a field with highly salt-tolerant vegetation would be available to use the discharge. If pipeline capacity is available, this water would be sent directly to the water treatment plants.

Drainage System. One key component of the reuse area would be the subsurface drainage system. No drainwater would be applied to reuse area fields until the required drains have been installed. The drainage system would consist of buried drain pipes at prescribed depths and spacing. The depths and spacing would vary from one reuse area to the next based upon the hydraulic characteristics of the subsoil. The drains would be sized to handle the peak flow generated by the irrigation of the salt-tolerant crops. The drainage system would be spaced to keep the water table at 4 feet, or more, below the ground surface all year.

Drainwater in the spaced drains would flow into a buried collector drain that would carry the drainwater to a small pumping plant where the water would be pumped to the water treatment facility. The entire drainage system would be underground with access for monitoring, cleaning, and sampling through concrete manholes at pipeline junctions. Some use of Drain or Sub-Irrigation Riser (DOS-IR) valves would be incorporated as flow controls when groundwater storage is required to distribute the water table more evenly under the fields. The water table would be used as a storage reservoir to allow the drain discharge to be regulated to near the average annual flow from each reuse area. The near steady drain discharge is desired for the water treatment plant design and operation.

The drainage systems would be installed as a part of the development of each reuse area. As installation progresses, more extensive subsoil investigations would be needed to determine adequate drainage system layouts and designs. Shallow observation wells would be used to provide water table depth information for proper storage/discharge operations of the drains.

The basis for selecting these 16 potential reuse areas is explained by area below.[4]

Northerly Reuse Area

The farmers in the GDA, as part of the Grassland Bypass Project, have proposed to extend their existing drainwater reuse site. The existing 4,000-acre reuse site is part of the No Action

[4] The reuse sites are mapped with site names on Figure 4-1 in the PFR Addendum (Reclamation 2004b) and shown without site names on figures for each action alternative.

Alternative. The land adjacent to the existing site would be a desirable location for expansion and would require only limited additional investigation for soils suitability. The proposed expansion area is as much as 4,300 acres in size. Total area needed for drainwater reuse is 8,200 acres to serve 81,000 acres of commercial farmland, of which 54,000 acres would have tile drains.

Westlands North Service Area

Seven potential reuse areas encompassing about 3,000 acres have been selected in the northern part of Westlands to accommodate the reuse acreage needed to control the drainwater from 67,800 acres. Several criteria were used for these site selections. Each site is located to take advantage of gravity flows to convey drainwater to the reuse area, without using unduly large pipe sizes. Each site location attempts to make use of some existing retired land. Soil types, both from the Natural Resources Conservation Service (NRCS) and Reclamation Land Class were important criteria, primarily to avoid heavy clay contents and the low hydraulic conductivity boundary, as shown in the *Drainage Appendix* (Reclamation 1962). Field hydraulic conductivity tests were completed during Summer 2004 to provide data for the subsurface drainage estimates for all reuse areas. All sites have been sized to include source control reductions. Using these criteria, the areas were selected based on a gravity flow location, suitable soil type, and using retired lands as much as possible.

The seven Westlands North potential reuse sites are summarized as follows:

Reuse Site Name	Reuse Site Size, acres estimated	Area Served, acres estimated
I	231	5,070
J	315	6,920
K	303	6,660
L	522	11,460
M	882	20,730
N	463	10,880
O	277	6,080
Totals	**2,994**	**67,800**

NOTE: The reuse site size and area served are subject to revisions during the SLDFR Feasibility Study.

Panoche–Silver Creek Detention Basin and the drainage treatment and reuse locations that are under consideration by Westlands were considered in the sites identified above (Betner, 2000, pers. comm.). Potential expansion or relocation of some reuse sites could later be made, depending upon the land sale in Broadview Water District. For this reason, the location adjacent to Broadview Water District was factored into the selection process. With recent land purchases and settlements, other large areas of retired lands could be equally suitable for future reuse sites.

The reuse site sizing could be somewhat flexible by using the existing San Luis Drain to transport drainwater to the Westlands North service area and developing all drainwater reuse on these lands. Using the Drain would require considerable rehabilitation of the Drain’s lining; however, cost of purchasing “new” reuse site lands could also be significant.

Westlands Central Service Area

Five areas, encompassing 5,138 acres, in Westlands Central service area have been selected to control drainwater from 120,462 acres, following similar criteria used for Westlands North. Existing retired lands are limited in this area, so some additional land purchase would be required. Soils in this area contain some heavy clays (NRCS Tranquility Clay, Cievo Clay, and Calflax Clay Loam), and some of the area lies east of the 1962 low hydraulic conductivity boundary line. Therefore, some higher drainage costs may be incurred in developing sites.

The five potential Westlands Central reuse sites are summarized as follows:

Reuse Site Name	Reuse Size, acres estimated	Area Served, acres estimated
D	1,500	37,633
E	392	9,828
F	344	8,622
G	1,710	36,378
H	1,192	28,001
Totals	**5,138**	**120,462**

NOTE: The reuse site size and area served are subject to revisions during the SLDFR Feasibility Study.

Westlands South Service Area

Three areas, encompassing 2,631 acres, in Westlands South service area have been selected to accommodate the reuse acreage needed to provide drainage service to 57,769 acres, following similar criteria used for the other areas. The soils in this area are predominantly clay. The reuse locations along the district's eastern boundary make the best use of gravity flow to the reuse areas and also use the existing Westlands retired lands as much as possible. Furthermore, the area was selected to avoid interference with Lemoore Naval Air Station.

The three potential Westlands South reuse sites are summarized as follows:

Reuse Site Name	Reuse Size, acres estimated	Area Served, acres estimated
A	320	7,035
B	1,205	26,440
C	1,107	24,294
Totals	**2,631**	**57,769**

NOTE: The reuse site size and area served are subject to revisions during the SLDFR Feasibility Study.

2.3.3 Land Retirement

See Table 2.3-1 for the minimum land retirement assumptions for all action alternatives compared to existing conditions and No Action. A total of 44,106 acres is assumed to be retired for all of the action alternatives (common element). Retired lands are assumed to be managed as dryland farming, grazed, or fallowed. However, additional land retirement (of 48,486 to 263,894 acres) is assumed for three of the In-Valley Alternatives (discussed in Sections 2.5, 2.6, and 2.7).

Table 2.3-1
Minimum Land Retirement Assumptions

	Existing Conditions 2001 (acres)	Existing Conditions 2002 (acres)	No Action (acres)	Action Alternatives (acres)
Reclamation CVPIA Land Retirement Program[1,2]				
Westlands North	2,091	2,091	7,000	7,000
Westlands Central	0	0	0	0
Westlands South	0	0	0	0
Westlands Total	2,091	2,091	7,000	7,000
Britz Settlement				
Westlands North	0	2,574	2,574	2,574
Westlands Central	0	432	432	432
Westlands South	0	0	0	0
Westlands Total	0	3,006	3,006	3,006
Sumner Peck Ranch et al Settlement (December 2002)[3]				
Westlands North	0	0	28,711	28,711
Westlands Central	0	0	5,389	5,389
Westlands South	0	0	0	0
Westlands Total	0	0	34,100	34,100
Westlands Water District Settlement (Sagouspe et al)[4]				
Westlands North	0	6,355	28,188	0
Westlands Central	0	2,792	12,382	0
Westlands South	0	6,274	27,830	0
Westlands Total	0	15,421	65,000	0
Total	**2,091**	**20,518**	**109,106**	**44,106**

[1] Of the 7,000 acres of land to be retired under the CVPIA land retirement program, a total of 2,091 acres have been retired within Westlands North. The remaining 4,904 acres are assumed to be retired at a rate of 981 acres per year in each year 2003, 2004, 2005, 2006, and 2007.

[2] For the calculation of the flows for the action alternatives, it was assumed that all 7,000 acres to be retired under the CVPIA land retirement program would be retired within Westlands North.

[3] Of the 34,100 acres of land to be retired under the Sumner Peck Ranch et al settlement, approximately 1/3 is scheduled to go out of production in each year 2003, 2004, and 2005.

[4] Out of the 65,000 acres to be retired under the Westlands Water District settlement, a total of 15,080 acres is assumed out of production in 2002. Of the remaining acres, 34,040 are assumed to come out of production in 2003 and 15,880 acres in 2004 for No Action.

2.4 IN-VALLEY DISPOSAL ALTERNATIVE

2.4.1 Description

The In-Valley Disposal Alternative would lie within the San Joaquin Valley entirely within the boundaries of the drainage study area. This alternative would include the common elements of all alternatives: on-farm and in-district activities, drainwater collection systems, Delta-Mendota Canal Drain, and regional reuse facilities. In addition, reuse facility drainwater would be treated with reverse osmosis (RO) treatment and Se biotreatment before disposal in evaporation basins. Figure 2.4-1 illustrates the key features of the In-Valley Disposal Alternative, including a preliminary pipeline alignment with reuse pumping stations to convey drainwater to these facilities.

Final selection of conveyance and facility locations would require additional field investigations and data analysis to evaluate a variety of engineering and environmental parameters (e.g., soils, geotechnical, groundwater, land use, and endangered and protected species).

The Federal components of this alternative are:

- Common elements:
  - Drainwater collection system
  - Firebaugh Sumps (Delta-Mendota Canal Drain)
  - Regional reuse facilities
- Reverse osmosis treatment
- Selenium biotreatment
- Evaporation basins
- Conveyance system

Potential locations for reuse, treatment, and evaporation facilities identified for appraisal-level designs are shown on Figure 2.4-1. Table 2.4-1 summarizes the key features of this alternative. These features are described in more detail in separate sections below.

Table 2.4-1
Summary of Features and Specifications, In-Valley Disposal Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains, installed	218,020
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	5,731
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	17,002
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	69,645
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	20,604
	Volume reduction in Westlands per year (AF)	27,925
Drainage Rate After Reuse	Drainage volume in AF/year (average)	21,116
	Drainage flow rate in cfs (average)	29.2
Treatment	Initial average Se concentration of reused drainwater (µg/L)	110
	Final average Se concentration of reused drainwater (µg/L)	240
	Volume to RO treatment per year (AF)	21,116
	Volume to Se biological treatment per year (AF)	10,558
	Average Se concentration in influent to evap basins (µg/L)	10
	Initial average TDS concentration at point of discharge (mg/L)	24,700
	Final average TDS concentration at point of discharge (mg/L)	35,600
Land Conveyance	Miles of pipe	71
	Miles of canal	0
Underwater Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	0
Total Conveyance	Total miles of conveyance	71
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	6,343,000
	Energy requirements for RO treatment (kw-hr/year)	18,700,000
	Energy requirements for Se Bio treatment (kw-hr/year)	750,000
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	19,000
	Acres of RO treatment facility	8
	Acres of Se treatment facility (4 plants)	6
	Acres of evaporation basin-maximum	3,290
	Acres of evaporation basin – average	2,870
	Acres of temporary right-of-way[2]	645
	Acres of permanent right-of-way[2]	260
	Acres retired[3]	44,106
	Acres needed for drainage facilities not in retired lands	7,864
Biology	Acres of sensitive habitat affected[4]	NA
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	10,558

Notes:

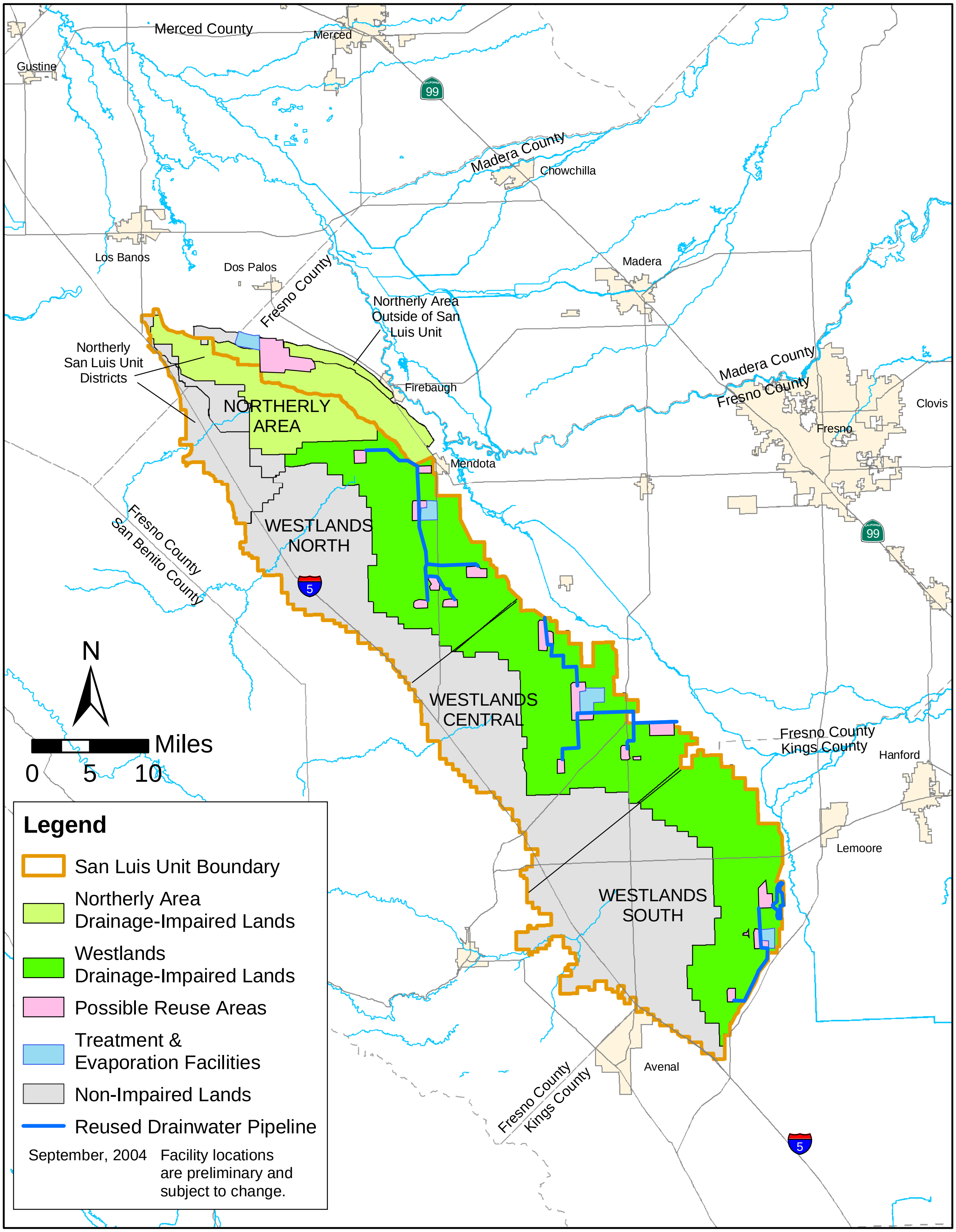
[1] The values reflect SLDFR appraisal-level designs as of September 2004.

[2] Pumping plants are located in reuse areas and are not included in right-of-way acres.

[3] Retired lands may be acquired by Reclamation for development of project facilities.

[4] Identified during appraisal-level analysis.

NA=Not applicable to this disposal alternative



San Luis Drainage Feature Re-evaluation	In-Valley Disposal Alternative Features	Figure 2.4-1
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_4-1_In-Valley Disposal Alternative Features.mxd Date: 9/23/2004 11:54:54 AM Name: dwright0

2.4.1.1 *Reverse Osmosis Treatment*

Reused drainwater from all 16 potential reuse areas would be conveyed to four areas for RO treatment to produce high quality product water that could be blended with CVP water for irrigation. RO treatment plants would be located near each of four evaporation basins. Each RO system would consist of a single-stage, single-pass array with appropriate pretreatment to achieve 50 percent recovery. A schematic of the RO treatment plant operation is shown on Figure 2.4-2.

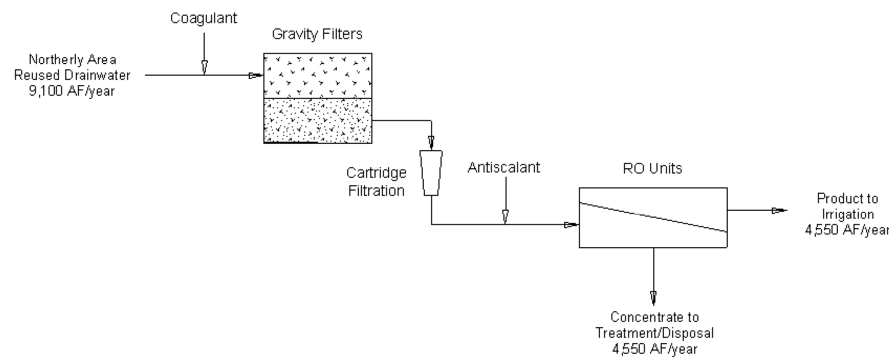


Figure 2.4-2 Schematic of RO Treatment Plant

Before the reused drainwater reaches the treatment plants, it would be filtered to remove suspended particles and colloids that could cause fouling of the RO membrane surfaces. Filtration would consist of rapid sand filters followed by cartridge filters. A coagulant chemical would be injected upstream of the gravity filters to agglomerate the colloids and suspended matter into larger particles that are easier to filter. Particles removed (treatment byproduct) would be tested and disposed appropriately. An antiscalant chemical would be injected into the filtered drainwater to prevent scale formation on the membranes, and injection of a biocide may be required to prevent biological growth in the membrane elements.

The RO facility would comprise a main treatment building, outdoor treatment components, and appurtenant structures occupying about 12 acres. It is assumed that the product water would be conveyed to and blended with CVP water in a nearby canal. The concentrate stream (brine) would be conveyed to a biotreatment facility for Se removal and later to an evaporation facility for disposal.

2.4.1.2 Selenium Biotreatment

The concentrate reject stream from each of the four RO facilities would be conveyed to four Se treatment facilities. The effluent from the Se biotreatment plants would be discharged to evaporation basins in each of the four drainage areas. The flow rate to the biotreatment plant for the Northerly Area would be approximately 4,428 AF/yr, while the flow rates for the Westlands North, Central, and South areas would be approximately 1,668, 2,992, and 1,421 AF/yr, respectively. The flow-weighted average final Se and TDS concentrations after reuse facility operation and RO treatment are estimated to be 475 micrograms per liter (µg/L) and 35,600 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants can remove Se to below 10 µg/L in the treated effluent. See Appendix B for additional information on the biotreatment pilot study.

A schematic of a typical 1,000 AF/yr biotreatment module is shown on Figure 2.4-3. The facility is constructed for gravity flow. The facility consists of a modular bioreactor system and accompanying nutrient distribution and flushing system. Each module is composed of 2 trains of 3 bioreactor cells per train with a capacity of 1,000 AF/yr per module. The residence time in a bioreactor train is approximately 6 hours. The bioreactor cells are filled with carbon media that provide a surface area to develop a biological film that reduces the dissolved Se to a solid form that is captured within the biomass. One bioreactor cell is roughly 23 feet in height, length, and width; thus, one module is 69 feet in length and 46 feet in width.

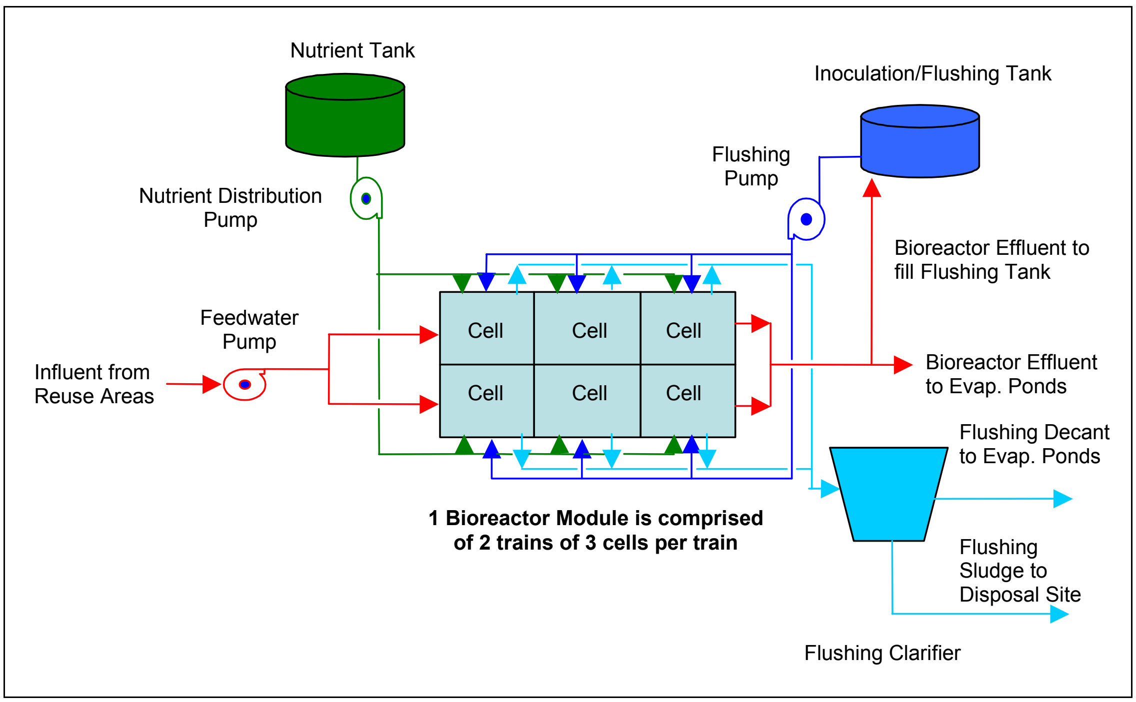


Figure 2.4-3 Process Flow Schematic for Typical Bioreactor Module

Biotreatment plants with capacities in excess of 1,000 AF/yr would consist of multiple modules. For example, a plant that treats 5,000 AF/yr would consist of 5 modules. The flushing system could be shared between modules, thereby providing some economy of scale; however, an additional flushing system would be required for each increment in plant capacity of

5,000 AF/yr. Treatments biosolids with Se would be tested and disposed/reused appropriately. The drainage system from the reuse area would be designed to provide a constant inflow to the plant or the plant would be sized to handle the peak drainage inflow.

A description of the biotreatment plant is provided below:

- **Plant Feedwater Pump:** Drainwater would be delivered to the plant via a variable speed centrifugal pump. A backup pump would also be on site to continue operations during repairs and pump overhaul. The plant influent would be divided between the two trains of three bioreactor cells.
- **Bioreactor Cells:** Plant influent would be directed into the bottom of the first bioreactor cell in the series. The water would flow through a false floor and nozzles of underdrain system to ensure even distribution throughout the reactor media. The bioreactor cells are fixed film reactors that use a microbial support media to promote the growth of a biofilm and maintain the microbes within the reactor. The bioreactors would remove Se from the drainwater by precipitating into insoluble elemental Se. Water from the first reactor cell would be gravity fed into the bottom of the next reactor cell in series.
- **Nutrient Storage Tank:** The nutrient storage tank would have enough capacity to hold a 1-month supply of nutrient. The nutrient would be molasses-based and would provide the microbes with a carbon and energy source for biomass growth and contaminant removal.
- **Nutrient Pump:** The nutrient would have a viscosity between 2,000 and 10,000 centipoises depending on temperature. Because of the high viscosity, a gear pump or other positive displacement pump would be used to inject nutrient into the reactor cells influent stream. The nutrient would be provided to the bacteria at predetermined, discrete dosages throughout the day.
- **Inoculation/Flushing Storage Tank:** During plant startup, the Se-reducing bacteria population would be developed within an inoculation tank and then injected into the bioreactor cells. After plant startup, the inoculation tank would serve as a storage tank for flushing operations performed periodically to remove excessive biomass.
- **Flushing Pump:** The flushing pump would be used to circulate water at a high flow rate through the bioreactors to periodically remove accumulated biofilm and Se. A flushing cycle would be conducted one cell at a time, for a duration of 20 minutes per bioreactor cell at a frequency of 6 to 9 months between cycles. The used flushing water would be sent to the clarifier to separate the sludge from the water. The Se and biomass sludge would be collected and disposed of in accordance with applicable local regulations. The flushing decant water would be conveyed to the evaporation basins or recycled back to the treatment plant.

2.4.1.3 Evaporation Basins

Preliminary designs and costs for evaporation basins assume the following features:

- Bottom of basins would be constructed using natural clay liners compacted from native soils to reduce overall permeability of foundation soils.
- Basins would be located where underlying groundwater is not potable and not considered to be a source of drinking water (i.e., TDS > 3,000 mg/L).

- Wells would be established near each basin site to verify and monitor groundwater conditions before, during, and after evaporation basin installation.
- Basins would be located above the 100-year floodplain or would be constructed to prevent overtopping during 100-year flood events.
- Basins would be located on existing retired lands where practical.
- Basins would be located in areas with gently sloping terrain.
- Basins would **not** be located within the habitats of endangered or protected species.
- Most basins would be surrounded by reuse areas, which would act as a buffer zone to nearby commercial irrigated agriculture.
- Design and management techniques would be implemented to minimize adverse biological effects associated with wildlife exposure to Se, including maintaining basin depths > 4 feet, vegetation control, no islands or wind breaks, side slopes at least 3:1, and hazing of waterfowl.
- Evaporation basins would consist of sequential evaporation cells that diminish in size as the drainage flows towards the terminal cell where final salt precipitation occurs.
- Basin operational design would include provisions to evacuate individual evaporation basin cells if inflow is not sufficient to maintain a 4-foot minimum depth.
- Net evaporation rate would be 4.75 feet/year (including precipitation and loss from seepage).
- Se concentrations within basins would be below levels designated as hazardous waste.
- Se concentrations within precipitated salts would be below levels designated as hazardous waste.
- Site closure would entail in-place burial of precipitated salts, placement of low-permeability soil cap, grading to control runoff and ponding of precipitation, establishment of vegetation to minimize erosion, and long-term monitoring of selected biota and the underlying groundwater.

Evaporation basins have been used in the San Joaquin Valley for about two decades as a means of disposal of irrigation drainwater. About 4,000 acres of evaporation basins are currently in operation within the valley, most or all of which incorporate the above features. Information from a variety of sources was analyzed to locate additional areas within the San Joaquin Valley that meet the above siting criteria.

About 16 square miles of land are under investigation for four sites for evaporation facilities. At present, it is estimated that up to 3,290 acres would be needed in total for the four facilities. This acreage is a maximum estimate for wet years of flow and represents a maximum disturbed land area. It is based on the peak flow being provided by the reuse areas. The estimate of 2,870 acres is the average "wetted" area. The final evaporation basin sites would be fine-tuned based upon the flow from the reuse areas and the amount of water treatment provided to the influent. Selection for the locations of the proposed evaporation basins was based on the following characteristics:

- Soil type
- Groundwater quality
- Land use
- Endangered/protected species and habitats
- Flood risk
- Seismic risk
- Proximity to proposed reuse areas served

Figure 2.4-1 shows the areas under consideration for evaporation basins. Acres needed (3,290) by subarea at the end of the 50-year planning period are 1,390 acres in the Northerly Area and 1,900 acres in Westlands. The figure also shows the proximity of the evaporation basins to the reuse areas.

Northerly Area Evaporation Basin

The area selected for the Northerly Area evaporation basin is based on lands recommended by the Grassland Area Farmers. The proposed site is contiguous to their existing drainwater reuse site (Grassland Bypass Project) and lies adjacent to a wildlife refuge area north of the GDA land. The existing reuse site would be expanded under the San Luis Drainage Feature Re-Evaluation. The proposed site is located within an area of 45 to 60 percent clay content. The area does have existing tile drains that would need to be incorporated into the evaporation basin system design. The specific basin location and configuration would be determined from the subsurface field investigations being performed at this site. The actual amount of acreage utilized would be determined by the anticipated flow from the proposed adjacent reuse area.

Westlands North Evaporation Basin

The Westlands North Evaporation Basin would be located about 3 miles south of the outskirts of the town of Mendota and would be adjacent to reuse areas. This site is located in an area with clay content greater than 45 percent, according to available NRCS data. The location was selected to utilize retired lands as much as possible.

Westlands Central Evaporation Basin

Selection for Westlands Central Evaporation Basin followed similar criteria to that used for the Westlands North Evaporation Basin. This basin would be located near Reuse Area G and has soil with clay content greater than 45 percent. This basin would also be partially encircled by an approximate ½-mile-wide reuse area. Existing retired lands in this area are limited, and none have appropriate soil clay contents, according to the available data. The groundwater quality is poor in this area, and the soil properties are satisfactory for evaporation basin construction.

Westlands South Evaporation Basin

Westlands South Evaporation Basin would be located adjacent to the southern boundary of the district and within Kings County. South Evaporation Basin would be partially surrounded by a ½-mile-wide reuse area (Sites A, B) similar to the other Westlands evaporation basins. The estimated clay content is between 25 and 60 percent. Other sites in Westlands South do not have the adequate clay contents or high EC that are needed for evaporation basin construction.

Salts would precipitate and accumulate at the bottom of the basins' terminal cells during the evaporation process at the rate of 100,000 to 700,000 tons/year. It is estimated that the depth of accumulated salts would range from 12 to 18 inches at the end of the 50-year planning horizon. Presumably the evaporation basins would continue to operate indefinitely until no longer needed; however, periodic excavation and burial (or reclamation) of accumulated salts would be required. The salts would be consolidated and buried within some of the existing evaporation cells. The process would entail excavation of salts and about 3 inches of underlying soil. Excavated material would be hauled to the selected storage location and compacted to a depth of about 5 feet. The surface would be capped with a compacted 12-inch layer of soil followed by vegetation seeding.

2.4.1.4 Conveyance System

Key components of the In-Valley Disposal Alternative conveyance system are shown in Table 2.4-2. The conveyance system also includes 16 pumping plants. These plants pump reuse water from the reuse areas to either another pumping plant or a treatment and evaporation basin area. Reuse Area G has two plants. Reuse Area F does not have a plant, but uses gravity to convey its reuse water. All of these pumping plants are in reuse areas.

Table 2.4-2
Key Components in In-Valley Conveyance Segments

Pipeline Segment	Length (miles)	Diameter (inches)	Capacity (cfs)
Northerly Area reuse facility to Westlands North treatment/evaporation facility	1.1	10	0.9
Westlands North reuse facilities to northern treatment/evaporation facility	29.1	6-16	4.6
Westlands Central reuse facilities to southern treatment/evaporation facility	29.6	8-16	6.9
Westlands South reuse facilities to southern treatment/evaporation facility	11.0	8-12	2.8
Total Length	**70.8**		**15.2**

2.4.2 Implementation Schedule and Costs

Implementing drainage service in the San Luis Unit is planned over an extended period of time. Specifically, Reclamation anticipates that farmers will install subsurface tile drains to collect drainwater throughout the 50-year planning period as economic conditions justify the installation. Since not all lands will come on-line for drainage service at one time, drainage service systems need not be constructed for 100 percent capacity immediately. Reclamation's In-Valley Disposal Alternative includes the flexibility to expand treatment and disposal components as needed to meet drainage needs over time; however, this EIS evaluates the potential environmental effects of the full system when it is completely constructed. Implementation of the In-Valley Alternatives is discussed in Appendix J (Implementation of In-Valley Alternatives).

Changes in farming practices, new treatment and disposal technologies, and land use differences may change the drainage service need and the treatment and disposal methods during the planning period. Therefore, Reclamation has identified an action alternative that relies on proven technologies to provide drainage service when it is needed, consistent with the court order, while at the same time allowing the flexibility to adapt treatment and disposal methods when more effective, less costly, and less environmentally damaging techniques become available. This flexibility allows for continued research to improve efficiency and cost-effectiveness and to reduce the potential adverse effects of treatment and disposal technologies.

A preliminary implementation schedule was developed for the In-Valley Disposal Alternative (Figure 2.4-4). Factors used in developing the schedule include permitting, engineering design, land acquisition, and construction. The schedule assumes that land acquisition and engineering design would occur concurrent with permitting activities. Construction of project features includes first-phase components of the drainage collection system, drainage reduction measures, reuse facilities, treatment plants, evaporation basins, conveyance, and mitigation.

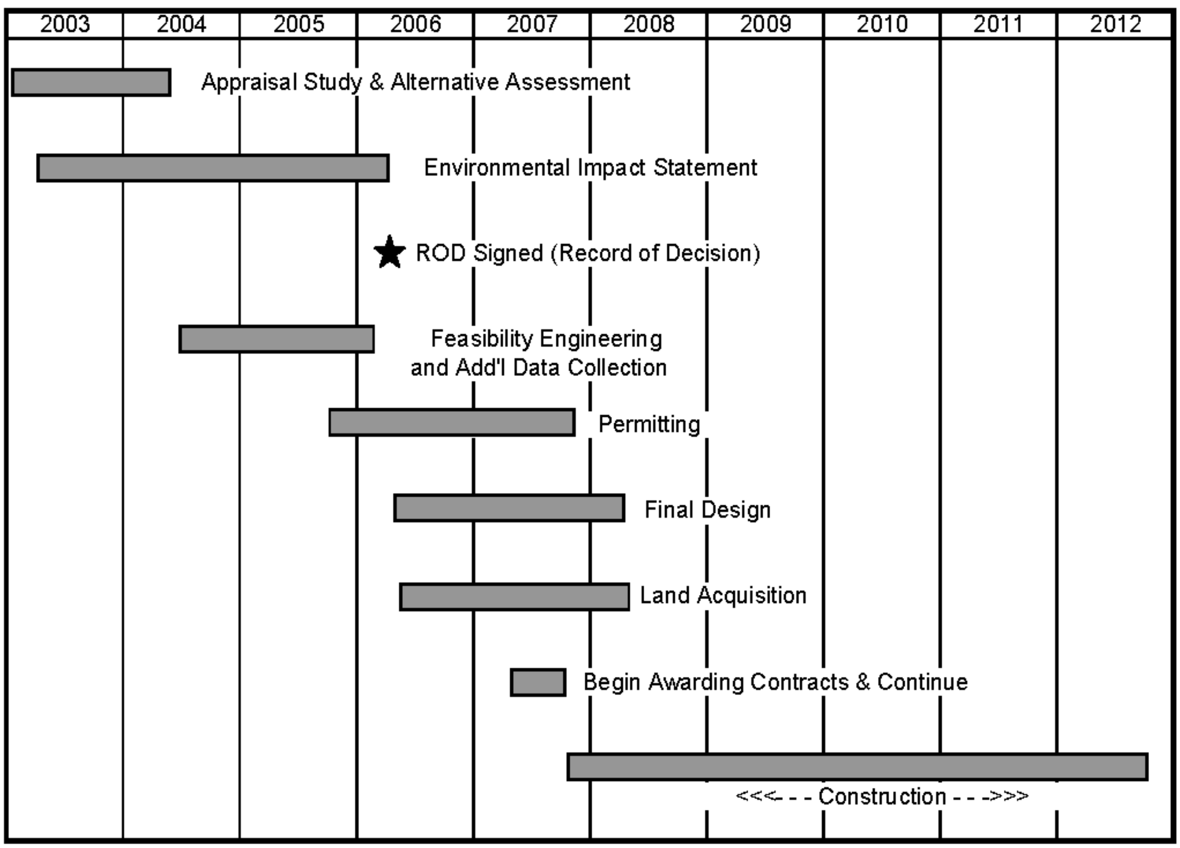


Figure 2.4-4 In-Valley Disposal Alternative Implementation Schedule

The total drainage capacity needed over the 50-year planning horizon would be constructed in two phases because drainage flows would increase gradually during this period. About 50 percent of the total capacity needed for reuse, biotreatment, evaporation, and mitigation would be constructed initially. The other 50 percent would be constructed when needed, after about

15 years. For this alternative, disposal facilities would not need to be completed for the entire drainage study area before drainage services would begin. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

The summary of the present value and estimated annual equivalent costs for the In-Valley Disposal Alternative at less than 69,645 AF/year drainage volume (based on the SLDFR appraisal-level designs updated since September 2004) is included in Table 2.4-3. The assumptions for development of these cost estimates are discussed in Section 2.8.

Table 2.4-3
In-Valley Disposal Alternative,
Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	26.6	1.6
Evaporation Basins	114.7	6.9
Mitigation Facilities*	N/A	N/A
Reverse Osmosis Facilities	85.4	5.1
Biological Selenium Treatment	59.7	3.6
Land Retirement	10.7	0.6
Subtotal – Alternative-Specific Federal Costs	297.1	17.9
Common Federal Costs		
Drainage Collection System	186.1	11.2
Regional Reuse Facilities	76.8	4.6
Delta-Mendota Canal Drainage Collection/Reuse	1.7	0.1
Subtotal - Common Federal Costs	264.7	15.9
TOTAL – FEDERAL PROJECT COSTS	**561.8**	**33.8**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.5 IN-VALLEY/GROUNDWATER QUALITY LAND RETIREMENT ALTERNATIVE

Introduction to All Land Retirement Alternatives

Based on the screening of the many combinations of land retirement and other drainwater reduction measures, three land retirement scenarios were selected to become partial alternatives for analysis in the EIS. All three assume 10,000 acres would be retired in Broadview Water District in the Northerly Area. All of the selected scenarios were based on the In-Valley Disposal Alternative.

The first of the three scenarios (In-Valley/Groundwater Quality) would retire land previously acquired by Westlands and land with Se concentration greater than 50 parts per billion (ppb) in shallow groundwater (92,600 acres). The second would retire land in Westlands up to the level at which the water made available could be used to fulfill other irrigation demands in the San Luis Unit (194,000 acres) targeting lands with Se concentrations greater than 20 ppb in the shallow groundwater. The third would retire the entire Westlands drainage-impaired area (308,000 acres).

All three are assumed to be variations of the original In-Valley Disposal Alternative (Alternative 4) in the 2002 PFR. The collection, treatment, and disposal of drainwater collected from drained lands would be similar to that described in the 2002 PFR and updated in Sections 2.4, 2.5, 2.6, and 2.7 of this EIS for the In-Valley Disposal and Land Retirement Alternatives.

The components that characterize all of the land retirement alternatives include:

- Acres to be retired permanently (ranging from 92,600 to 308,000 acres for the three In-Valley land retirement alternatives and 44,106 for the four other action alternatives)
- Implementation method (i.e., targeted acquisition as blocks of land for cost-effective construction of collector system)
- Future land management/use (to include agriculture-related land uses of grazing, fallowing, and dryland farming on lands not acquired for project facilities)
- Treatment and disposal of remaining drainage utilizing RO treatment, Se biotreatment, and evaporation basins (with mitigation) as needed

For purposes of developing cost information and this EIS, retired lands not acquired for project facilities were assumed to be managed in three ways: one-third of the purchased land would be used for dry land farming, one-third would be used for grazing, and one-third would remain fallow. Dry land farming and grazing would require some initial capital investment, and all three would require annual maintenance. Table 2.4-4 shows the capital and operation, maintenance, and replacement (OM&R) costs for the three land management options.

Table 2.4-4
Unit Cost Estimates for Land Management Options

Dry Land Farming ($/acre)	Grazing ($/acre)	Fallowing ($/acre)	Average Cost ($/acre)
Capital Costs			
$35	$47	$0	$27.33
OM&R Costs			
$15	$–*	$30	$15.00

*No net annual OM&R costs because grazing for revenue offsets costs.

Capital costs of acquiring land for both land retirement purposes and to locate project facilities were estimated at $2,600 per acre, based on available data obtained from Fresno County land sale records as well as land purchases by Westlands. This per-acre cost was applied to the amount of land projected to be retired in each alternative to determine the amount of federal funding that would be required for the land retirement component. The same per-acre value was included in the cost estimates of certain land-intensive project features, such as evaporation ponds and reuse areas, if those features were assumed to be located on lands that were not already targeted for retirement. Section 2.11.4 explains the development of the land retirement alternatives and others that were eliminated from further analysis in this EIS.

2.5.1 Description

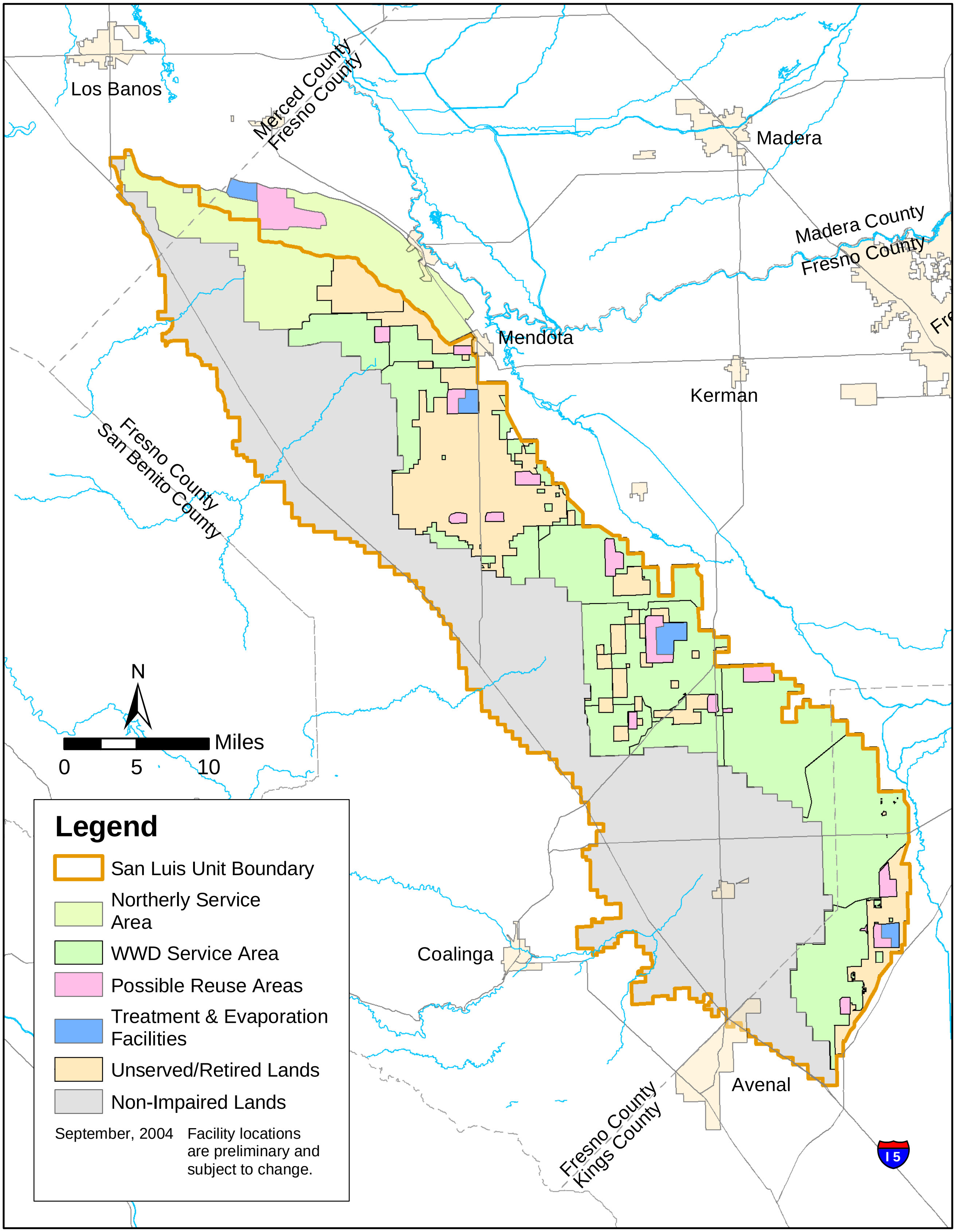
The In-Valley/Groundwater Quality Land Retirement Alternative consists of retiring all the lands in Westlands with Se concentration greater than 50 ppb in the shallow groundwater and lands acquired by Westlands (that could be brought into production with drainage service, Table 2.3-1). It would also retire 10,000 acres in Broadview Water District in the Northerly Area. Total land retirement is about 92,600 acres (44,106 plus additional 48,486 acres). This alternative includes irrigation system improvements to reduce deep percolation to shallow groundwater.

Lands remaining in production within the drainage-impaired area would be eligible for drainage service. The collection, treatment, and disposal of drainwater collected from drained lands would be similar to that described for the In-Valley Disposal Alternative for RO treatment and the evaporation basins, and the changes to Se biotreatment and conveyance are described in the following sections. Figure 2.5-1 shows relevant features of the In-Valley/Groundwater Quality Land Retirement Alternative. Lands that could be retired are outside of the areas with drainwater collection but inside the drainage-impaired areas.

2.5.1.1 Selenium Biotreatment

There would be four Se biotreatment plants, one for each of the drainage areas (Northerly, Westlands North, Westlands Central, and Westlands South) for the In-Valley/Groundwater Quality Land Retirement Alternative. The effluent from the biotreatment plants would be discharged to evaporation basins located in each of the four drainage areas. The flow rate to the biotreatment plant for the Northerly Area would be approximately 4,050 AF/yr, while the flow rates for the combined Westlands North, Central, and South areas would be 5,179 AF/yr. These flows are based on the assumption that the drainage rate from the reuse area would be maintained at a fairly constant level throughout the year. The flow-weighted average Se and TDS concentrations after several years of reuse facility operation and RO treatment are estimated to be 528 µg/L and 33,000 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants can remove Se to below 10 µg/L in the treated effluent.

Table 2.5-1 summarizes the key features of the In-Valley/Groundwater Quality Land Retirement Alternative.



San Luis Drainage Feature Re-evaluation	In-Valley/Groundwater Quality Land Retirement Alternative Features	Figure 2.5-1
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_5-1_IV_GW_Qual_Land_Retirement_alt.mxd Date: 8/27/2004 12:02:27 PM Name: dhwrigh0

Table 2.5-1
Summary of Features and Specifications, In-Valley/Groundwater Quality Land Retirement Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains, installed	187,116
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	4,898
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	15,171
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	61,036
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	18,730
	Volume reduction in Westlands per year (AF)	23,848
Drainage Rate After Reuse	Drainage volume in AF/year (average)	18,458
	Drainage flow rate in cfs (average)	25.6
Treatment	Initial average Se concentration of reused drainwater (µg/L)	120
	Final average Se concentration of reused drainwater (µg/L)	260
	Volume to RO treatment per year (AF)	18,458
	Volume to Se biological treatment per year (AF)	9,229
	Average Se concentration in influent to evap basins (µg/L)	10
	Initial average TDS concentration at point of discharge (mg/L)	26,900
	Final average TDS concentration at point of discharge (mg/L)	33,000
Land Conveyance	Miles of pipe	<71
	Miles of canal	0
Underwater Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	0
Total Conveyance	Total miles of conveyance	<71
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	5,600,000
	Energy requirements for RO treatment (kw-hr/year)	15,900,000
	Energy requirements for Se Bio treatment (kw-hr/year)	550,000
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	16,700
	Acres of RO treatment facility	7
	Acres of Se treatment facility (4 plants)	5
	Acres of evaporation basin – maximum	2,890
	Acres of evaporation basin – average	2,530
	Acres of temporary right-of-way[2]	645
	Acres of permanent right-of-way[2]	260
	Acres retired[3]	92,592
	Acres needed for drainage facilities not in retired lands	0
Biology	Acres of sensitive habitat affected[4]	NA
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	9,229

Notes:

[1] The values reflect SLDFR appraisal-level designs as of September 2004.

[2] Pumping plants are located in reuse areas and are not included in right-of-way acres.

[3] Retired lands may be acquired by Reclamation for development of project facilities.

[4] Identified during appraisal-level analysis.

NA=Not applicable to this disposal alternative

2.5.1.2 Conveyance

Key components of the In-Valley/Groundwater Quality Land Retirement Alternative conveyance system are shown in Table 2.5-2. Any differences between this alternative and the In-Valley Disposal Alternative would depend upon the quantity of water to be conveyed. A smaller quantity could require a smaller pipe size, and a larger quantity could require a larger pipe size.

Table 2.5-2
Key Components in In-Valley/Groundwater Quality Land Retirement Alternative Conveyance Segments[1]

Pipeline Segment	Length (miles)
Northerly Area reuse facility to Westlands North treatment/evaporation facility	1.1
Westlands North reuse facilities to northern treatment/evaporation facility	29.1
Westlands Central reuse facilities to southern treatment/evaporation facility	29.6
Westlands South reuse facilities to southern treatment/evaporation facility	11.0
Total Length	**<70.8**

[1]Diameter and capacity of pipe to be determined (less than those in Table 2.4-2).

2.5.2 Implementation Schedule and Costs

A preliminary implementation schedule was developed for the In-Valley Disposal Alternative (Section 2.4.1) and a similar schedule is assumed for the In-Valley/Groundwater Quality Land Retirement Alternative (Figure 2.5-2). Factors used in developing the schedule include permitting, engineering design, land acquisition, and construction. The schedule assumes that land acquisition and engineering design would occur concurrent with permitting activities. Construction of project features includes first phase components of the drainage collection system, drainage reduction measures, reuse facilities, treatment plants, evaporation basins, conveyance, and mitigation.

The total drainage capacity needed over the 50-year planning horizon would be constructed in two phases because drainage flows would increase gradually during this period. About 50 percent of the total capacity needed for reuse, biotreatment, evaporation, and mitigation would be constructed initially. The other 50 percent would be constructed when needed, after about 15 years. For this alternative, disposal facilities would not need to be completed for the entire study area before drainage services would begin. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

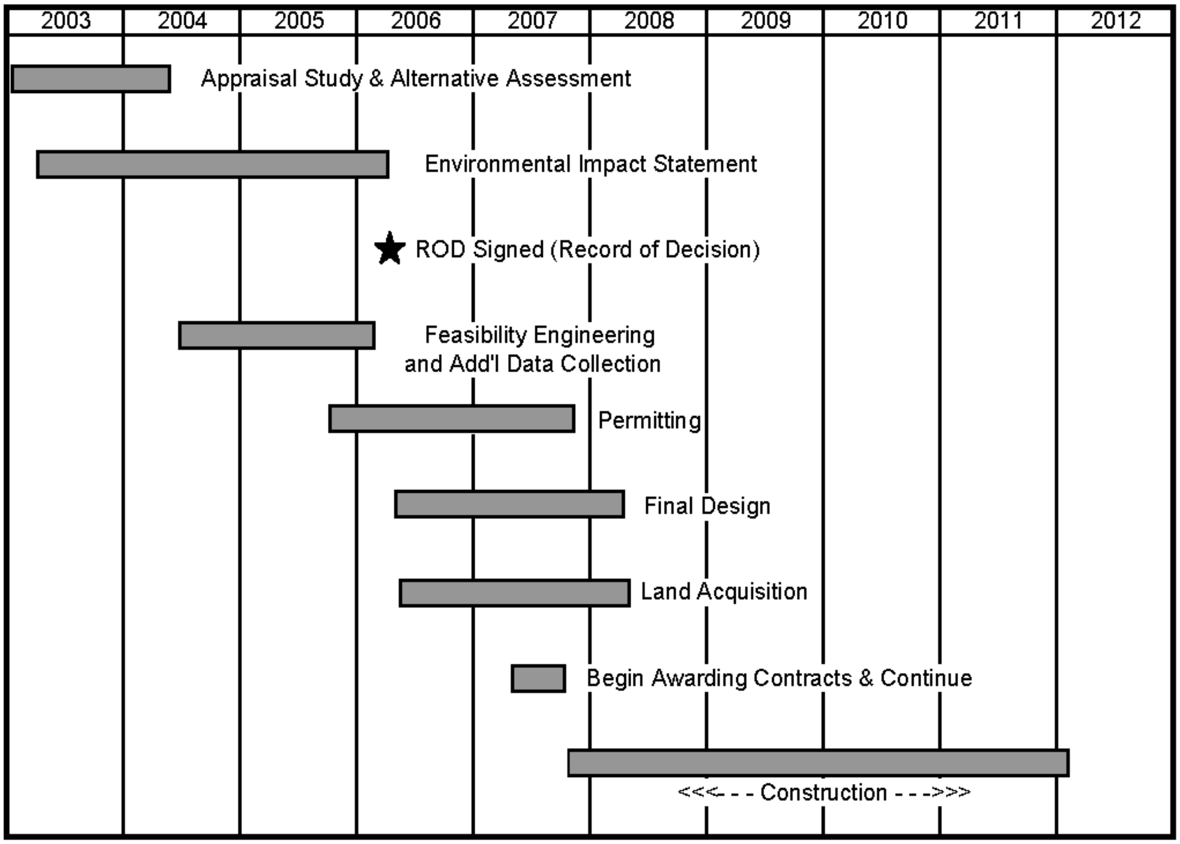


Figure 2.5-2 In-Valley/Groundwater Quality Land Retirement Alternative Implementation Schedule

The summary of the present value and estimated annual equivalent costs for the In-Valley/Groundwater Quality Land Retirement Alternative at less than 61,036 AF/year drainage volume (based on SLDFR appraisal-level design updates since September 2004) is included in Table 2.5-3. The assumptions for development of these cost estimates are discussed in Section 2.11.

Table 2.5-3
In-Valley/Groundwater Quality Land Retirement Alternative, Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	25.0	1.5
Evaporation Basins	102.2	6.1
Mitigation Facilities*	N/A	N/A
Reverse Osmosis Facilities	77.9	4.7
Biological Selenium Treatment	53.0	3.2
Land Retirement	140.4	8.4
Subtotal – Alternative-Specific Federal Costs	398.5	24.0
Common Federal Costs		
Drainage Collection System	158.4	9.5
Regional Reuse Facilities	67.1	4.0
Delta-Mendota Canal Drainage Collection/Reuse	1.7	0.1
Subtotal - Common Federal Costs	227.3	13.7
TOTAL – FEDERAL PROJECT COSTS	**625.8**	**37.6**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.6 IN-VALLEY/WATER NEEDS LAND RETIREMENT ALTERNATIVE

2.6.1 Description

The In-Valley/Water Needs Land Retirement Alternative would retire lands such that the water needs of the lands remaining in production could be met by the Unit's foreseeable water supply from its CVP contracts and groundwater resources. This results in an estimated 194,000 acres retired (44,106 plus 149,850 additional acres). This estimate of land retirement is a planning-level approximation and should not be viewed as a firm prediction of future water supply or water needs. For purposes of SLDFR analyses for plan formulation and this EIS, the Unit's available water supply is based on the five districts receiving an average of 70 percent of their existing CVP contract amounts totaling 1,399,100 AF/yr (or about 979,400 AF/yr) plus local groundwater supplies (about 185,000 AF/yr) for a total available water supply of 1,164,400 AF/yr.[5] This acreage value would include lands with Se concentrations greater than 20 ppb in Westlands, lands acquired by Westlands (that could be brought into production with drainage service, Table 2.3-1) and 10,000 acres in Broadview Water District. The alternative would include irrigation system improvements to reduce deep percolation to shallow groundwater. The irrigation system improvement program would be similar to that described in Section 2.4 for the In-Valley Disposal Alternative.

[5] This 70 percent is not an explicit assumption nor is it to be confused with the 59 percent of CVP contract supply assumption used for calculating drainage quantity for the other action alternatives.

Lands remaining in production within the drainage-impaired area would be eligible for drainage service as under the previous alternative. Figure 2.6-1 shows relevant features for the In-Valley/Water Needs Land Retirement Alternative. Lands that could be retired are outside of the areas with drainwater collection but inside the drainage-impaired areas.

2.6.1.1 Selenium Biotreatment

There would be four Se biotreatment plants as in the previous alternative, one for each of the drainage areas. The flow rate to the biotreatment plant for the Northerly Area would be approximately 4,050 AF/yr, while the flow rates for the combined Westlands service areas would be approximately 2,815 AF/yr. The flow-weighted average Se and TDS concentrations after several years of reuse facility operation and RO treatment are estimated to be 534 µg/L and 32,520 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants can remove Se to below 10 µg/L in the treated effluent.

Table 2.6-1 summarizes the key features of the In-Valley/Water Needs Land Retirement Alternative.

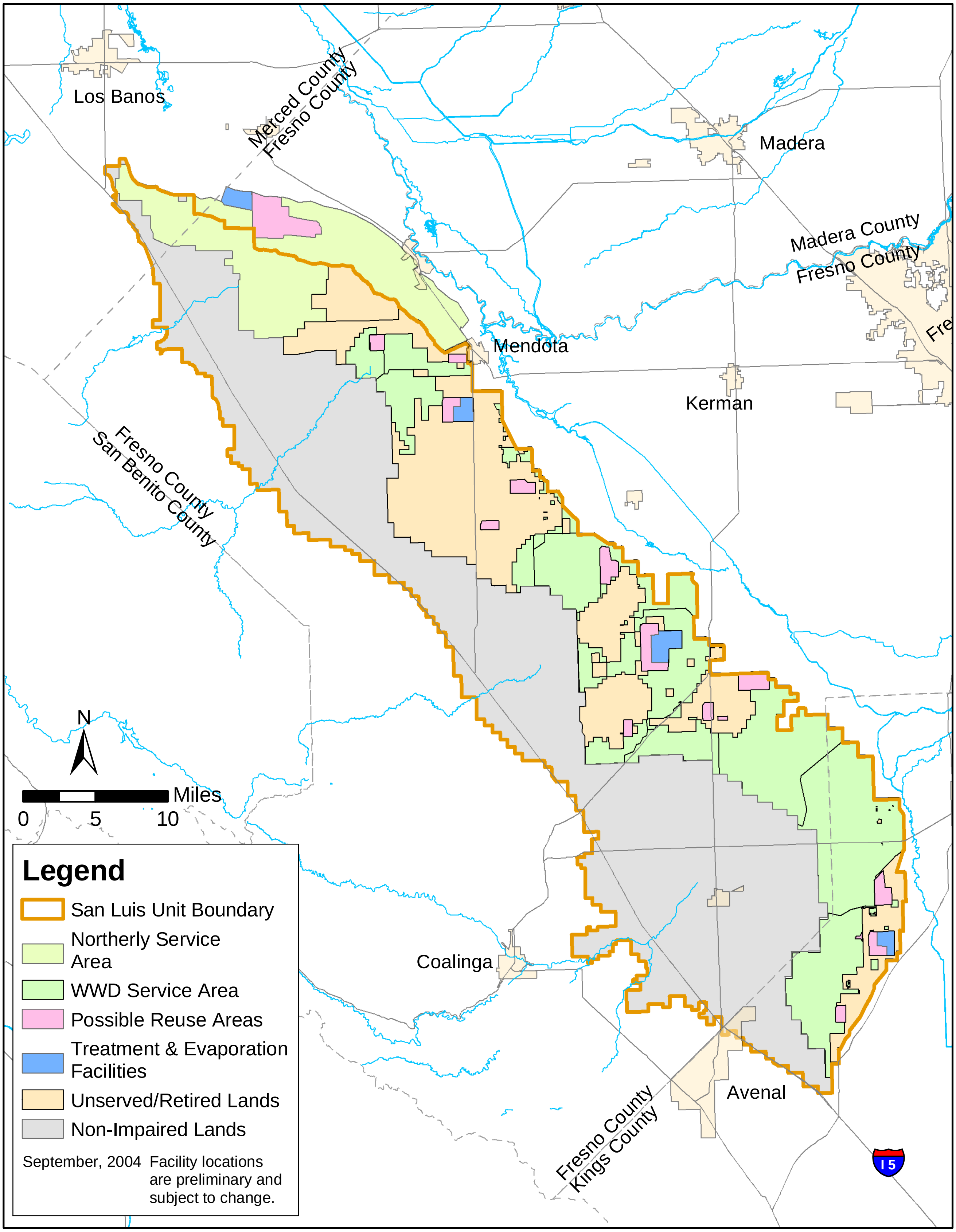
Table 2.6-1
Summary of Features and Specifications, In-Valley/Water Needs Land Retirement Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains, installed	122,833
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	2,970
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	10,350
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	45,287
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	18,730
	Volume reduction in Westlands per year (AF)	12,827
Drainage Rate After Reuse	Drainage volume in AF/year (average)	13,730
	Drainage flow rate in cfs (average)	19.0
Treatment	Initial average Se concentration of reused drainwater (µg/L)	120
	Final average Se concentration of reused drainwater (µg/L)	270
	Volume to RO treatment per year (AF)	13,730
	Volume to Se biological treatment per year (AF)	6,865
	Average Se concentration in influent to evap basins (µg/L)	10
	Initial average TDS concentration at point of discharge (mg/L)	13,700
	Final average TDS concentration at point of discharge (mg/L)	27,600
Land Conveyance	Miles of pipe	<71
	Miles of canal	0
Underwater Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	0
Total Conveyance	Total miles of conveyance	<71
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	4,000,000
	Energy requirements for RO treatment (kw-hr/year)	11,100,000
	Energy requirements for Se Bio treatment (kw-hr/year)	450,000
	Energy generated (kw-hr/year)	0

Table 2.6-1 (concluded)
Summary of Features and Specifications, In-Valley/Water Needs Land Retirement Alternative[1]

Component	Characteristic	
Land Requirements	Acres of reuse	12,500
	Acres of RO treatment facility	5
	Acres of Se treatment facility (4 plants)	4
	Acres of evaporation basin - maximum	2,150
	Acres of evaporation basin - average	1,880
	Acres of temporary right-of-way[3]	645
	Acres of permanent right-of-way[3]	260
	Acres retired[4]	193,956
	Acres needed for drainage facilities not in retired lands	0
Biology	Acres of sensitive habitat affected[5]	NA
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	6,865

Notes:
[1] The values reflect SLDFR appraisal-level designs as of September 2004.
[2] Initial values used.
[3] Pumping plants are located in reuse areas and are not included in right-of-way acres.
[4] Retired lands may be acquired by Reclamation for development of project facilities.
[5] Identified during appraisal-level analysis.
NA=Not applicable to this disposal alternative



San Luis Drainage Feature Re-evaluation	In-Valley/Water Needs Land Retirement Alternative Features	Figure 2.6-1
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_6-1_IV_Water_Needs_Land_Retirement_alt.mxd Date: 8/27/2004 12:04:39 PM Name: dwright0

2.6.1.2 Conveyance System

Key components of the In-Valley/Water Needs Land Retirement Alternative conveyance system are shown in Table 2.6-2.

Table 2.6-2
Key Components in In-Valley/Water Needs Land Retirement Alternative Conveyance Segments[1]

Pipeline Segment	Length (miles)
Northerly Area reuse facility to Westlands North treatment/evaporation facility	1.1
Westlands North reuse facilities to northern treatment/evaporation facility	29.1
Westlands Central reuse facilities to southern treatment/evaporation facility	29.6
Westlands South reuse facilities to southern treatment/evaporation facility	11.0
Total Length	**<70.8**

[1]Diameter and capacity of pipe to be determined (less than those in Table 2.4-2).

2.6.2 Implementation Schedule and Costs

A preliminary implementation schedule was developed for the In-Valley Disposal Alternative, and a different schedule is assumed for the In-Valley/Water Needs Land Retirement Alternative (Figure 2.6-2). Factors used in developing the schedule include permitting, engineering design, land acquisition, and construction. The schedule assumes that land acquisition and engineering design would occur concurrent with permitting activities. Construction of project features includes first-phase components of the drainage collection system, drainage reduction measures, reuse facilities, treatment plants, evaporation basins, conveyance, and mitigation.

The total drainage capacity needed over the 50-year planning horizon would be constructed in two phases because drainage flows would increase gradually during this period. About 50 percent of the total capacity needed for reuse, biotreatment, evaporation and mitigation would be constructed initially. The other 50 percent would be constructed when needed, after about 15 years. For this alternative, disposal facilities would not need to be completed for the entire study area before drainage services would begin. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

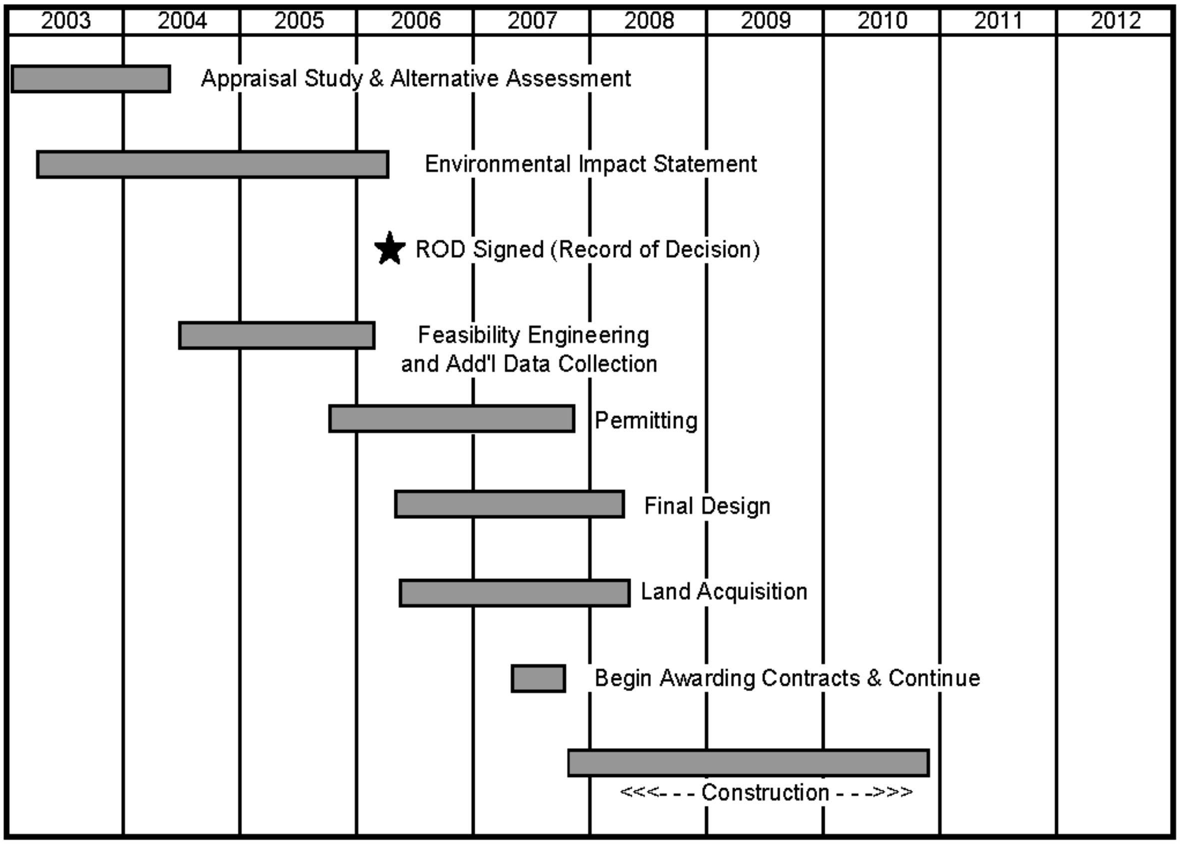


Figure 2.6-2 In-Valley/Water Needs Land Retirement Alternative Implementation Schedule

The summary of the present value and estimated annual equivalent costs for the In-Valley/Water Needs Land Retirement Alternative at less than 45,287 AF/year drainage volume (based on SLDFR appraisal-level design updates since September 2004) is included in Table 2.6-3. The assumptions for development of these cost estimates are discussed in Section 2.11.

Table 2.6-3
In-Valley/Water Needs Land Retirement Alternative,
Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	21.6	1.3
Evaporation Basins	80.6	4.9
Mitigation Facilities*	n/a	n/a
Reverse Osmosis Facilities	61.3	3.7
Biological Selenium Treatment	40.9	2.5
Land Retirement	416.7	25.1
Subtotal – Alternative-Specific Federal Costs	621.1	37.4
Common Federal Costs		
Drainage Collection System	89.0	5.4
Regional Reuse Facilities	61.3	3.7
Delta-Mendota Canal Drainage Collection/Reuse	1.8	0.1
Subtotal - Common Federal Costs	152.0	9.1
TOTAL – FEDERAL PROJECT COSTS	**773.1**	**46.5**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.7 IN-VALLEY/DRAINAGE-IMPAIRED AREA LAND RETIREMENT ALTERNATIVE

2.7.1 Description

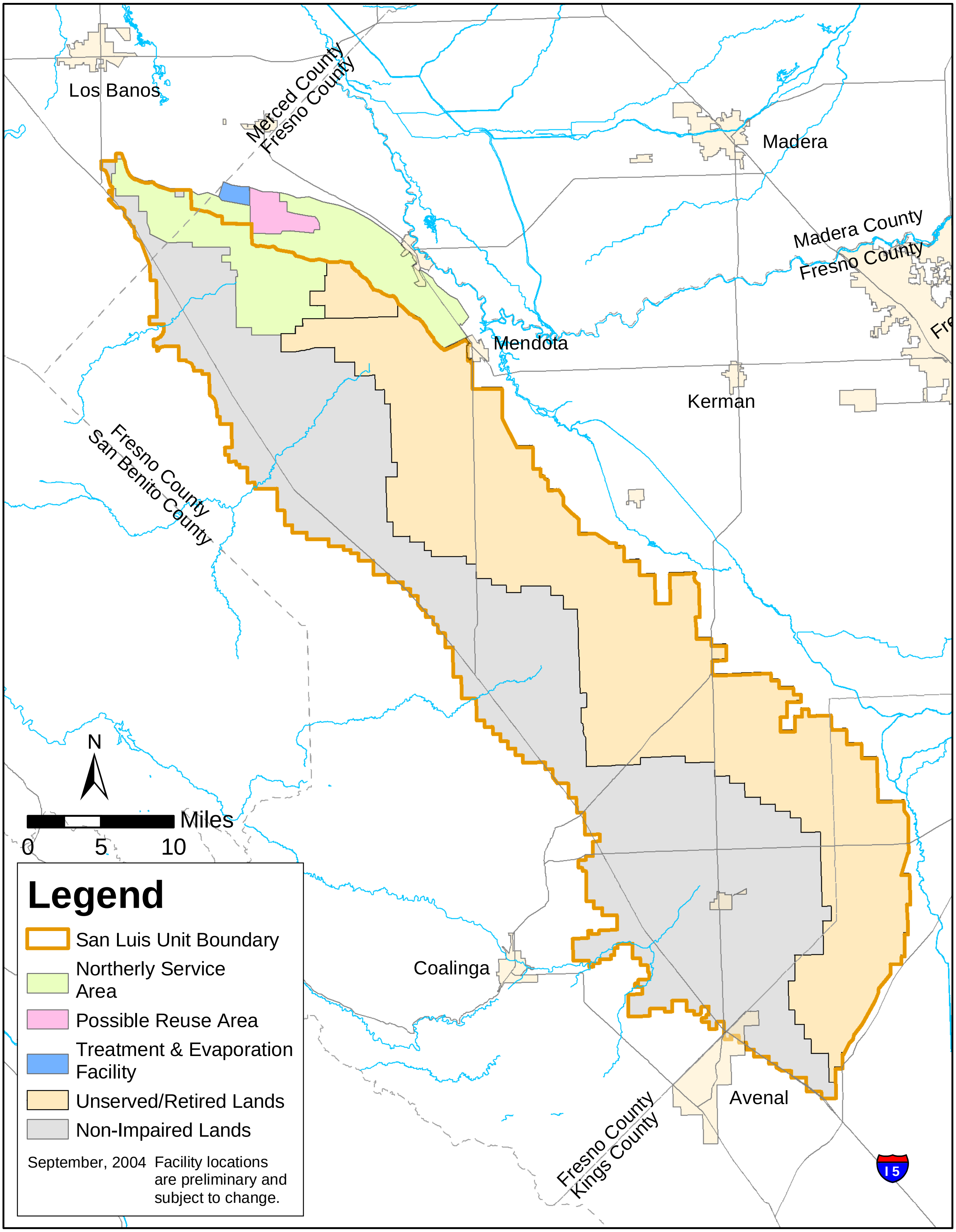
The In-Valley/Drainage-Impaired Area Land Retirement Alternative would retire 308,000 acres (44,106 plus 263,894 acres), including all of the drainage-impaired lands in Westlands – approximately 298,000 acres. The Northerly Area (non-Westlands) is excluded from land retirement except for 10,000 acres in Broadview Water District. Drainage collection, treatment, and disposal facilities would not be needed in the Westlands drainage-impaired areas. The alternative would include irrigation system improvements to reduce deep percolation to shallow groundwater. The irrigation system improvement program would be similar to that described in Section 2.4 for the In-Valley Disposal Alternative, but would occur only in the Northerly Area.

Lands remaining in production within the Northerly drainage-impaired area would be eligible for drainage service as under the previous alternative. The collection, treatment, and disposal of drainwater collected from drained lands would be only those needed to serve the Northerly Area. Figure 2.7-1 shows relevant features for the In-Valley/Drainage-Impaired Area Alternative. Lands that could be retired are outside of the areas with drainwater collection but inside the drainage-impaired area.

2.7.1.1 Selenium Biotreatment

There would be one Se biotreatment plant in the Northerly area for the In-Valley/Drainage-Impaired Area Land Retirement Alternative. The effluent from the biotreatment plant would be discharged to an evaporation basin located in the Northerly Area. The flow rate to the biotreatment plant would be approximately 4,050 AF/yr. This flow is based on the assumption that the drainage rate from the Northerly Reuse Area is maintained fairly constant throughout the year. The flow-weighted average Se and TDS concentrations after several years of reuse facility operation and RO treatment are estimated to be 640 µg/L and 30,000 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants will remove Se to below 10 µg/L in the treated effluent.

Table 2.7-1 summarizes the key features of the In-Valley/Drainage-Impaired Area Land Retirement Alternative.



San Luis Drainage Feature Re-evaluation	In-Valley/Drainage-Impaired Area Land Retirement Alternative Features	Figure 2.7-1
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_7-1_IV_Drainage-imparied Area_alt.mxd Date: 8/27/2004 1:39:24 PM Name: dhwrigh0

Table 2.7-1
Summary of Features and Specifications, In-Valley/Drainage-Impaired Area Land Retirement Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains, installed	47,500
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	710
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	4,700
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	26,830
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	18,730
	Volume reduction in Westlands per year (AF)	0
Drainage Rate After Reuse	Drainage volume in AF/year (average)	8,100
	Drainage flow rate in cfs (average)	11.2
Treatment	Initial average Se concentration of reused drainwater (µg/L)	140
	Final average Se concentration of reused drainwater (µg/L)	320
	Volume to RO treatment per year (AF)	8,100
	Volume to Se biological treatment per year (AF)	4,050
	Average Se concentration in influent to Northerly Area evap basins (µg/L)	10
	Initial average TDS concentration at point of discharge (mg/L)	29,400
	Final average TDS concentration at point of discharge (mg/L)	30,000
Land Conveyance	Miles of pipe	1.1
	Miles of canal	0
Underwater Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	0
Total Conveyance	Total miles of conveyance	1.1
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	2,457,000
	Energy requirements for RO treatment (kw-hr/year)	6,600,000
	Energy requirements for Se Bio treatment (kw-hr/year)	250,000
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	7,500
	Acres of RO treatment facility	3
	Acres of Se treatment facility (4 plants)	2
	Acres of evaporation basin – maximum	1,270
	Acres of evaporation basin – average	1,110
	Acres of temporary right-of-way[2]	10
	Acres of permanent right-of-way[2]	4
	Acres retired[3]	308,000
	Acres needed for drainage facilities not in retired lands	0
Biology	Acres of sensitive habitat affected[4]	NA
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	4,050

Notes:

[1] The values reflect SLDFR appraisal-level designs as of September 2004.

[2] Pumping plant is located in reuse area and is not included in right-of-way acres.

[3] Retired lands may be acquired by Reclamation for development of project facilities.

[4] Identified during appraisal-level analysis.

NA=Not applicable to this disposal alternative

2.7.1.2 Conveyance System

Key components of the In-Valley/Drainage-Impaired Area Land Retirement Alternative conveyance system are shown in Table 2.7-2.

Table 2.7-2
Key Components in In-Valley/Drainage-Impaired Area Land Retirement Alternative Conveyance Segments

Pipeline Segment	Length (miles)
Northerly Area reuse facility to Westlands North treatment/evaporation facility	1.1
Westlands North reuse facilities to northern treatment/evaporation facility	0
Westlands Central reuse facilities to southern treatment/evaporation facility	0
Westlands South reuse facilities to southern treatment/evaporation facility	0
Total Length	**1.1**

2.7.2 Implementation Schedule and Costs

A preliminary implementation schedule was developed for the In-Valley/Drainage-Impaired Area Land Retirement Alternative (Figure 2.7-2). Factors used in developing the schedule include permitting, engineering design, land acquisition, and construction. The schedule assumes that land acquisition and engineering design would occur concurrent with permitting activities. Construction of project features includes first-phase components of the drainage collection system, drainage reduction measures, reuse facilities, treatment plants, evaporation basins, conveyance, and mitigation. The schedule is designed to complete facilities by 2009 when the Grassland Bypass Project's use of the San Luis Drain is terminated.

The total drainage capacity needed over the 50-year planning horizon would be constructed in two phases because drainage flows would increase gradually during this period. About 50 percent of the total capacity needed for reuse, biotreatment, evaporation and mitigation would be constructed initially. The other 50 percent would be constructed when needed, after about 15 years. For this alternative, disposal facilities would not need to be completed for the entire study area before drainage services would begin. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

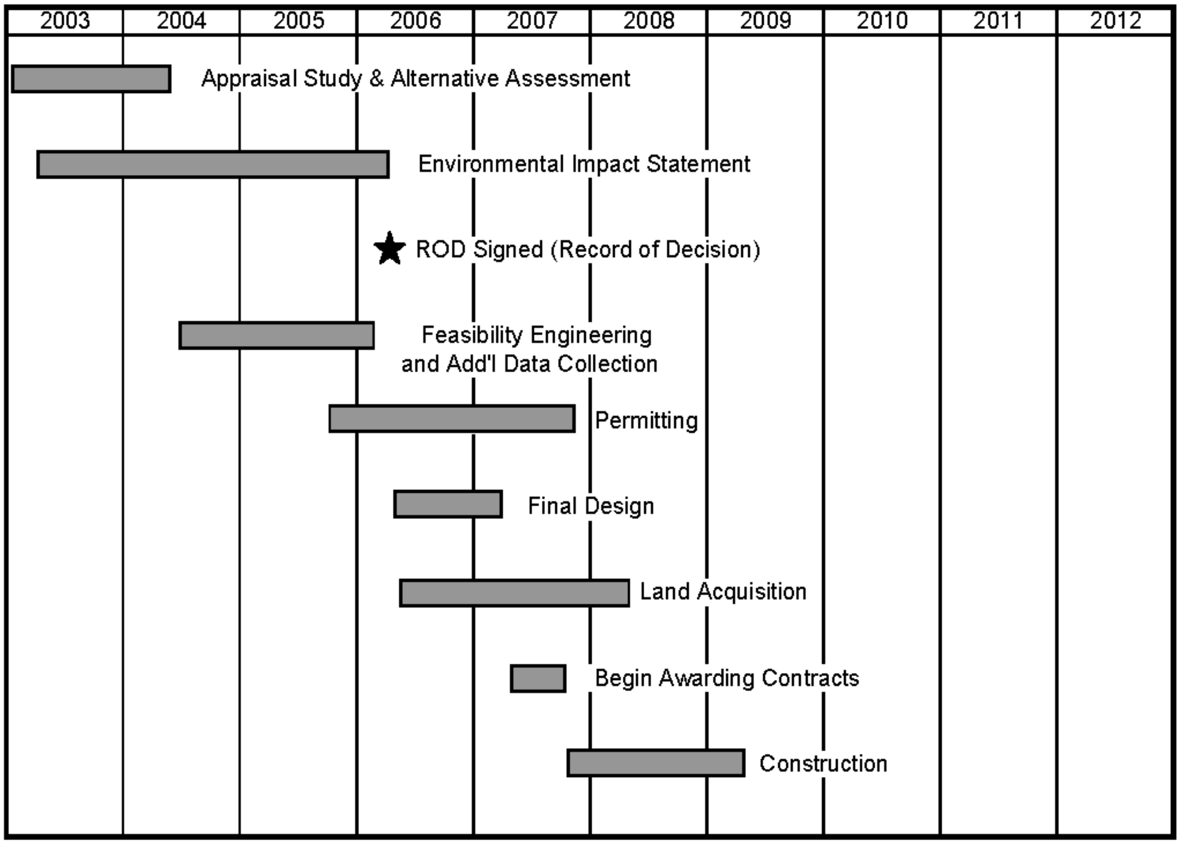


Figure 2.7-2 In-Valley/Drainage-Impaired Area Land Retirement Alternative Implementation Schedule

The summary of the present value and estimated annual equivalent costs for the In-Valley/Drainage-Impaired Land Retirement Alternative at less than 26,830 AF/year drainage volume (based on SLDFR appraisal-level design updates since September 2004) is included in Table 2.7-3. The assumptions for development of these cost estimates are discussed in Section 2.11.

Table 2.7-3
In-Valley/Drainage-Impaired Area Land Retirement Alternative,
Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	2.2	0.1
Evaporation Basins	39.7	2.4
Mitigation Facilities*	N/A	N/A
Reverse Osmosis Facilities	30.3	1.8
Biological Selenium Treatment	21.3	1.3
Land Retirement	725.5	43.6
Subtotal – Alternative-Specific Federal Costs	818.9	49.3
Common Federal Costs		
Drainage Collection System	2.8	0.2
Regional Reuse Facilities	34.0	2.0
Delta-Mendota Canal Drainage Collection/Reuse	1.8	0.1
Subtotal - Common Federal Costs	38.6	2.3
TOTAL – FEDERAL PROJECT COSTS	**857.5**	**51.6**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.8 OCEAN DISPOSAL ALTERNATIVE

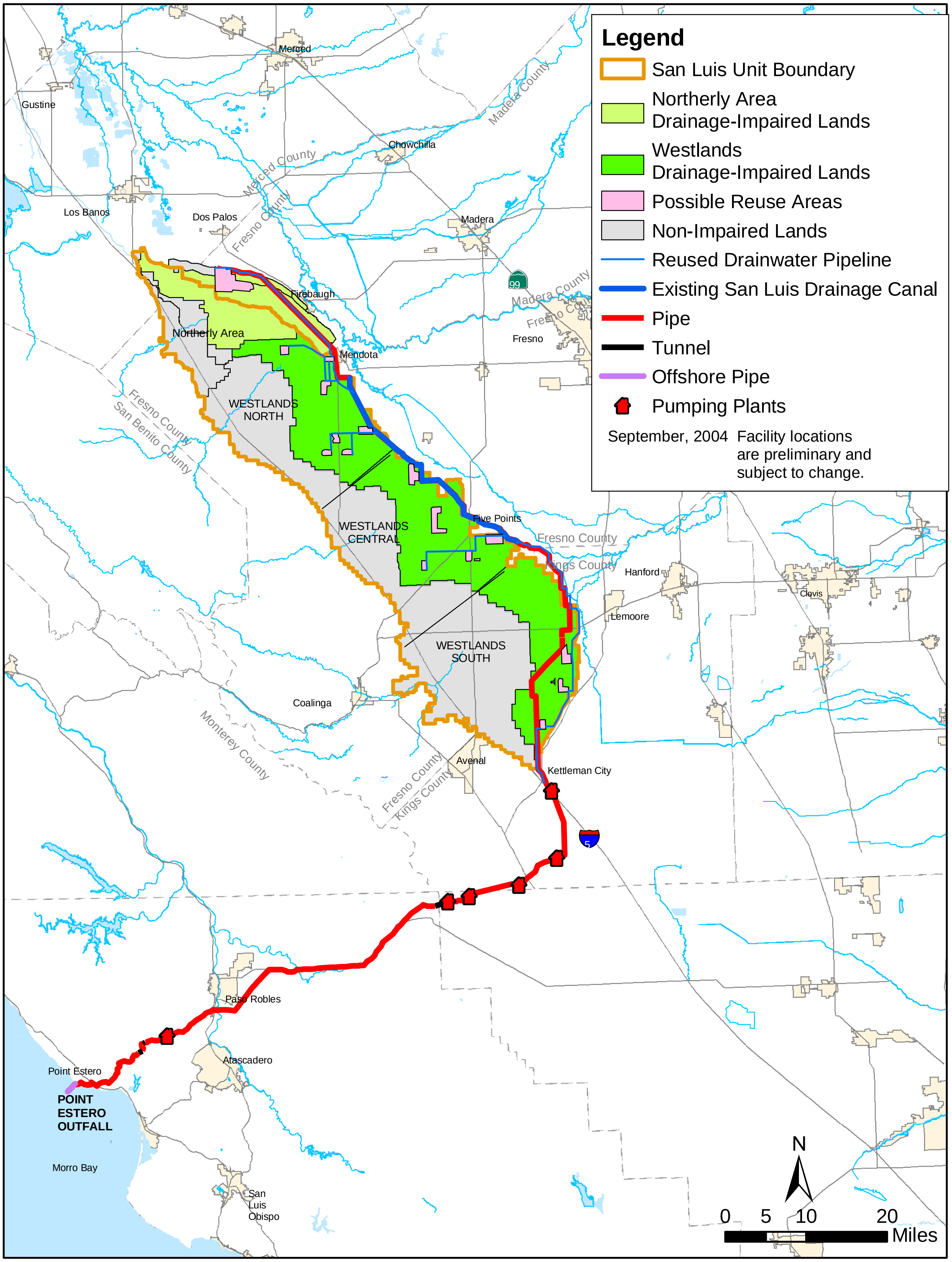
2.8.1 Description

The Ocean Disposal Alternative would include the common elements of all action alternatives: on-farm and in-district actions, drainwater collection systems, Firebaugh Sumps (Delta-Mendota Canal Drain), regional reuse facilities, and land retirement. Reused drainwater would be collected from the reuse facilities and transported by pipelines and tunnels to the Pacific Ocean for disposal. The pipeline conveyance system would lie within the San Joaquin Valley from near Los Banos southeast to just south of Kettleman City and then extend southwesterly to the Pacific Ocean at Point Estero. The ocean diffuser would be approximately 1.4 miles offshore at a depth of 200 feet, approximately 10 miles south of the southern boundary of the Monterey Bay National Marine Sanctuary.

The Federal components of this alternative are:

- Common elements
  - Drainwater collection system
  - Firebaugh Sumps (Delta-Mendota Canal Drain)
  - Regional reuse facilities
- Conveyance system
- Outfall

Figure 2.8-1 shows the general location and features of this alternative.



San Luis Drainage Feature Re-evaluation	Ocean Disposal Alternative Features	Figure 2.8-1
17324004		

URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_8-1_Ocean_Disposal_Alternative.mxd Date: 8/27/2004 1:48:47 PM Name: dhwrigh0

The drainwater aqueduct for the Ocean Disposal Alternative would include 211 miles of buried pipeline, with three tunnels through the coastal range and 23 pumping plants and sumps. The drainwater aqueduct begins at the Northerly Reuse Area, where water is collected below the surface and pumped to Pumping Plant O in Reuse Area O. This plant also receives water from Reuse Area N, by gravity flow, and Reuse Area O, which is pumped from a sump adjacent to Pumping Plant O.

Pumping Plant O pumps reuse water to Pumping Plant L. Along the way, the pipeline picks up reuse water from a pump located in Reuse Area M. Pumping Plant L also receives water from Reuse Areas I, J, and K by gravity flow. A pump adjacent to the pumping plant also collects Reuse Area L water and pumps it into Pumping Plant L.

Pumping Plant L pumps all of the water that it has collected to Pumping Plant H. Reuse Area H water is also pumped into the pumping plant by using an adjacent pump sump. All of this water from reuse areas north of Reuse Area H and from Reuse Area H is pumped to Reuse Area D. Along the way to Reuse Area D, the pipeline also collects water from Reuse Area G, where it is pumped from two locations.

Pumping Plant D also collects water from Reuse Areas E and F by gravity flow, and Reuse Area D, which is pumped into the plant from an adjacent sump. Pumping Plant D then pumps all of this water, which is all of the reuse water north of the Lemoore Navel Air Station runways, to Pumping Plant C.

Pumping Plant C pumps all of this water and water from Reuse Area C, by adjacent pump, to Pumping Plant A. Along the way, the pipeline collects water form Reuse Area B, which is pumped into the line. Pumping Plant A pumps all of this water, and that from Reuse Area A, which is pumped into the plant from an adjacent sump, to the ocean. The pipeline uses six more pumping plants to convey the reuse water to the ocean. These last six plants are not located in reuse areas. To the extent possible, existing right-of-ways and conveyance facilities would be used.

The aqueduct would collect drainwater at 16 locations near the existing San Luis Drain. The most northern intercept would be located south of Dos Palos. The aqueduct would proceed southerly to a point 10 miles south of Kettleman City, where it would head west to Point Estero. The aqueduct would proceed through and over the Coast Ranges and discharge into the ocean.

About 209.4 miles of 42-inch-diameter or less polyvinyl chloride (PVC) pipe and HDPE would be installed. About 2.1 miles of 7-foot-diameter tunnel would be excavated and a 1.1-mile-long siphon would be constructed. An additional 1.4 miles of HDPE pipeline would be installed either buried or suspended under water along the ocean floor.

The aqueduct would have only one diffuser, located 1.4 miles off Point Estero, 10 miles south of the Monterey Bay National Marine Sanctuary, at a depth of 200 feet.

Table 2.8-1 summarizes the key features and specifications of this alternative. The conveyance route and the principal components of the drainage aqueduct are included on Table 2.8-2.

Table 2.8-1
Summary of Features and Specifications, Ocean Disposal Alternative [1]

Component	Characteristic	
Drainage Area	Acres with tile drains installed	219,293
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	5,769
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	17,097
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	69,957
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	20,621
	Volume reduction in Westlands per year (AF)	28,347
Drainage Rate After Reuse	Drainage volume in AF/year (average)	20,988
	Drainage flow rate in cfs (average)	29.1
Treatment	Initial average Se concentration of reused drainwater (µg/L)	110
	Final average Se concentration of reused drainwater (µg/L)	220
	Volume to Se biological treatment per year (AF)	0
	Volume to RO treatment per year (AF)	0
	Initial Average Se concentration at point of discharge (µg/L)	110
	Final Average Se concentration at point of discharge (µg/L)	220
	Initial Average TDS concentration at point of discharge (mg/L)	12,500
	Final Average TDS concentration at point of discharge (mg/L)	19,000
Land Conveyance	Miles of pipe	209.4
	Miles of tunnel	2.1
Under Water Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0.71
	Miles of buried pipe under water	0.73
Total Conveyance	Total miles of conveyance	212.9
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	81,400,000
	Energy requirements for treatment (kw-hr/year)	0
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	19,000
	Acres of Se treatment facility	0
	Acres of evaporation basin	0
	Acres of temporary right-of-way[2]	1,980
	Acres of permanent right-of-way (conveyance, tunnel portals, and pumping plants)[3]	830
	Acres retired[4]	44,106
	Acres needed for drainage facilities not in retired lands	5,954
Biology	Acres of sensitive habitat affected[5]	55
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	0

Notes:

[1] The values reflect SLDFR appraisal-level designs as of September 2004.

[2] Includes temporary right-of-way for 3 tunnels/6 tunnel portals (60 acres), 6 pumping plants not in reuse areas (18 acres), and pipeline (75 feet wide). Some pumping plants are sited in reuse areas but are not included in right-of-way acres.

[3] Includes permanent right-of-way for 3 tunnels/6 tunnel portals (60 acres), 6 pumping plants not in reuse areas (12 acres), and pipeline (30 feet wide).

[4] Retired lands may be acquired by Reclamation for development of project facilities.

[5] Identified during appraisal-land analysis.

NA = not applicable to this Disposal Alternative.

Table 2.8-2
Conveyance Components of the Ocean Disposal Alternative

Item	Feature	Subfeature	Feature Length (miles)	Subfeature Length (miles)	Outlet Elevation (feet)	Inlet Elevation (feet)
1	Point Estero outfall	Diffuser	1.44		-200	
2		Suspended pipeline		0.71		
3		Buried pipeline		0.73		
4	Cottontail pipeline		11.35		0	1,278
5	Santa Lucia tunnel		0.50		1,278	1,280
6	Santa Rita siphon		1.11		1,280	1,318
7	Santa Rita tunnel Paso Robles pipeline		0.33 43.22		1,318 1,320	1,320 1,845
8		Reach 1				
9		PPPR1 1				
10		Reach 2				
11	Bluestone tunnel Kettleman City pipeline		1.23 46.13		1,845 1,850	1,850 225
12		Reach 1		0.93		
13		PP K1			1,425	
14		Reach 2		2.40		
15		PP K2			1,000	
16		Reach 3		6.8		
17		PP K3			600	
18		Reach 4		5.5		
19		PP K4			400	
20		Reach 5		10.50		
21		PP K5			300	
22				8.17		
23	Valley collection		120.27			

The potential facility locations and conveyance alignments were based on existing information that indicates they may be suitable for their intended purposes. Final selection of conveyance and facility locations will require additional field investigations and data analysis to evaluate engineering and environmental parameters (e.g., soils, groundwater, land use, and endangered and protected species) and issues raised in this EIS. The facilities would be designed to comply with current Federal and State regulations.

2.8.2 Implementation Schedule and Costs

A preliminary implementation schedule was developed for the Ocean Disposal Alternative, similar to previous alternatives (Figure 2.8-2). However, construction activities would take longer than in previous alternatives and would include the drainage collection system, drainage reduction measures, reuse facilities, and conveyance. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

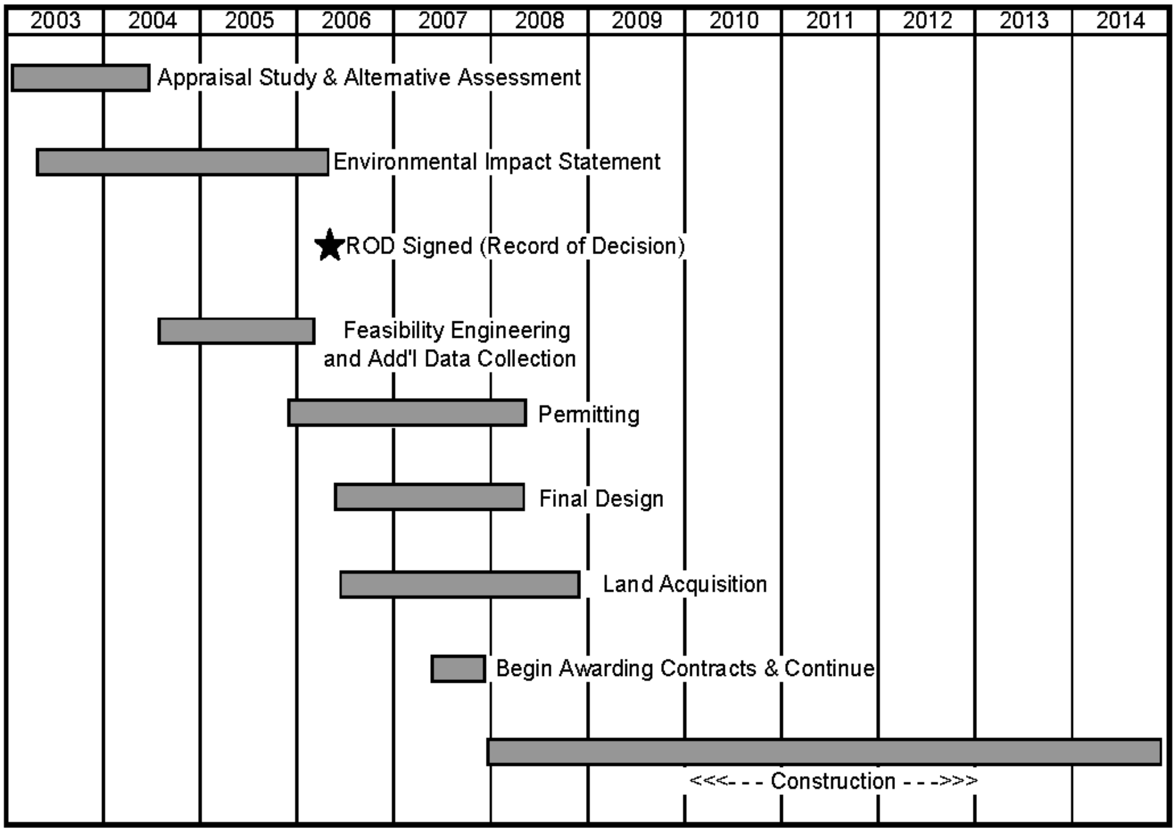


Figure 2.8-2 Ocean Disposal Alternative Implementation Schedule

The summary of the estimated present value and annual equivalent costs for the Ocean Disposal Alternative at less than 69,957 AF/year drainage volume (based on SLDFR appraisal-level design updates since September 2004) is included in Table 2.8-3. The assumptions for development of these cost estimates are discussed in Section 2.12.

Table 2.8-3
Ocean Disposal Alternative, Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	289.8	17.4
Evaporation Basins	0	0
Mitigation Facilities*	N/A	N/A
Reverse Osmosis Facilities	0	0
Biological Selenium Treatment	0	0
Land Retirement	10.2	0.6
Subtotal – Alternative-Specific Federal Costs	299.9	18.0
Common Federal Costs		
Drainage Collection System	184.1	11.1
Regional Reuse Facilities	77.0	4.6
Delta-Mendota Canal Drainage Collection/Reuse	1.7	0.1
Subtotal - Common Federal Costs	262.8	15.8
TOTAL – FEDERAL PROJECT COSTS	**562.7**	**33.8**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.9 DELTA-CHIPPS ISLAND DISPOSAL ALTERNATIVE

2.9.1 Description

The Delta-Chipps Island Disposal Alternative would include the common elements of all alternatives: on-farm and in-district actions, drainwater collection systems, Delta-Mendota Canal Drain, regional reuse facilities, and land retirement. RO treatment is not included in the Delta Disposal Alternative; however, reused drainwater would be treated with biological Se treatment. The Se biotreatment plant for the two Delta Disposal Alternatives (Delta-Chipps Island and Delta-Carquinez Strait) would be based on the same modular system described in the In-Valley Disposal Alternative. Drainwater from the four drainage service areas (Northerly, Westlands North, Westlands Central, and Westlands South) would be conveyed to a central Se biotreatment facility before conveyance by canal and pipeline to the Delta for disposal. The facility's location has not been determined. The canal and pipeline conveyance system would extend the existing San Luis Drain from its current terminal at Mud Slough to the north-northwest through Merced, Stanislaus, San Joaquin, and Contra Costa counties for disposal at the western end of the Delta at Chipps Island. The diffuser would be approximately 1 mile from the shoreline at Mallard Slough at a depth of 18 feet.

The Federal components of this alternative are:

- Common elements
  - Drainwater collection system
  - Firebaugh Sumps (Delta-Mendota Canal Drain)
  - Regional reuse facilities

- Selenium biotreatment
- Conveyance system
- Outfall

Figure 2.9-1 presents the general location and features of this alternative, except for the centralized Se biotreatment facility.

The drainwater aqueduct for the Delta-Chipps Island Disposal Alternative would traverse gradually sloping lands to flat lands. A total of about 160 miles of pipeline and canal would be installed, including 1 mile of buried pipe underwater. In addition, about 83 miles of the existing San Luis Drain would be used, for a total conveyance length of 143 miles.

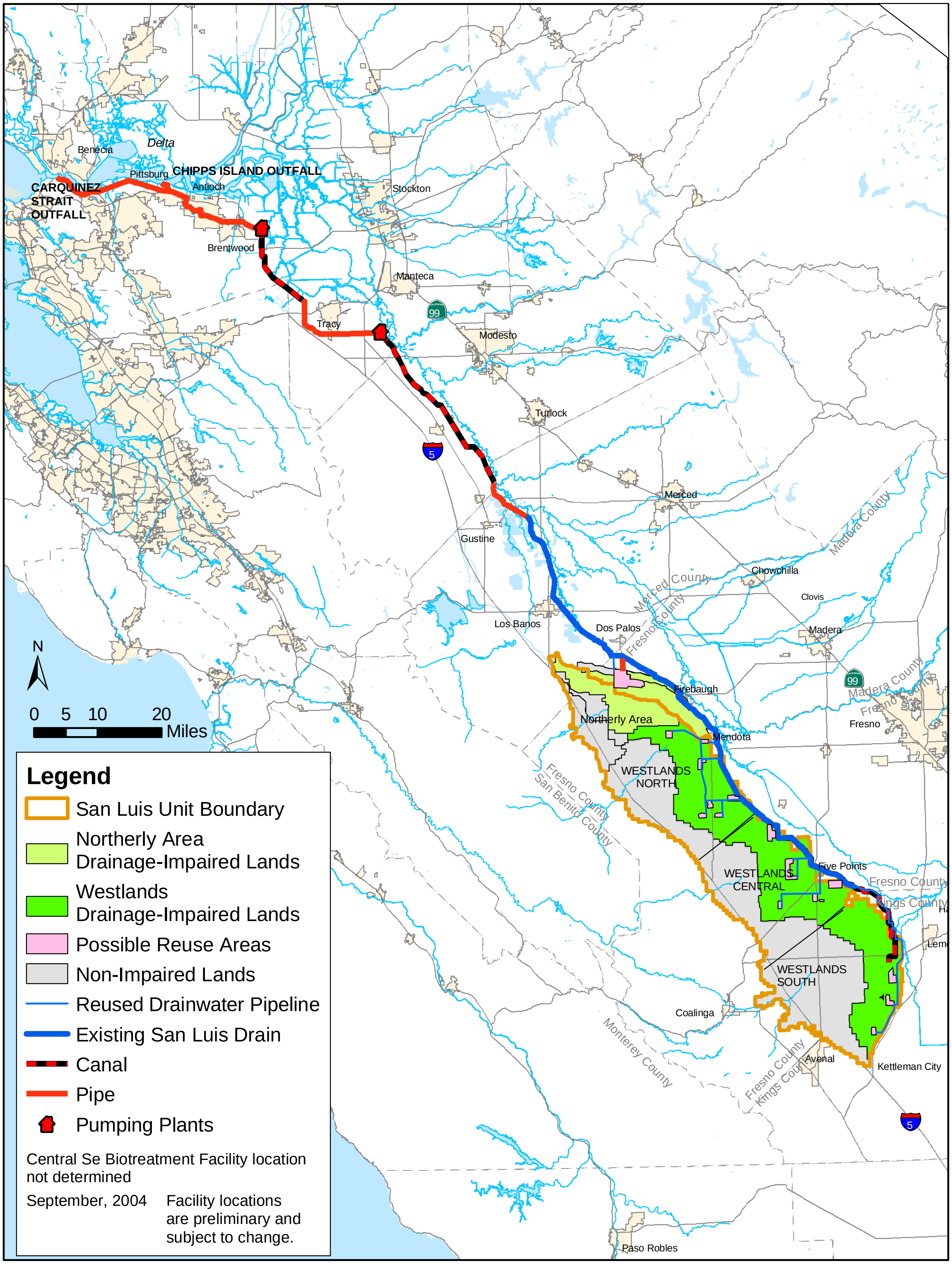
Relatively inexpensive canals and buried low-head pipelines would be used for conveyance in agricultural and sparsely populated areas. In the vicinity and through urban and rapid growth areas, the conveyance would be by pipelines. In two uphill areas, the flow would be in high-pressure pipelines from two pumping plants. One pumping plant would be located near the junction of Linne and Kasson roads, northwest of the San Joaquin River Club. The second pumping plant, located northeast of Brentwood, would deliver flow uphill toward Contra Loma Regional Park south of Antioch. Most of the pipeline alignment would follow existing highways, canals, and railroad tracks.

Conveying the water out of the valley area requires an additional 10 plants. Most of these plants pump water directly to the existing San Luis Drain. Plants in Reuse Areas A through C pump water from one to the other before pumping to the Drain. The pumping plant at Reuse Area O collects water from Reuse Area N before pumping to the Drain. Many reuse areas use gravity flow to convey their water to the Drain.

Drains would be designed with a 4-foot-wide bottom, a side slope of 2:1, and concrete lining. Pipelines would be designed with a 36-inch-diameter pipe for high-pressure lines and 60-inch-diameter pipe for low-head lines. Rugosity or roughness would be equal to 0.00001 foot. Approximately 10 miles of the high-pressure pipeline in urban areas, such as Pittsburg, would be constructed within narrow railroad right-of-ways that would reduce the efficiency of pipeline installation. Collection pipelines in the Valley range from a 6- to 18-inch diameter. The point of discharge would be 1 mile from the shoreline at Mallard Slough at a depth of 18 feet.

Final selection of conveyance and facility locations would require additional field investigations and data analysis to evaluate a variety of engineering and environmental parameters (e.g., soils, groundwater, land use, and endangered and protected species), and issues raised in this EIS. Potential locations were based on existing information that indicates these locations may be suitable for their intended purposes. The facilities would be designed to comply with current Federal and State regulations governing geology, seismicity, soils, stormwater, and discharges to surface waters.

Table 2.9-1 summarizes the key features and specifications. The principal components of the drainage aqueduct are included in Table 2.9-2.



URS Corporation L:\Projects\San Luis Drainage\MXD\Admin_Draft_EIS_Report2_08312004\Figure_2_9-1_Delta_Disposal_Alternative.mxd Date: 8/27/2004 1:52:23 PM Name: dhwrigh0

San Luis Drainage Feature Re-evaluation	Delta Disposal Alternatives Features	Figure 2.9-1
17324004		

Table 2.9-1
Summary of Features and Specifications, Delta-Chipps Island Disposal Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains installed	219,293
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	5,769
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	17,097
Drainage Rate Drainwater Reduction	Drainage volume per year (AF)	69,957
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	20,621
	Volume reduction in Westlands per year (AF)	28,347
Drainage Rate After Reuse	Drainage volume in AF/per year (average)	20,988
	Drainage flow rate in cfs (average)	29.1
Treatment	Initial average Se concentration of reused drainwater (µg/L)	110
	Final average Se concentration of reused drainwater (µg/L)	220
	Volume to Se biological treatment per year (AF)	20,988
	Volume to RO treatment per year (AF)	0
	Initial average Se concentration at point of discharge (µg/L)	10
	Final average Se concentration at point of discharge (µg/L)	10
	Initial TDS concentration at point of discharge (mg/L)	12,500
	Final TDS concentration at point of discharge (mg/L)	19,000
Land Conveyance	Miles of pipe	113.0
	Miles of new canal	45.6
	Miles of existing canal	83
Under Water Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	1
Total Conveyance	Total miles of conveyance	242.6
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	14,000,000
	Energy requirements for Se bio treatment (kw-hr/year)	1,000,000
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	19,000
	Acres of Se treatment facility (1 plant)	8
	Acres of evaporation basin	0
	Acres of temporary right-of-way[2]	1,600
	Acres of permanent right-of-way (pipeline)[3]	420
	Acres of permanent right-of-way (canal) [3]	560
	Acres retired[4]	44,106
	Acres needed for drainage facilities not in retired lands	5,954
Biology	Acres of sensitive habitat affected[5]	73
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	0

Notes:
[1] The values reflect SLDFR appraisal-level designs as of September 2004.
[2] Includes temporary right-of-way for 2 pumping plants and regulating tanks (8 acres), pipeline (75 feet wide), and canal (100 feet wide).
[3] Includes permanent right-of-way for 2 pumping plants and regulating tanks (6 acres), pipeline (30 feet wide), and canal (100 feet wide).
[4] Retired lands may be acquired by Reclamation for development of project facilities.
[5] Identified during appraisal-land analysis.
NA = not applicable to this Disposal Alternative.

Table 2.9-2
Conveyance Components of the Delta-Chipps Island Disposal Alternative

Component	Length (miles)	Conveyance Component
Valley Collection Canal		Canal
Existing San Luis Drain from southern terminus to Northern Areas Reuse Facility Collector		56 miles of existing canal
Valley Collection Pipeline	68.6	Pipeline
Existing San Luis Drain from Collector to its terminus in Kesterson National Wildlife Refuge		27 miles of existing canal
Terminus of existing San Luis Drain to Hills Ferry (through Wildlife Refuge)	8.6	Pipeline (Low Head)
Hills Ferry to Pump Station at San Joaquin River Club	30.5	Canal or Pipeline (Low Head)
Pump Station at San Joaquin River Club to Hansen/Byron Bethany Road west of Tracy	16.0	Pipeline (High Pressure)
Hansen/Bethany west of Tracy to Brentwood Pump Station [1]	15.1	Canal or Pipeline (Low Head)
Brentwood Pump Station to Willow Pass Road @ PG&E Pumping Plant (west of Pittsburg)	18.3	Pipeline (High Pressure)
Willow Pass Road @ PG&E Pumping Plant (west of Pittsburg) to shoreline (Mallard Slough)	1.5	Pipeline (High Pressure)
Shoreline Mallard Slough to diffuser south of Chipps Island	1.0	Offshore Pipeline (High Pressure)
Total Length (new construction)	**159.6**	
Total Length (including existing San Luis Drain)	**242.6**	

Note:
[1]A 60-inch-diameter low-head pipeline was considered as an alternative to the open channel in these segments. However, the channel was the most cost-effective option and was selected.

There would be one Se biotreatment plant for the Delta-Chipps Island Disposal Alternative. Drainwater from the four drainage areas (Northerly, Westlands North, Westlands Central, and Westlands South) would be conveyed to a central Se biotreatment facility before conveyance by canal and pipeline to the Delta for disposal. The flow rate to the biotreatment plant would be approximately 20,988 AF/yr. These flows are based on the assumption that the drainage rate from the reuse area would be maintained at a fairly constant level throughout the year. The flow-weighted average Se and TDS concentrations after several years of reuse facility operation are estimated to be up to 220 µg/L and 19,000 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants can remove Se to below 10 µg/L in the treated effluent

2.9.2 Implementation Schedule and Costs

A preliminary implementation schedule was developed for both the Delta Disposal Alternatives (Figure 2.9-2), similar to previous alternatives. The timeframe for construction is slightly shorter than the Ocean Disposal Alternative and includes the drainage collection system, drainage reduction measures, reuse facilities, Se biotreatment plants, and conveyance. A projection of drainage buildup for the installation of subsurface drainage systems is provided in Appendix C, Section C1.1.5.

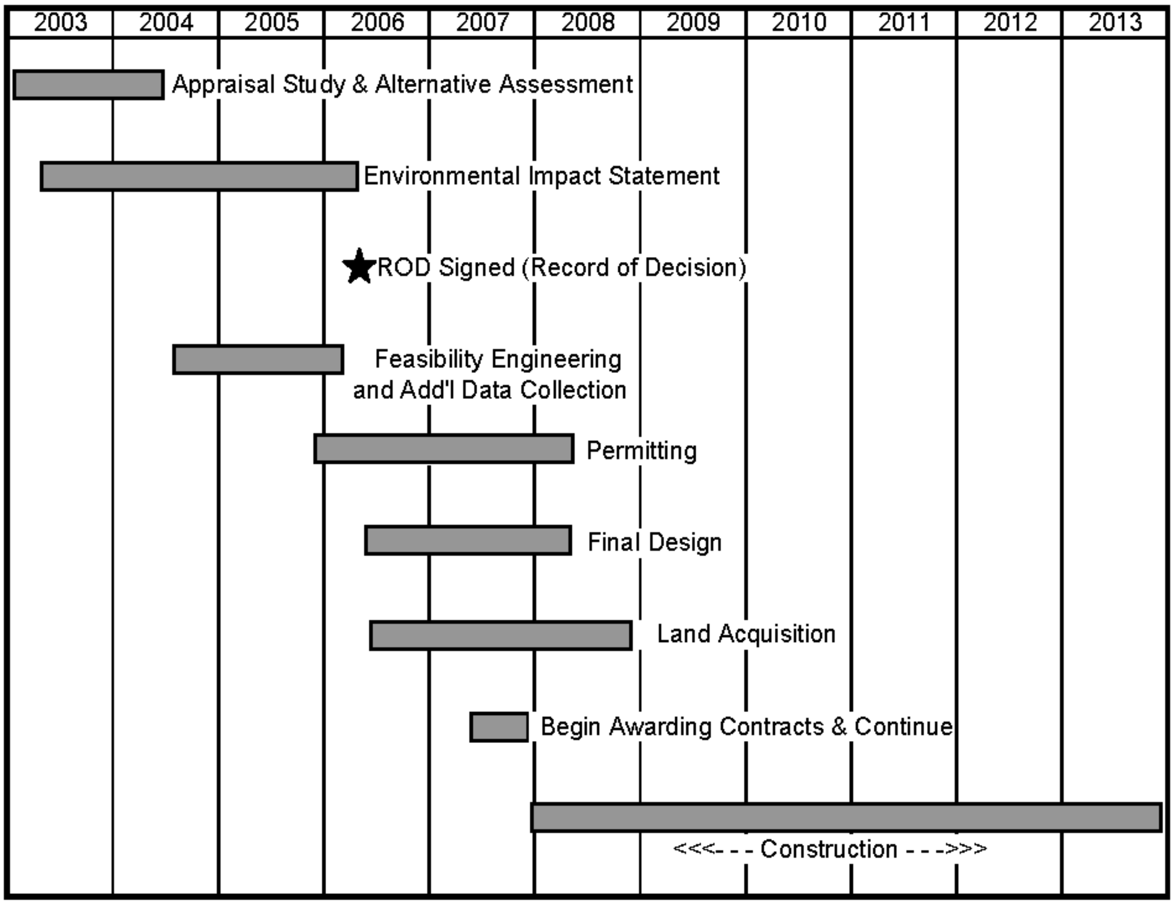


Figure 2.9-2 Delta Disposal Alternatives Implementation Schedule

The summary of the estimated present value and annual equivalent costs for the Delta-Chipps Island Disposal Alternative at less than 69,957 AF/year drainage volume (based on SLDFR appraisal-level design updates since September 2004) is included in Table 2.9-3. Assumptions for estimating costs are provided in Section 2.12.

Table 2.9-3
Delta-Chipps Island Disposal Alternative,
Present Worth of Total Federal Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	179.7	10.8
Evaporation Basins	0	0
Mitigation Facilities*	N/a	N/a
Reverse Osmosis Facilities	0	0
Biological Selenium Treatment	108.1	6.5
Land Retirement	10.2	0.6
Subtotal – Alternative-Specific Federal Costs	298.0	17.9
Common Federal Costs		
Drainage Collection System	185.7	11.2
Regional Reuse Facilities	77.0	4.6
Delta-Mendota Canal Drainage Collection/Reuse	1.7	0.1
Subtotal - Common Federal Costs	264.5	15.9
TOTAL – FEDERAL PROJECT COSTS	**562.4**	**33.8**

*Mitigation facilities may be a component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

2.10 DELTA-CARQUINEZ STRAIT DISPOSAL ALTERNATIVE

2.10.1 Description

This alternative has the same route and design elements as the Delta-Chipps Island Disposal Alternative, except that it continues west along the railroad tracks past Martinez to Carquinez Strait Regional Shoreline to the city of Crockett, where it goes offshore to the diffuser for disposal immediately upstream of Carquinez Bridge. Tidal flows heavily influence the mixing of the water in this area. Figure 2.9-1 shows the key features of this alternative and presents the general location of its components. Table 2.10-1 summarizes key features and specifications of this alternative. The conveyance route is shown on Figure 2.9-1 and the principal components of the drainage aqueduct are included in Table 2.10-2.

A total of about 177 miles of pipeline and canal would be installed, including 1 mile of pipe buried underwater. In addition, about 83 miles of the existing San Luis Drain would be used, for a total conveyance length of 260 miles. Approximately 20 miles of pipeline would be installed within the narrow railroad right-of-ways in urban areas, such as Pittsburg, and along the railroad tracks on the shoreline from Mallard Slough to Carquinez Strait. The limited right-of-way can be expected to reduce the efficiency of pipeline installation. The diffuser would be approximately 16 miles downstream of the western end of the Delta and 1 mile from the shoreline at Crockett at a depth of 18 feet. This disposal location has greater tidal action and is further removed from drinking water intakes than the Delta-Chipps Island Alternative.

There would be one Se biotreatment plant for the Delta-Carquinez Straight Disposal Alternative. Drainwater from the four drainage areas (Northerly, Westlands North, Westlands Central, and

Westlands South) would be conveyed to a central Se biotreatment facility before conveyance by canal and pipeline for disposal immediately upstream of Carquinez Bridge. The flow rate to the biotreatment plant would be approximately 20,988 AF/yr. These flows are based on the assumption that the drainage rate from the reuse areas would be maintained at a fairly constant level throughout the year. The flow-weighted average Se and TDS concentrations after several years of reuse facility operation are estimated to be up to 220 μg/L and 19,000 mg/L, respectively. Based on results of laboratory and pilot tests of this technology using actual drainwater, it is estimated that full-scale biotreatment plants can remove Se to below 10 μg/L in the treated effluent

2.10.2 Implementation Schedule and Costs

The time to implement this alternative is the same as for the Delta-Chipps Island Disposal Alternative (see Section 2.9 and Figure 2.9-2). Drainage service would begin in October 2013.

The summary of the estimated present value and annual equivalent costs for the Delta-Carquinez Strait Disposal Alternative at 29.1 cfs is included in Table 2.10-3. The same design considerations and assumptions identified for the Delta-Chipps Island Disposal Alternative apply to this alternative.

Table 2.10-1
Summary of Features and Specifications, Delta-Carquinez Strait Disposal Alternative[1]

Component	Characteristic	
Drainage Area	Acres with tile drains installed	219,293
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	5,769
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	17,097
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	69,957
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	20,621
	Volume reduction in Westlands per year (AF)	28,347
Drainage Rate After Reuse	Drainage volume in AF/year (average)	20,988
	Drainage flow rate in cfs (average)	29.1
Treatment	Initial average Se concentration of reused drainwater (µg/L)	110
	Final average Se concentration of reused drainwater (µg/L)	220
	Volume to Se biological treatment per year (AF)	20,988
	Volume to RO treatment per year (AF)	0
	Initial Average Se concentration at point of discharge (µg/L)	10
	Final average Se concentration at point of discharge (µg/L)	10
	Initial TDS concentration at point of discharge (mg/L)	12,500
	Final TDS concentration at point of discharge (mg/L)	19,000
Land Conveyance	Miles of pipe	130.4
	Miles of new canal	45.6
	Miles of existing canal	83
Under Water Conveyance	Miles of tunnel pipe under water	0
	Miles of suspended pipe under water	0
	Miles of buried pipe under water	1
Total Conveyance	Total miles of conveyance	260
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	14,000,000
	Energy requirements for Se bio treatment (kw-hr/year)	1,000,000
	Energy generated (kw-hr/year)	0
Land Requirements	Acres of reuse	19,000
	Acres of Se treatment facility (1 plant)	8
	Acres of evaporation basin	0
	Acres of temporary right-of-way[2]	1,750
	Acres of permanent right-of-way (pipeline)[3]	480
	Acres of permanent right-of-way (canal)	560
	Acres retired[4]	44,106
	Acres needed for drainage facilities not in retired lands	5,954
Biology	Acres of sensitive habitat affected[5]	120
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	0

Notes:
[1] The values reflect SLDFR appraisal-level designs as of September 2004.
[2]Includes temporary right-of-way for 2 pumping plants and regulating tanks (8 acres), pipeline (75 feet wide) and canal (100 feet wide).
[3]Includes permanent right-of-way for 2 pumping plants and regulating tanks (6 acres), pipeline (30 feet wide) and canal (100 feet wide
[4]Retired lands may be acquired by Reclamation for development of project facilities.
[5]Identified during appraisal-land analysis.
NA = not applicable to this Disposal Alternative.

Table 2.10-2
Conveyance Components of the Delta-Carquinez Strait Disposal Alternative

Component	Length (miles)	Conveyance Component
Valley Collection Canal		Canal
Existing San Luis Drain from southern terminus to Northern Areas Reuse Facility Collector		56 miles of existing canal
Valley Collection Pipeline	68.6	Pipeline
Existing San Luis Drain from Collector to its terminus in Kesterson National Wildlife Refuge		27 miles of existing canal
Terminus of existing San Luis Drain to Hills Ferry (through Wildlife Refuge)	8.6	Pipeline (Low Head)
Hills Ferry to Pump Station at San Joaquin River Club	30.5	Canal or Pipeline (Low Head)
Pump Station at San Joaquin River Club to Hansen/Byron Bethany Road west of Tracy	16.0	Pipeline (High Pressure)
Hansen/Bethany west of Tracy to Brentwood Pump Station[1]	15.1	Canal or Pipeline (Low Head)
Brentwood Pump Station to Willow Pass Road @ PG&E Pumping Plant (west of Pittsburg)	18.3	Pipeline (High Pressure)
Willow Pass Road @ PG&E Pumping Plant (west of Pittsburg) to Crockett	18.9	Pipeline (High Pressure)
Crockett shoreline to diffuser in Carquinez Strait	1.0	Offshore Pipeline (High Pressure)
Total Length (new construction)	**177.0**	
Total Length (including existing San Luis Drain)	**260.0**	

Table 2.10-3
Delta-Carquinez Strait Disposal Alternative,
Present Worth of Federal Project Costs

Project Features	Present Value ($1,000,000)	Annual Equivalent ($1,000,000)
FEDERAL PROJECT COSTS		
Alternative-Specific Federal Costs		
Conveyance System	215.5	13.0
Evaporation Basins	0	0
Mitigation Facilities*	N/A	N/A
Reverse Osmosis Facilities	0	0
Biological Selenium Treatment	108.1	6.5
Land Retirement	10.2	0.6
Subtotal – Alternative-Specific Federal Costs	333.7	20.1
Common Federal Costs		
Drainage Collection System	185.7	11.2
Regional Reuse Facilities	77.0	4.6
Delta-Mendota Canal Drainage Collection/Reuse	1.7	0.1
Subtotal - Common Federal Costs	264.5	15.9
TOTAL – FEDERAL PROJECT COSTS	**598.2**	**36.0**

*Mitigation facilities may be component of any of the action alternatives. Sufficient detail is not currently available for calculation of costs.

Section 2.12 further discusses the assumptions used in these cost estimates.

2.11 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

NEPA regulations (40 Code of Federal Regulations [CFR] 1502.14[a]) require that this section include and evaluate all reasonable alternatives. Each action alternative is to fulfill the requirements of the purpose of and need for the action as described in Section 1.1 of this EIS. The project purpose is to provide agricultural drainage service to the San Luis Unit and the general area to achieve long-term, sustainable salt and water balance in the root zone of irrigated lands. Drainage service is defined as managing the regional shallow groundwater table by collecting and disposing of shallow groundwater from the root zone and/or reducing contributions of water to the shallow groundwater table through land retirement.

This section describes potential alternatives that were considered and eliminated from further evaluation, based on the alternative's failure to meet the purpose and need or for other technical reasons that meant the alternative was infeasible or otherwise unreasonable. A brief description of the process of developing and screening the other alternatives is provided, based on the discussion contained in Reclamation's PFR (Reclamation 2002) and PFR Addendum (Reclamation 2004b), which are incorporated by reference into this EIS. This summary is followed by the reasons why other alternatives, including various land retirement scenarios, were eliminated from further analysis in this EIS.

2.11.1 Preliminary Alternatives

Reclamation identified 21 preliminary alternatives that were presented in the PAR (Reclamation 2001b). The PAR identified a wide range of alternatives for providing drainage service based on two broad initial screening criteria: an alternative must (1) meet the Court order and (2) utilize proven technology. The 21 alternatives in the PAR were grouped among three broad concepts: In-Valley Disposal, Out-of-Valley Disposal, and Beneficial Use.

The concept of beneficial use alternatives was subsequently eliminated to reduce overlapping and redundancy among the alternatives. It was recognized that all beneficial use options could be incorporated within the In-Valley and Out-of-Valley Disposal Alternatives. The most significant opportunity for beneficial use is irrigation of salt-tolerant crops (referred to as “Integrated Drainage Management” in the PAR). This reuse option can be applied to both the In-Valley and Out-of-Valley Alternatives. In addition, the RO facility produces product water (Delta and In-Valley Disposal Alternatives). Salt from the evaporation basins could be recovered, depending on market forces (In-Valley Disposal Alternative).

Several of the preliminary alternatives in the PAR included components that have since been eliminated due to uncertainties regarding their technical and/or economic viability. For example, deep-well disposal would require additional field investigations to determine whether the subsurface geology has the capacity to receive and isolate injected drainwater. A determination of the potential for salt reuse would require laboratory and field testing to evaluate precipitation processes, as well as a marketing analysis of potential salt users. While these investigations have been initiated, the results are not yet available. Although these drainage service options have been eliminated from the list of alternatives, they could be reinstated in the future if the field results are positive.

2.11.2 Complete Alternatives

Many of the preliminary alternatives in the PAR were eliminated, modified, or repackaged to develop complete, stand-alone alternatives that met the project purpose and need. The next stage of the evaluation process was to develop complete In-Valley and Out-of-Valley Disposal Alternatives and then compare and rate them on the basis of cost, implementation, and expected environmental effects. Between December 2001 and June 2002, site visits and additional public scoping helped the Project Team to develop more specific evaluation criteria and apply those criteria to determine reasonable alternatives requiring further evaluation.

Because drainwater flows had not yet been refined, two scenarios derived from two different drainage rates were evaluated for each disposal alternative. A drainage rate of 0.3 AF/acre of irrigated land was used to represent the drainwater yield assuming a variety of drainwater reduction measures were implemented. A drainage rate of 0.5 AF/acre of irrigated land was used to represent the drainwater yield assuming no drainwater reduction measures were implemented.

2.11.2.1 Ocean Disposal Alternatives

Two general locations were considered in the Pacific Ocean along the California coast for drainwater disposal (shown on Figure 4.2-1 in the PFR). One location is near Needle Point and the other is near Point Estero. These locations have different aqueduct and disposal requirements. The Needle Point location is a few miles west of the city of Santa Cruz and 2.53 miles offshore.

The diffuser would be within the Monterey Bay National Marine Sanctuary. Point Estero is about 120 miles south of the Needle Point site and located nearly 10 miles outside the southern boundary of the Monterey Bay National Marine Sanctuary. Outfall locations were identified from the Brown and Caldwell (1987) report.

Elements for each outfall option included the existing San Luis Drain as a right-of-way, piping the drainwater through/over the Coast Ranges, and discharging the water in the ocean. To the extent possible, existing right-of-ways and conveyance facilities would be used. Criteria for selecting the depth and offshore distance of the ocean outfall locations were:

- Ocean currents
- Drainwater to ocean temperature differential
- Depth of the discharge pipe
- Effects to marine life
- Water chemistry

The Needle Point aqueduct would intercept the drainwater in the existing San Luis Drain a few miles east of Los Banos, near Highway 152. From the intake, the aqueduct would proceed westerly to Monterey Bay. Three routes are possible as the aqueduct approaches the Monterey Bay. One route would convey the drainwater through the city of Santa Cruz in a pipeline, the second would use a tunnel under the bay between the shore and the diffuser, and the third route would use a pipeline suspended off the bay floor to the diffuser. All of these alternatives would discharge their waters into the Monterey Bay National Marine Sanctuary

2.11.2.2 In-Valley Disposal Alternatives

Six In-Valley Disposal Alternatives are described below. A flow chart schematic of these alternatives is provided on Figure 2.11-1.

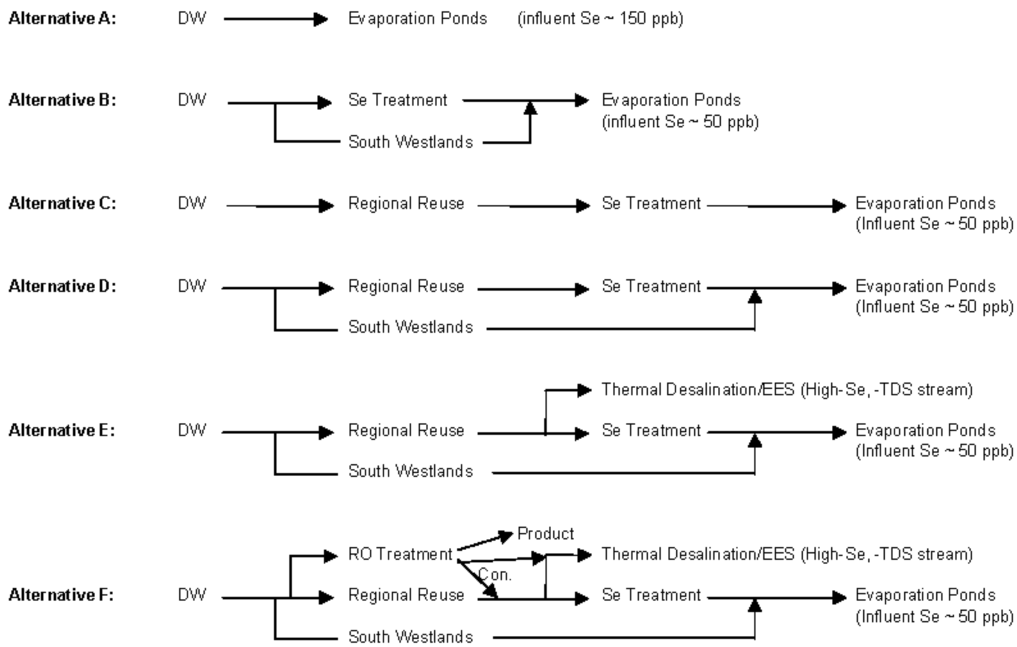


Figure 2.11-1 Schematic of In-Valley Disposal Alternatives

- **Alternative A.** Drainwater from all zones is conveyed and discharged to evaporation basins. Dried salts are disposed in place at the end of the project. Drainwater quality remains stable during the life of the project. Average Se concentration of the combined drainwater going into the evaporation basins is about 150 ppb.
- **Alternative B.** Low-Se (<50 ppb) drainwater from Westlands South (about 25 percent of total drainwater) is discharged directly to evaporation basins. Drainwater from all other zones is treated biologically to remove Se to a concentration below 50 ppb and subsequently discharged to evaporation basins.
- **Alternative C.** Drainwater from all zones is conveyed to regional reuse facilities where it is used to irrigate salt-tolerant crops. ET within the reuse facilities reduces the drainwater volume by about 75 percent. The reused drainwater is collected in tile drains and conveyed to a biological treatment facility to reduce the concentration of Se. The initial quality of the reused drainwater is that of the perched aquifer. During the life of the project, however, the drainwater gradually becomes more concentrated. After 50 years, it is estimated that the reused drainwater would contain about 20,000 mg/L of TDS and about 300 ppb of Se. Reused and treated drainwater is discharged to evaporation basins for final disposal.
- **Alternative D.** Low-Se (<50 ppb) drainwater from Westlands South (about 25 percent of total drainwater) is discharged directly to evaporation basins. Drainwater from all other zones is conveyed to regional reuse facilities, followed by biological treatment to reduce the concentration of Se, and then discharged to evaporation basins.
- **Alternative E.** Low-Se (<50 ppb) drainwater from Westlands South (about 25 percent of total drainwater) is discharged directly to evaporation basins. Drainwater from all other zones is conveyed to regional reuse facilities. Subsequent treatment and disposal of the reused drainwater is dependent upon the TDS concentrations. Biological treatment of drainwater

may not be effective or economical at TDS concentrations above 20,000 mg/L. This alternative presumes drainwater with TDS > 20,000 mg/L (i.e., Westlands North and Central) is disposed through a combination of thermal desalination and an enhanced evaporation system (EES). Reused drainwater with TDS below 20,000 mg/L (i.e., GDA) is treated biologically and discharged to evaporation basins. An EES would be used only when ambient conditions yield evaporation rates > 90 percent so that residual liquid spray is minimized to the point that ponding does not occur. Thermal desalination would reduce the high-Se/TDS drainwater to dried salt during the periods when an EES is not used. In this alternative, thermal desalting and an EES is compared to the combination of biological treatment and evaporation basins in Alternative D for the disposal of high-Se/TDS drainwater.

- **Alternative F.** This alternative is identical to Alternative E except that drainwater flows are split between reuse and RO treatment as competing methods of concentration. Reuse is estimated to reduce the volume of drainwater by about 75 percent through ET. Similarly, RO treatment could reduce the drainwater volume by as much as 75 percent. The resulting waste streams would be similar in both quantity and quality; however, RO treatment also produces high quality product water that can be reused for irrigation of salt-sensitive crops. The RO concentrate stream would be disposed by either the thermal desalting/EES combination or the biotreatment/evaporation combination depending on the TDS concentration. In this alternative, the economics of RO desalting is compared to the economics of regional reuse as competing methods of drainwater concentration.

2.11.3 Disposal Alternatives Eliminated

The evaluation process to determine the most feasible and reasonable of the above alternatives for further evaluation is described in detail in the PFR (Section 4), which is incorporated by reference into this EIS. After the preliminary alternatives were identified, further screening criteria were developed for three evaluation factors or categories: cost, implementation, and potential environmental effects. The screening criteria and the evaluation factors are shown in Table 2.11-1.

While cost and time are quantitative factors (natural scales of number of dollars and years), most of the other factors are subjective or nonquantitative and need a constructed evaluation scale. To simplify the screening process, the nonquantitative factors were ranked with numbers 1 through 5. The most positive is 5, 3 is neutral, and 1 is the most negative.

These criteria were incorporated into a matrix for use at a Project Team workshop in June 2002. The completed matrices with the resulting scores are included in Appendix C of the PFR. The findings of this evaluation and screening process are summarized below by disposal alternative:

Ocean Disposal. The Point Estero option was selected over the three Needle Point options for the following reasons:

- Time to implement was less for Point Estero, 13 years rather than 18.
- Point Estero discharge location is outside the Monterey Bay National Marine Sanctuary.
- The more southerly alignment of the Point Estero conveyance has the potential for other drainage producers to utilize the conveyance and disposal facilities.
- Point Estero had the highest average score for "other factors" (17.75 versus 11-12.75).

Delta Disposal. The Chipps Island discharge location had the lowest cost, but "other factors" scored lower. The Carquinez Strait location was kept for further analysis, even though the cost was higher, because it avoids critical Suisun Marsh habitat, it avoids municipal water intakes near Antioch, and it is subject to greater tidal velocities and mixing.

Table 2.11-1
Screening Criteria and Factors

- Cost
  - Annual equivalent
  - Construction costs
- Implementation
  - Time to implement
  - *Public acceptability*
    - *Political*
    - *Public*
  - *Legal and institutional constraints (permitting process)*
  - *Flexibility to meet changing conditions*
    - *Potential future regulations*
    - *Changes in drainage quantity or quality*
- Environmental Impacts
  - Land impacts
    - Permanent land takes (acres)
    - Temporary construction impacts (acres)
  - *Risk*
    - *Social*
    - *Environmental*

Note: Nonquantitative factors are shown in italics.

In-Valley Disposal. Of the six In-Valley alternatives, Alternatives A and B were eliminated based on cost and land requirements. Alternatives C, D, E, and F were kept for optimization because they met the construction cost factor threshold (30 percent from the lowest cost), had the shortest time to implement (2 to 8 years), and had the highest scores for "other factors" (19.5 to 22.25).

The results of the screening process were subject to additional review and refinement, and the results of this refinement are contained in Section 5 and Appendices A and C of the PFR. This refinement process included the following key components:

- Development of cost curves for drainage quantity versus cost
- Update of conveyance routes and land costs
- Review of timelines for permits
- Optimization of drainwater reduction options
- Evaluation of treatment options
- Packaging of disposal with drainwater reduction, treatment, and reuse components

Additional analyses were required to further reduce the number of In-Valley Disposal Alternatives. Figure 2.11-2 shows the results of the additional analyses, specifically the alternatives and components of alternatives that were eliminated. The rationale for this elimination is provided below.

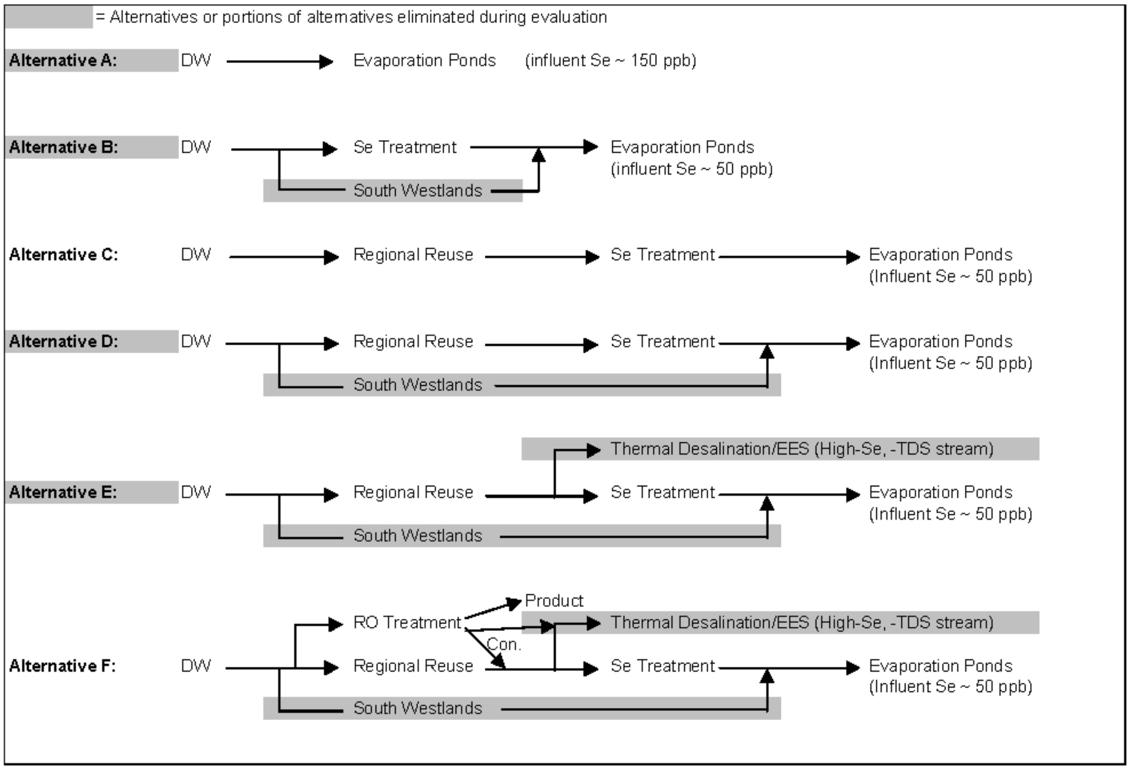


Figure 2.11-2 Additional Evaluation of In-Valley Disposal Alternatives

The cost per unit of drainwater treated or disposed was calculated for each of the components in these alternatives. A comparison of the unit costs found that reuse is much less expensive than all other components per unit of drainwater disposed. It was concluded that all drainwater should be reused on salt-tolerant crops prior to other treatment and disposal options. Consequently, Alternative D was eliminated, and the South Westlands bypass option was removed from all alternatives.

The unit cost for the combination of thermal desalting/EES was much higher than the unit cost for the combination of biotreatment/evaporation. Additionally, it was determined that biotreatment would be effective even in the high-total-dissolved-solids (>20,000 mg/L) environment that is projected to occur in the reused drainwater over the project life. Based on this information, Alternative E was eliminated, and the thermal desalting/EES option was removed from all alternatives.

Thus far, the rating and analysis process eliminated Alternatives A, B, D, and E and portions of Alternative F as depicted on Figure 2.11-2. The only remaining difference between Alternatives C and F is RO treatment of a portion of the drainwater. The performance and cost of RO treatment are sensitive to the concentrations of hardness and TDS in the influent drainwater. The drainwater reduction analysis yielded water quality projections for each of the four drainage zones over a 50-year period.

- RO treatment should be considered only after drainwater reuse. Agricultural reuse of the drainwater is much less expensive than RO treatment for all potential combinations. Both options achieve similar rates of volume reduction and concentration of the drainwater although RO produces a high-quality product stream.

- RO treatment of reused drainwater from all Westlands subareas is not economical over the long term. Operation of RO at a recovery greater than 50 percent would require a very expensive softening pretreatment. Operation of RO at about 50 percent recovery initially would be economical because softening would not be required. The hardness of the reused drainwater, however, is projected to increase substantially within 10 years, and operation at 50 percent recovery would not be sustainable without softening pretreatment.
- RO treatment of reused drainwater from the GDA would be economical over the long term. Projections of the drainwater quality indicate that RO operation at 50 percent recovery could be sustained during the project life without softening pretreatment.

The **optimum configuration** of the components in Alternatives C and F yields a hybrid that combines aspects of both. The drainwater flows from Westlands would follow the schematic of Alternative C. The GDA drainwater would utilize the RO treatment of Alternative F after agricultural reuse. Concentrate from RO would undergo biological treatment to reduce the Se concentration followed by discharge to evaporation basins.

2.11.4 Land Retirement Alternatives

Westlands Water District, several environmental groups, and other interests in the San Luis Unit requested that Reclamation include a land retirement alternative in the EIS. Specifically, these interests have suggested that Reclamation consider the Westlands proposed land retirement plan or an alternative that retires sufficient lands to eliminate the drainage problem in the Unit. The land retirement analysis in the 2002 PFR was broadened to respond to requests from stakeholders and interested agencies. Preliminary alternatives were developed, refined, and optimized based on specific criteria. The optimization process led to the selection of three new alternatives. The rationale for eliminating other land retirement alternatives is provided in this section as well.

On February 5, 2004, Reclamation submitted to the Court an *Amended Plan of Action for Drainage to the San Luis Unit*. The Amended Plan of Action states that Reclamation will continue to refine and evaluate all five alternatives (including No Action) described in the PFR for inclusion in the EIS. Additionally, Reclamation will formulate alternative(s) that use land retirement as a method to control drainage need, by comparing costs, benefits, and effects for alternatives with different amounts of land retirement.

In October 2003, Reclamation began land retirement alternatives development by meeting with project stakeholders to define the parameters that would constitute a complete land retirement program and the range of sizes (acreage) for alternatives. Stakeholders included representatives from San Luis Unit districts (San Luis Water District, Broadview Water District, Westlands Water District, and Panoche Water and Drainage District), San Joaquin River Exchange Contractors Water Authority, and environmental and Delta interests (Environmental Defense, Contra Costa County, Contra Costa Water District). The initial range of alternatives included alternatives based on the following reports and comments provided by the stakeholders:

- Westside Regional Drainage Plan (SJRECWA et al. 2003) including lands within Westlands and the Northerly Area
- U.S. Fish and Wildlife Service comments on the PFR, including an alternative that would retire all drainage-impaired lands in the San Luis Unit

- "Drainage Without a Drain" concept proposed by a coalition of environmental groups and local agencies downstream of the San Joaquin Valley[6]

The Project Team refined the initial alternatives developed from the public outreach process to arrive at complete alternatives that include the disposal of any residual drainwater. Factors considered included:

- Amount of land retirement
- Land retirement implementation method
- Future retired land use and ownership
- Future use of water currently used to irrigate land that would be retired
- Extent of drainage reduction measures including irrigation efficiencies and groundwater pumping
- Inclusion of drainage service components necessary to provide a complete disposal alternative

By December 2003, the following five concepts were identified for further refinement and optimization:

- Locally Preferred 1: Westside Regional Drainage Plan
- Locally Preferred 2: Optimized Retirement
- Reclamation 1: Federal Management
- Reclamation 2: Maximum Retirement
- Environmental: Drainage Without a Drain

2.11.4.1 Refinement and Optimization Process

Beginning in December 2003, Reclamation refined the alternatives by determining how the cost, benefit, and potential environmental effects of the resulting drainage service plan compared to previous alternatives using a variety of modeling and analysis tools. Using an iterative evaluation process, Reclamation considered the following factors for varied levels of land retirement:

- **Improved irrigation efficiency** balanced with deep percolation rates to maintain salt balance in the root zone.
- The **amount of drainage** to be expected under the different land retirement scenarios using the regional groundwater model.
- Estimated **costs of drainage service** for the land retirement scenarios using engineering cost curves, which calculated the cost for each component of drainage service (e.g., collector system, treatment system, and disposal) for a corresponding drainage rate.

---

[6] The Bay Institute, Contra Costa County, Contra Costa County Water Agency, Contra Costa Water District, and Environmental Defense.

- The **economic benefits** of each scenario to provide another measure to select a final set of alternatives for analysis.
- **Indicators of environmental effect** (such as acres of reuse and evaporation basins needed, or amount of drainwater reclaimed for irrigation) for each scenario.

Reclamation developed and analyzed potential alternatives that include combinations of land retirement, source reduction (including reduced percolation losses from irrigation, and drainwater recycling and reuse), and treatment and disposal. These potential alternatives, called land retirement scenarios, were compared primarily using costs. Scenarios mix different levels of land retirement, source reduction, and treatment/disposal. Alternatives that provided for partial retirement of drainage-impaired lands were further evaluated to balance the amount of land retired with the implementation of drainage-reduction measures to improve farm profits. The primary drainage-reduction measure evaluated was increases in irrigation efficiencies.

Because the cost of Se removal from drainwater is high, Reclamation developed a land retirement alternative that was based on retiring lands with high Se concentrations in the shallow groundwater and that used groundwater well monitoring data to estimate the Se concentration in shallow groundwater. Several different groundwater concentrations were used as criteria for selecting land retirement areas. The alternatives were assessed based on the amount of land that would be retired and the potential decrease in Se concentration in drainwater. In addition, the effect of retiring lands already acquired by Westlands because of drainwater quality was also evaluated.

Another two-step process was used to evaluate, compare, and screen land retirement scenarios. The first step covered a fairly wide range of retirement and source control combinations and was used to:

- Screen out scenarios that were clearly inferior (e.g., more costly for the same or less benefit).
- Screen out scenarios that were technically impractical or questionable.
- Identify potential scenarios that might be more effective and/or less costly.

The second step evaluated four scenarios in comparison to the In-Valley Disposal Alternative, including the change in applied water.

First Screening Step

Three land retirement levels and three levels of increased irrigation efficiencies were evaluated. The three retirement levels were:

- Lands retired as in the In-Valley Disposal Alternative (approximately 44,100 acres within Westlands drainage-impaired area)
- 200,000 acres retired within the Westlands drainage-impaired area
- All drainage-impaired lands in the Unit retired (298,000 acres in Westlands and 45,000 acres in the Northerly Area)

Three increased irrigation efficiency rates were evaluated for the first two retirement levels (because with all drainage-impaired lands retired, reducing drainage with source controls is not needed).

The following conclusions were drawn from this screening:

- Comparison of the cost for land retirement (land acquisition and land management costs) versus the cost for collection, treatment, and disposal indicated that land retirement was more costly. In other words, it cost more to avoid the drainage through land retirement than to collect, treat, and dispose of the drainwater.
- Further analysis is needed to estimate the value of water that land retirement makes available for other uses, which should be factored into a comparison of final alternatives.
- Root zone salinity analysis indicated that Level 2 deep percolation reduction (i.e., increased irrigation efficiency) probably does not allow for salinity balance in the root zone for the drainage-impaired area. Level 2 deep percolation reduction was eliminated from further consideration.
- Level 1 deep percolation reduction did appear to be technically feasible and cost-effective, but root zone salinity balance in the Westlands drainage-impaired area could be achieved only with extremely careful management. It was agreed to include Level 1 reduction in further screening of scenarios, although questions were raised about the practicality of growers being able to achieve deep percolation rates of 0.27 foot/year.
- Full retirement of drainage-impaired lands eliminated the need for drainage service, but the 200,000-acre retirement level did not. Analysis of additional intermediate levels of retirement was suggested to see if some acreage less than full retirement could eliminate the need for drainage in Westlands.
- Other implications besides cost and drainage volume were requested for consideration in the land retirement scenario screening. Specifically, a scenario could target retirement of lands based on Se concentrations in shallow groundwater. Two target levels were suggested: greater than 20 ppb and greater than 50 ppb Se in shallow groundwater.

Retirement of the remaining 35,000 acres of lands in the Northerly San Luis Unit (lands other than the 10,000 acres in Broadview WD) was not included in scenarios for further analysis. This project team decision was supported by a variety of factors, including the following:

- Initial screening showed land retirement to be more costly than drainage service.
- Northerly Unit lands already have a substantial investment in installed drainage system components (drains, collector system, recirculation systems, reuse areas, etc.). These systems have been funded using a variety of local funding and State and Federal Grants, Loans and Bond funds. Repayment of the remaining obligation from the 12 million dollars funded from the State Revolving Loan funds would add to the cost of land retirement.
- Other non-Unit lands in the Northerly Area could not be retired under the current San Luis Unit authorization. Retirement of the remaining Northerly Unit lands would result in approximately 36,000 acres of lands outside the Unit needing drainage service. Drainage flows would continue to occur on these lands including seepage into deep open drains, drain water and tailwater (from continued non-Unit farms) that is not able to be recycled, and runoff from storm events. In the absence of drainage service, these uncontrolled flows would continue downstream and could reach the adjacent wildlife refuges or the San Joaquin River, resulting in adverse effects to water quality and wildlife.

- Furthermore, land retirement combined with the Out-of-Valley Disposal Alternatives was also not cost-effective. See Section 2.11.4.3 below.

Second Screening Results

Four scenarios were evaluated and compared to the In-Valley Disposal Alternative in this screening:

- Revision of the In-Valley Disposal Alternative to include Level 1 deep percolation reduction and 55,311 total acres retired in Westlands (including lands for project facilities).
- Retirement of all lands in Westlands with Se concentration greater than 50 ppb and implementing Level 1 deep percolation reduction. Total land retired would be 88,576 acres in Westlands and the 10,000 acres of Broadview Water District in the Northerly Area.
- Retirement of all lands in Westlands with Se concentration greater than 20 ppb and implementing Level 1 deep percolation reduction. Total land retired would be 129,051 acres in Westlands and the 10,000 acres of Broadview Water District in the Northerly Area.
- Retirement of 198,000 acres within the drainage-impaired area of Westlands plus 10,000 acres in the Northerly Area. Implementation of Level 1 deep percolation reduction.

Some additional groundwater modeling analysis was performed to see if the need for drainage could be eliminated by combinations of deep percolation reduction and land retirement (less than complete retirement of all lands in the drainage-impaired area). Only a few combinations were tested, but it appeared that eliminating all need for current or future drainage service in the Unit could only be assured by retiring all drainage-impaired lands.

2.11.4.2 Selected Land Retirement Scenarios

Based on the screening of the many combinations of land retirement and other drainwater reduction measures, three land retirement scenarios were selected (as variations on the In-Valley Disposal Alternative) as reasonable alternatives for analysis in the EIS, and all three assume 10,000 acres would be retired in Broadview Water District in the Northerly Area. The first of the three scenarios would retire land with Se concentration greater than 50 ppb in shallow groundwater (92,600 acres). The second would retire land in Westlands up to the level at which the water made available could be used to fulfill other irrigation demands in the San Luis Unit (194,000 acres). The third would retire the entire drainage-impaired area (308,000 acres). All three are assumed to be variations of the original In-Valley Disposal Alternative (Alternative 4) in the 2002 PFR. The collection, treatment, and disposal of drainwater collected from drained lands would be similar to that described in the 2002 PFR and updated in Sections 2.4, 2.5, 2.6, and 2.7 of this EIS for the In-Valley Disposal and Land Retirement Alternatives.

2.11.4.3 Out-of-Valley Alternatives with Land Retirement

As the SLDFR Feasibility Study progresses, the costs of the action alternatives are being refined. Initially, the Out-of-Valley Disposal Alternative costs were significantly higher than the In-Valley Disposal Alternative costs. Consequently, additional land retirement was not considered cost effective for any of the Out-of-Valley Disposal Alternatives. However, with revisions to the costs of In-Valley treatment and disposal components, additional analysis was performed to identify the costs of the Out-of-Valley Disposal Alternatives with additional land retirement (greater than 44,106 acres). The results of this analysis are documented in Appendix K and summarized below.

Preliminary analyses of various land retirement scenarios were conducted during the plan formulation process to compare the costs of retiring varying amounts of drainage-impaired lands versus the cost of providing drainage service to those same lands. The analyses were based on comparing the In-Valley Disposal Alternative with land retirement to the least expensive Out-of-Valley Disposal Alternative (Chipps Island) with the same level of land retirement. That analysis indicated that the In-Valley/Land Retirement Alternative was consistently less expensive than the least expensive Out-of-Valley/Land Retirement Alternative, regardless of the amount of land retirement.

However, as the cost estimates of various project features were refined, the cost differences between the alternatives changed. The two most notable changes that occurred as feature costs changed were: (1) the difference in costs between all of the Out-of-Valley Disposal Alternatives and the In-Valley Disposal Alternative decreased, and (2) the Ocean Disposal Alternative became the least expensive Out-of-Valley alternative. As a result of these changes, it was decided to conduct another brief analysis of land retirement with the Ocean Disposal Alternative to determine if a more thorough analysis would be required. This second analysis indicated that, even though the cost differences between the various alternatives were much closer than they had been previously, the In-Valley Disposal Alternative was still consistently less expensive than the least costing Out-of-Valley alternative, regardless of the amount of land retirement. Consequently, the Out-of-Valley alternatives with additional land retirement were not carried forward into this EIS for full analysis.

2.12 COST ESTIMATING AND ASSUMPTIONS

Cost estimates for each alternative were prepared in accordance with Reclamation instructions for appraisal studies. Appraisal-level cost estimates are based mostly on existing information with a very limited amount of new data but are adequate to support a preliminary assessment of alternatives. The level of data and sophistication of the analyses are adequate to support a decision whether the alternatives should be carried forward for more detailed analyses and cost estimates (i.e., feasibility level) or eliminated from further studies. This decision is necessarily subjective, based on existing data, input from various specialists, and the judgment of Reclamation personnel. The cost estimates for each alternative were developed in a similar fashion as explained below:

1. Existing information regarding topography, land use, soil type, groundwater quality, and environmental parameters was used to select preliminary locations for the component features of each alternative.
2. Size and capacity of the features were determined based on projections of drainwater quantity and quality over a 50-year planning period.
3. Typical design layouts, preliminary locations, and capacities were used to calculate quantities of items needed to construct features.
4. Quantities of items needed to operate and maintain the features over a 50-year period were estimated.

5. Current unit or lump sum costs were obtained for each of the listed construction, operation, and maintenance items. These costs were obtained through a variety of sources including: vendor quotes, construction cost publications, utilities, construction firms, cost data from previous projects, and cost curves. Cost information from previous years was updated to year 2002 dollars using cost indices.
6. For appraisal studies the level of detail does not warrant a complete listing of all the minor construction items. Minor unlisted items were accounted for by adding 15 percent of the total itemized construction cost. The sum of the listed and unlisted items is referred to as the Contract Cost.
7. A contingency was added to the Contract Cost for additional costs incurred after the contract is awarded and construction begins. This contingency (25 percent of the Contract Cost) covers quantity overruns, changed site conditions, change orders, etc. The sum of the Contract Cost and the contingency is referred to as the Field Cost.
8. Noncontract costs were added to account for site investigations, final design, contract administration, and construction oversight. The noncontract costs were estimated as 33 percent of the Field Cost. The sum of the Field Cost and the noncontract costs is referred to as the Total Construction Cost.
9. The cost comparison of the alternatives was based on an economic analysis that discounted costs at 5.625 percent over a 50-year period.

The summary of the estimated annual equivalent costs for all action alternatives is included in Table 2.12-1. The costs do not include costs for mitigation of environmental effects, which will be determined as the SLDFR Feasibility Study progresses.

Table 2.12-1
All Alternatives
Federal Project Costs
Summary of Federal Project Costs ($ millions, 2002 dollars)

Alternatives	Federal Cost*			
	Construction/ Funding Rqmts	Annual OM&R	Present Worth	Annual Equivalent
In-Valley	607	19.8	562	33.8
In-Valley/Groundwater Quality	676	18.1	626	37.6
In-Valley/Water Needs	828	15.1	773	46.5
In-Valley/Drainage-Impaired Area	918	10.9	857	51.6
Delta-Chipps Island	630	12.5	562	33.8
Delta-Carquinez Strait	673	12.5	598	36.0
Ocean	589	11.6	563	33.8

Federal Cost – Costs for facilities that would be part of the Federal drainage service plan and are Federally funded. See Section 5.2 for the components that would be Federal facilities.

Construction/Funding Rqmts – Includes all capital costs for lands (including funding requirements for land retirement), right-of-ways, construction, mitigation, and interest during construction, displayed in 2002 dollars.

Annual OM&R – All costs required each year to operate, maintain, and replace project facilities, displayed in 2002 dollars, including energy costs.

Present Worth – The combined construction and annual OM&R costs presented as a one-time cost, displayed in 2002 dollars.

Annual Equivalent – The present worth cost presented as a series of equal annual payments over 50 years.

* The Federal costs for each of the action alternatives would exceed the current Federal spending limit authorized under the San Luis Act.

2.13 SUMMARY COMPARISON OF ALTERNATIVES

Table 2.13-1 provides a comparison of the features of the Disposal Alternatives. Table 2.13-2 summarizes the effects on the environment of the seven action alternatives compared to No Action. Effects are considered adverse effects unless specifically stated as beneficial.

Highlights of Table 2.13-2 are presented below for key effects: significant beneficial effects and significant adverse effects that cannot be mitigated to no significant effect at this point in the analysis. Other significant adverse effects on the environment can be mitigated to not significant, and Section 20 describes potential mitigation measures.

Significant beneficial effects would occur to surface water, groundwater, air quality, agricultural production, and land and soil resources.

- The analysis indicates that significant beneficial effects would occur from all of the action alternatives to surface water quality in the San Joaquin River and to New Melones Reservoir operations (lower dilution flow releases). All of the In-Valley and Ocean Disposal Alternatives would improve Bay-Delta water quality due to no drainwater discharges to the San Joaquin River.

Table 2.13-1
Comparison of Features and Specifications, All Disposal Alternatives[1]

Component	Characteristic	In-Valley	In-Valley/ Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean	Delta	
							Chipps Island	Carquinez Strait
Drainage Area	Acres with tile drains installed	218,020	187,116	122,833	47,500	219,293	219,293	219,293
On-Farm Drainwater Reduction	Volume reduced by shallow-water management per year (AF)	5,731	4,898	2,970	710	5,769	5,769	5,769
Regional Drainwater Reduction	Volume reduced by seepage reduction per year (AF)	4,200	4,200	4,200	4,200	4,200	4,200	4,200
Other Drainwater Reduction	Volume reduced by recycling per year (AF)	17,002	15,171	10,350	4,700	17,097	17,097	17,097
Drainage Rate After Drainwater Reduction	Drainage volume per year (AF)	69,645	61,036	45,287	26,830	69,957	69,957	69,957
Drainage Reuse	Volume reduction in Northerly Area per year (AF)	20,604	18,730	18,730	18,730	20,621	20,621	20,621
	Volume reduction in Westlands per year (AF)	27,925	23,848	12,827	0	28,347	28,347	28,347
Drainage Rate After Reuse	Drainage volume in AF/acre/year (average)	21,116	18,458	13,730	8,100	20,988	20,988	20,988
	Drainage flow rate in cfs (average)	29.2	25.6	19.0	11.2	29.1	29.1	29.1
Treatment	Initial average Se concentration of reused drainwater (µg/L)	110	120	120	140	110	110	110
	Final average Se concentration of reused drainwater (µg/L)	240	260	270	320	220	220	220
	Volume to RO treatment per year (AF)	21,116	18,458	13,730	8,100	0	0	0
	Volume to Se biological treatment per year (AF)	10,558	9,229	6,865	4,050	0	20,988	20,988
	Initial average Se concentration at point of discharge (ocean, Delta, or evap basins) (µg/L)	10	10	10	10	110	10	10
	Final average Se concentration at point of discharge (ocean, Delta, or evap basins) (µg/L)	10	10	10	10	220	10	10
	Initial average TDS concentration at point of discharge (mg/L)	24,700	26,900	13,700	29,400	12,500	12,500	12,500
	Final average TDS concentration at point of discharge (mg/L)	35,600	33,000	27,600	30,000	19,000	19,000	19,000
Land Conveyance	Miles of pipe	71	<71	<71	1.1	209.4	113.0	130.4
	Miles of canal	0	0	0	0	0	128.6	128.6
	Miles of new canal	0	0	0	0	0	45.6	45.6
	Miles of existing canal	0	0	0	0	0	83	83
	Miles of tunnel	0	0	0	0	2.1	0	0
Underwater Conveyance	Miles of suspended pipe under water	0	0	0	0	0.71	0	0
	Miles of buried pipe under water	0	0	0	0	0.73	1	1
Total Conveyance	Total miles of conveyance	71	<71	<71	1.1	212.9	242.6	260
Energy Use/Generation	Energy requirements for conveyance (kw-hr/year)	6,343,000	5,600,000	4,000,000	2,457,000	81,400,000	14,000,000	14,000,000
	Energy requirements for RO treatment (kw-hr/year)	18,700,000	15,900,000	11,100,000	6,600,000	0	0	0
	Energy requirements for Se bio treatment (kw-hr/year)	750,000	550,000	450,000	250,000	0	1,000,000	1,000,000
	Energy generated (kw-hr/year)	0	0	0	0	0	0	0
Land Requirements	Acres of reuse	19,000	16,700	12,500	7,500	19,000	19,000	19,000
	Acres of RO treatment facility	8	7	5	3	0	0	0
	Acres of Se treatment facility	6	5	4	2	0	8	8
	Acres of evaporation basin – maximum	3,290	2,890	2,150	1,270	0	0	0
	Acres of evaporation basin – average	2,870	2,530	1,880	1,110	0	0	0
	Acres of temporary right-of-way	645[3]	645[3]	645[3]	10[3]	1,980[4]	1,600[6]	1,750[6]
	Acres of permanent right-of-way	260[3]	260[3]	260[3]	4[3]	830[5]	0	0
	Acres of permanent right-of-way (pipeline)	0	0	0	0	0	420[7]	480[7]
	Acres of permanent right-of-way (canal)	0	0	0	0	0	560[7]	560[7]
	Acres retired	44,106	92,592	193,956	308,000	44,106	44,106	44,106
	Acres needed for drainage facilities not in retired lands	7,864	0	0	0	5,954	5,954	5,954
Biology	Acres of sensitive habitat impacted[2]	NA	NA	NA	NA	55	73	120
Drainwater Reclamation	Volume of water reclaimed per year (product water) (AF)	10,558	9,229	6,865	4,050	0	0	0

1 Values reflect SLDFR appraisal-level designs as of September 2004.
2 Identified during appraisal level analysis.
3 Pumping plants are located in reuse areas and are not included in acres of right-of-way.
4 Includes temporary right-of-way for 3 tunnels/6 tunnel portals (60 acres), 6 pumping plants not in reuse areas (18 acres) and pipeline (75 feet wide). Some pumping plants are sited in reuse areas but are not included in acres of right-of-way.
5 Includes permanent right-of-way for 3 tunnels/6 tunnel portals (60 acres), 6 pumping plants not in reuse areas (12 acres), and pipeline (30 feet wide).
6 Includes temporary right-of-way for 2 pumping plants and regulating tanks (8 acres), pipeline (75 feet wide), and canal (100 feet wide).
7 Includes permanent right-of-way for 2 pumping plants and regulating tanks (6 acres), pipeline (30 feet wide), and canal (100 feet wide).

NA – Not available yet

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
SURFACE WATER							
Delta Drinking Water Intakes	Drainwater no longer disposed to the San Joaquin River. No significant effect.	Drainwater no longer disposed to the San Joaquin River. No significant effect.	Drainwater no longer disposed to the San Joaquin River. No significant effect.	Drainwater no longer disposed to the San Joaquin River. No significant effect.	Drainwater no longer disposed to the San Joaquin River. No significant effect.	Treated drainwater is disposed near Mallard and Rock Slough, Se, TDS, Bromide and TOC are expected to increase but the increase would not cause MCLs to be exceeded. No significant effect.	Treated drainwater is disposed near Mallard and Rock Slough. Se, TDS, bromide, and TOC are expected to increase, but the increase will not cause MCLs to be exceeded. No significant effect.
Water Quality in San Joaquin River and Tributaries	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.	San Joaquin River no longer receives drainwater. Significant beneficial effect.
New Melones Reservoir Operations	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.	Lower dilution flow releases required. Significant beneficial effect.
Bay-Delta Water Quality	Drainwater no longer disposed to the San Joaquin River. Significant beneficial effect.	Drainwater no longer disposed to the San Joaquin River. Significant beneficial effect.	Drainwater no longer disposed to the San Joaquin River. Significant beneficial effect.	Drainwater no longer disposed to the San Joaquin River. Significant beneficial effect.	Drainwater no longer disposed to the San Joaquin River. Significant beneficial effect.	Water quality degraded in the vicinity of the diffuser, WQOs met outside of mixing zone. No significant effect.	Water quality degraded in the vicinity of the diffuser. WQOs met outside of mixing zone. No significant effect.
Ocean Water Quality	No changes occur to the ocean. No significant effect.	No changes occur to the ocean. No significant effect.	No changes occur to the ocean. No significant effect.	No changes occur to the ocean. No significant effect.	Water quality degraded in the vicinity of the diffuser, WQOs met outside of mixing zone. No significant effect.	No significant effect.	No significant effect.
Construction Impacts	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
GROUNDWATER							
Bare-Soil Evaporation	Rate decreases 0.24 foot/year. Significant beneficial effect.	Rate decreases 0.23 foot/year. Significant beneficial effect.	Rate decreases 0.23 foot/year. Significant beneficial effect.	Rate decreases 0.23 foot/year. Significant beneficial effect.	Rate decreases 0.24 foot/year. Significant beneficial effect.	Rate decreases 0.24 foot/year. Significant beneficial effect.	Rate decreases 0.24 foot/year. Significant beneficial effect.
Undrained Area Affected by Shallow Water Table	Area decreases 161 square miles. Significant beneficial effect.	Area decreases 205 square miles. Significant beneficial effect.	Area decreases 214 square miles. Significant beneficial effect.	Area decreases 226 square miles. Significant beneficial effect.	Area decreases 161 square miles. Significant beneficial effect.	Area decreases 161 square miles. Significant beneficial effect.	Area decreases 161 square miles. Significant beneficial effect.
Groundwater Salinity	Increase of 3 percent. No significant effect.	Increase of 3 percent. No significant effect.	Increase of 3 percent. No significant effect.	Increase of 3 percent. No significant effect.	Slight increase. No significant effect.	Slight increase. No significant effect.	Slight increase. No significant effect.
Drinking Water Supplies	No significant effect to drinking water sources. Reduction in drainwater would slow contamination of drinking water sources. Beneficial effect.	No significant effect to drinking water sources. Reduction in drainwater would slow contamination of drinking water sources. Beneficial effect.	No significant effect to drinking water sources. Reduction in drainwater would slow contamination of drinking water sources. Beneficial effect.	No significant effect to drinking water sources. Large reduction in drainwater would slow contamination of drinking water sources. Beneficial effect.	Reducing drainwater recharge would slow the transport of contaminated groundwater toward drinking wells. Beneficial effect.	Reducing drainwater recharge would slow the transport of contaminated groundwater toward drinking wells. Beneficial effect.	Reducing drainwater recharge would slow the transport of contaminated groundwater toward drinking wells. Beneficial effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
BIOLOGICAL RESOURCES							
Terrestrial Resources							
Permanent changes in agricultural and ruderal habitats affecting terrestrial habitat value	23,000 acres used for project facilities. 44,106 acres retired. No significant effect.	20,000 acres used for project facilities. 92,592 acres retired. No significant effect.	15,000 acres used for project facilities. No significant effect. 193,956 acres retired. Unavoidable significant effects for some foraging species.	9,000 acres used for project facilities. No significant effect. 308,000 acres retired. Unavoidable significant effects for some foraging species.	19,000 acres used for project facilities. 44,106 acres retired. No significant effect.	19,560 acres used for project facilities. 44,106 acres retired. No significant effect.	19,560 acres used for project facilities. 44,106 acres retired. No significant effect.
Permanent changes in native and natural habitats	No siting, construction, or operation of facilities in native or natural habitat. No significant adverse effect. No agricultural land acquired under project authority converted to native or natural terrestrial habitat. No significant beneficial effect. 4,900 additional acres acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting, construction, or operation of facilities in native or natural habitat. No significant adverse effect No agricultural land acquired under project authority converted to native or natural terrestrial habitat. No significant beneficial effect. 4,900 additional acres acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting, construction, or operation of facilities in native or natural habitat. No significant adverse effect. No agricultural land acquired under project authority converted to native or natural terrestrial habitat. No significant beneficial effect. 4,900 additional acres acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting, construction, or operation of facilities in native or natural habitat. No significant adverse effect. No agricultural land acquired under project authority converted to native or natural terrestrial habitat. No significant beneficial effect. 4,900 additional acres acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting of permanent facilities in native or natural habitats. 1,980 acres temporarily disturbed during aqueduct construction. Significant adverse effect; with mitigation=no significant effect. No agricultural land acquired under project authority converted to native or natural terrestrial habitats; however, 4,900 additional acres acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting of permanent facilities in native or natural habitat. 1,000 acres temporarily disturbed during aqueduct construction Significant adverse effect; with mitigation=no significant effect. No agricultural land acquired under project authority would be converted to natural terrestrial habitats; however, 4,900 additional acres would be acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.	No siting of permanent facilities in native or natural habitat. Approximately 1,000 acres temporarily disturbed during aqueduct construction Significant adverse effect; with mitigation=no significant effect. No agricultural land acquired under project authority would be converted to natural terrestrial habitat; however, 4,900 additional acres would be acquired and revegetated under CVPIA Land Retirement Program. No significant beneficial effect.
Permanent loss or degradation of recognized sensitive, rare, or ecologically important natural communities	Less mobile species could be killed or displaced during construction. Significant effect; with mitigation=no significant effect.	Less mobile species could be killed or displaced during construction. Significant effect; with mitigation=no significant effect.	Less mobile species could be killed or displaced during construction. Significant effect; with mitigation=no significant effect.	Less mobile species could be killed or displaced during construction. Significant effect; with mitigation=no significant effect.	3 acres valley foothills riparian and 56 acres valley oak woodland habitats permanently removed for aqueduct construction. Significant adverse effect; with mitigation=no significant effect.	73 acres disturbed during aqueduct construction. Significant adverse effect; with mitigation=no significant effect.	120 acres disturbed during aqueduct construction. Significant adverse effect; with mitigation=no significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Introduction or spread of noxious weeds	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.	Noxious weeds could be introduced and spread at disturbed construction sites and project facilities. No significant effect with appropriate site management, construction procedures, and operating controls. Retired lands that are fallowed or grazed may facilitate the spread of noxious weeds. No significant effect with implementation of a weed management program.
Population-level effects to terrestrial resources due to Se bioaccumulation in the San Joaquin Valley	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Aquatic and Wetland Resources							
Adverse effects to aquatic or wetland-dependent species (also see Section 8 for an evaluation of effects due to Se bioaccumulation)	Significant unavoidable adverse effect to waterbirds at evaporation basins due to human activity, seasonal conditions, hazing, salt toxicosis and encrustation, and other physical/behavioral stressors.	Significant unavoidable adverse effect to waterbirds at evaporation basins due to human activity, seasonal conditions, hazing, salt toxicosis and encrustation, and other physical/behavioral stressors.	Significant unavoidable adverse effect to waterbirds at evaporation basins due to human activity, seasonal conditions, hazing, salt toxicosis and encrustation, and other physical/behavioral stressors.	Significant unavoidable adverse effect to waterbirds at evaporation basins due to human activity, seasonal conditions, hazing, salt toxicosis and encrustation, and other physical/behavioral stressors.	Disturbance or permanent loss of habitat along aqueduct and outfall. Significant adverse effect; with mitigation=no significant effect.	73 acres disturbed during aqueduct construction. Significant adverse effect; with mitigation=no significant effect.	120 acres disturbed during aqueduct construction. Significant adverse effect; with mitigation=no significant effect.
Filling, draining, or net loss of existing wetlands	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Alteration of historic stream channel characteristics	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect on channels at pipeline and aqueduct crossings; with mitigation=no significant effect.	Significant adverse effect on channels at pipeline and aqueduct crossings; with mitigation=no significant effect.	Significant adverse effect on channels at pipeline and aqueduct crossings; with mitigation=no significant effect.
Interference with migratory movements of native fish	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
Population-level effects to aquatic resources (including waterbirds) due to Se bioaccumulation in the Bay-Delta	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Population-level effects to aquatic resources (including waterbirds) due to Se bioaccumulation in the San Joaquin Valley	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	No significant effect.	No significant effect.	No significant effect.
Population-level effects to aquatic resources (including waterbirds) due to Se bioaccumulation in Morro Bay	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
Federally Listed Special-Status Species							
Adverse effects resulting in take of a listed terrestrial species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Significant adverse effects to San Joaquin kit fox and bald eagle from construction or operation of project facilities. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox and bald eagle from construction or operation of project facilities. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox and bald eagle from construction or operation of project facilities. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox and bald eagle from construction or operation of project facilities. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox, giant kangaroo rat, and San Joaquin wooly-threads from construction of aqueduct. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox from construction of aqueduct and reuse areas. Section 7 consultation is required.	Significant adverse effects to San Joaquin kit fox from construction of aqueduct and reuse areas. Section 7 consultation is required.
Adverse effects resulting in take of a listed freshwater aquatic/wetland species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant adverse effects to California clapper rail, saltmarsh harvest mouse, four vernal pool crustaceans, California tiger salamander, California red-legged frog, and giant garter snake from construction of aqueduct. Section 7 consultation is required. Significant adverse effects to three Chinook salmon ESUs, Central Valley steelhead, Delta smelt, and green sturgeon during construction of underwater outfall. Section 7 consultation is required. Minor improvement in water quality for giant garter snake and California red-legged frog in Grasslands area habitats. No significant effect.	Significant adverse effects to California clapper rail, saltmarsh harvest mouse, four vernal pool crustaceans, California tiger salamander, California red-legged frog, and giant garter snake from construction of aqueduct. Section 7 consultation is required. Significant adverse effects to three Chinook salmon ESUs, Central Valley steelhead, Delta smelt, and green sturgeon during construction of underwater outfall. Section 7 consultation is required. Minor improvement in water quality for giant garter snake and California red-legged frog in Grasslands area habitats. No significant effect.
Adverse effects resulting in take of a listed marine/coastal aquatic species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Significant adverse effects to tidewater goby. Section 7 consultation is required.	No effects to marine/coastal species.	No effect to marine/coastal species.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Individual-level effects to federally listed special status species due to Se bioaccumulation in the Bay Delta	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	Significant adverse effects to the green sturgeon (currently a federal candidate species). Section 7 consultation is required.	Significant adverse effects to the green sturgeon (currently a federal candidate species). Section 7 consultation is required.
Individual-level effects to federally listed special status species due to Se bioaccumulation in the San Joaquin Valley	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.	Significant adverse effects to the San Joaquin kit fox. Section 7 consultation is required.
Individual-level effects to federally listed special status species due to Se bioaccumulation in Morro Bay	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
State-listed Special-Status Species							
Adverse effects resulting in take of a listed terrestrial species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Significant adverse effects to San Joaquin kit fox, Swainson's hawk, peregrine falcon, bald eagle, California black rail, western yellow-billed cuckoo, and burrowing owl; with mitigation=no significant effect.	Significant adverse effects to San Joaquin kit fox, Swainson's hawk, peregrine falcon, bald eagle, California black rail, western yellow-billed cuckoo, and burrowing owl; with mitigation=no significant effect.	Significant adverse effects to San Joaquin kit fox, Swainson's hawk, peregrine falcon, bald eagle, California black rail, western yellow-billed cuckoo, and burrowing owl; with mitigation=no significant effect.	Significant adverse effects to San Joaquin kit fox, Swainson's hawk, peregrine falcon, bald eagle, California black rail, western yellow-billed cuckoo, and burrowing owl; with mitigation=no significant effect.	Potential adverse effects to San Joaquin kit fox, Swainson's hawk, giant kangaroo rat, and western burrowing owl from construction; with mitigation=no significant effect.	Potential significant adverse effects to San Joaquin kit fox, Swainson's hawk, and western burrowing owl from construction of aqueduct and reuse areas; with mitigation=no significant effect.	Potential significant adverse effects to San Joaquin kit fox, Swainson's hawk, and western burrowing owl from construction of aqueduct and reuse areas; with mitigation=no significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Adverse effects resulting in take of a listed freshwater aquatic/wetland species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant effect to giant garter snake and California red-legged frog from construction activities; with mitigation=no significant effect.	Significant adverse effects to California clapper rail, California black rail, saltmarsh harvest mouse, California tiger salamander, California red-legged frog, Delta button-celery and giant garter snake from construction of aqueduct; with mitigation=no significant effect. Significant adverse effects to three Chinook salmon ESUs, Delta smelt, and green sturgeon during construction of underwater outfall; with mitigation=no significant effect. Minor improvement in water quality for giant garter snake and California red-legged frog in Grasslands area habitats. No significant effect.	Significant adverse effects to California clapper rail, California black rail, saltmarsh harvest mouse, California tiger salamander, California red-legged frog, Delta button-celery and giant garter snake from construction of aqueduct; with mitigation=no significant effect. Significant adverse effects to three Chinook salmon ESUs, Delta smelt, and green sturgeon during construction of underwater outfall; with mitigation=no significant effect. Minor improvement in water quality for giant garter snake and California red-legged frog in Grasslands area habitats. No significant effect.
Adverse effects resulting in take of a listed marine/coastal aquatic species or loss, degradation, fragmentation, or disturbance of its habitat(s)	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Significant adverse effects to tidewater goby; with mitigation=no significant effect.	No effects to marine/coastal species.	No effect to marine/coastal species.
Individual-level effects to state-listed special status species due to Se bioaccumulation in the Bay Delta	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	Significant adverse effects to the green sturgeon. Potentially unavoidable.	Significant adverse effects to the green sturgeon. Potentially unavoidable.
Individual-level effects to state- listed special status species due to Se bioaccumulation in the San Joaquin Valley	Significant adverse effects to the American peregrine falcon, Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant adverse effects to the American peregrine falcon, Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant adverse effects to the American peregrine falcon, Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant adverse effects to the American peregrine falcon, Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant adverse effects to the Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant effects Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.	Significant effects Swainson's hawk, greater sandhill crane, and San Joaquin kit fox. Potentially unavoidable.
Individual-level effects to state- listed special status species due to Se bioaccumulation in Morro Bay	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
GEOLOGY							
Earthquake Ground Shaking	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.
Surface Fault Rupture	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No damage if pipeline fault crossing undergoes extension. Significant effect; with mitigation = no significant effect.	No damage if pipeline fault crossing undergoes extension. Significant effect; with mitigation = no significant effect.	No damage if pipeline fault crossing undergoes extension. Significant effect; with mitigation = no significant effect.
Liquefaction and Lateral Spreading	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.	No damage when designed to current codes. No significant effect.
Landsliding / Mass Wasting	No significant effect.	No significant effect.	No significant effect.	No significant effect.	Significant effect; with mitigation=no significant effect.	No significant effect.	No significant effect.
Subsidence / Uplift	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Expansive Soils	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Erosion	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Geologic Resources of Economic and Scientific Value	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
Tsunami or Seiche	No significant effect.	No significant effect.	No significant effect.	No significant effect.	Significant effect; with mitigation=no significant effect.	No significant effect.	No significant effect.
ENERGY RESOURCES							
Energy Use	Higher incremental energy requirement (25.793 GWh/yr). No significant effect.	Higher incremental energy requirement (22.05 GWh/yr). No significant effect	Higher incremental energy requirement (15.55 GWh/yr). No significant effect	Higher incremental energy requirement (9.307 GWh/yr). No significant effect	Higher incremental energy requirement (81.4 GWh/yr). No significant effect.	Higher incremental energy requirement (15.0 GWh/yr). No significant effect.	Higher incremental energy requirement (15.0 GWh/yr). No significant effect.
Transmission Infrastructure	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.25 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.2 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.2 percent increase in incremental load of nearest substation. No significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
AIR RESOURCES							
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of pipeline and pumping stations would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of pipeline and pumping stations would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of pipeline and pumping stations would generate emissions. Significant effect; with mitigation=no significant effect.
Air Quality - Operation Phase							
• Vehicular Traffic Emissions	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
• Maintenance	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
• Emergency Generators	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
• Odorous Emissions	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.	No significant effect.
• Agricultural Operations	Approximately 65,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Nearly equivalent (approximately 10,000 acres less) land retirement. No significant effect.	Approximately 90,000 acres more land retirement. Significant beneficial effect.	Approximately 200,000 acres more land retirement. Significant beneficial effect.	Approximately 65,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Approximately 65,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Approximately 65,000 acres less land retirement. Significant effect; with mitigation=no significant effect.
AGRICULTURAL PRODUCTION AND ECONOMICS							
Agricultural Lands in Production	52,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.	6,000 acres back in production (65,000 acres avoided land retirement minus lands retired for drainage control and lands used for drainage facilities). Not a significant effect.	90,000 acres out of production (net change in lands retired for drainage control and lands used for drainage facilities). Significant effect, but not irreversible.	203,000 acres out of production (net change in lands retired for drainage control and lands used for drainage facilities). Significant effect, but not irreversible.	55,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.	55,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.	55,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.
Crop Yields, Revenues, Production Costs	Annual avoided losses of $30.1 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not significant.	Annual avoided losses of $23.2 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not significant.	Annual avoided losses of $9.0 million. Improved flexibility of crop selection. Moderately beneficial financial and economic effect, but not significant.	Annual losses of $7.7 million. Not a significant environmental effect.	Annual avoided losses of $30.6 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not significant.	Annual avoided losses of $30.6 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not significant.	Annual avoided losses of $30.6 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not significant.
Salt Balance	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction of almost 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction of about 440,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net removal of about 370,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.
Cost of Supplemental Water	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. No significant effect.	Almost $3 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. No significant effect.	$25 million/year reduction in cost of additional water purchases as a result of land retirement. No significant effect.	$56 million/year reduction in cost of additional water purchases (includes value of excess water for other uses) as a result of land retirement. No significant effect.	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. No significant effect.	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. No significant effect.	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. No significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
LAND AND SOIL RESOURCES							
Prime Farmland	Increase of 294,000 acres. Significant beneficial effect.	Increase of 263,000 acres. Significant beneficial effect.	Increase of 198,000 acres. Significant beneficial effect.	Increase of 23,000 acres. Significant beneficial effect.	Increase of 295,000 acres. Significant beneficial effect.	Increase of 295,000 acres. Significant beneficial effect.	Increase of 295,000 acres. Significant beneficial effect.
FSI	Increase of 54,000 acres. Significant beneficial effect.	Increase of 14,000 acres. No significant effect.	Decrease of 91,000 acres. Significant adverse effect; mostly unavoidable.	Decrease of 211,000 acres. Significant adverse effect; mostly unavoidable.	Increase of 59,000. Significant beneficial effect.	Increase of 59,000 acres. Significant beneficial effect.	Increase of 59,000 acres. Significant beneficial effect.
Evaporation Basins	Increase of 3,290 acres. Significant adverse effect; unavoidable.	Increase of 2,890 acres. Significant adverse effect; unavoidable.	Increase of 2,150 acres. Significant adverse effect; unavoidable.	Increase of 1,270 acres. Significant adverse effect; unavoidable.	None. No effect.	None. No effect.	None. No effect.
Salt Sink	Decrease of 5,500 acres. Significant beneficial effect.	Decrease of 5,100 acres. Significant beneficial effect	Decrease of 3,700 acres. Significant beneficial effect	Decrease of 500 acres. Significant beneficial effect	Decrease of 5,500 acres. Significant beneficial effect	Decrease of 5,500 acres. Significant beneficial effect	Decrease of 5,500 acres. Significant beneficial effect
Construction-related	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	No significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.	Significant adverse effect; with mitigation=no significant effect.
Land Use	50,000 acres of land stays in production, cropping patterns improve. Significant beneficial effect.	Minor changes. No significant effects.	Major land use changes inconsistent with local and state plans and laws. Significant adverse effects; unavoidable.	Major changes inconsistent with local and state plans and laws. Significant adverse effect; unavoidable.	50,000 acres of land stay in agricultural production. Cropping patterns improve. Significant beneficial effect.	50,000 acres stay in agricultural production. Cropping patterns improve. Significant beneficial effect.	50,000 acres stay in agricultural production. Cropping patterns improve. Significant beneficial effect.
RECREATION RESOURCES							
Wildlife Viewing/Hunting	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant adverse effect; with mitigation=no significant effect.	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant adverse effect; with mitigation=no significant effect.	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant adverse effect; with mitigation=no significant effect.	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant adverse effect; with mitigation=no significant effect.	Salts and Se could accumulate in reuse facilities. No significant effect.	Salts and Se could accumulate in reuse facilities. No significant effect.	Salts and Se could accumulate in reuse facilities. No significant effect.
Ocean-Based Recreation	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Pipeline diffuser would be 1.4 miles out to sea and 200 feet deep. No significant effect.	Not applicable.	Not applicable.
Delta Recreation	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Not applicable.	Pipeline diffuser would be 1 mile offshore and 18 feet deep. No significant effect.	Pipeline diffuser would be 1 mile offshore and 18 feet deep. No significant effect.
CULTURAL RESOURCES							
Cultural Resources	Five known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant adverse effect; with mitigation=no significant effect.	Undetermined number of known cultural resources. Significant adverse effect; with mitigation=no significant effect.	Undetermined number of known cultural resources. Significant adverse effect; with mitigation=no significant effect.	Undetermined number of known cultural resources. Significant adverse effect; with mitigation=no significant effect.	92 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant adverse effect; with mitigation=no significant effect.	166 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant adverse effect; with mitigation=no significant effect.	197 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant adverse effect; with mitigation=no significant effect.

Table 2.13-2
Summary of Environmental Effects for All Action Alternatives Compared to No Action

Affected Resource and Area of Potential Effect	In-Valley Disposal	In-Valley/Groundwater Quality Land Retirement	In-Valley/Water Needs Land Retirement	In-Valley/Drainage-Impaired Area Land Retirement	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
AESTHETICS							
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.	No new visual elements introduced. No significant effect.
Scenic Highways	No new visual elements introduced along Highways 5 and 152. No significant effect.	No new visual elements introduced along Highways 5 and 152. No significant effect.	No new visual elements introduced along Highways 5 and 152. No significant effect.	No new visual elements introduced along Highways 5 and 152. No significant effect.	No new visual elements introduced along Highways 5, 152, 41, 46, 101, and 1. No significant effect.	No new visual elements introduced along Highways 5, 152, 580, and 4. No significant effect.	No new visual elements introduced along Highways 5, 152, 580, and 4. No significant effect.
REGIONAL ECONOMICS							
Regional Economics (All values are shown in thousands of 2000 dollars, except jobs)	Farm Employment: 1,569 compared to 108,711 (1.44 percent). Agricultural Income: $25,208 compared to $4,133,271 (0.61 percent). Agricultural Output: $93,471 compared to $9,753,912 (0.96 percent). No significant effect.	Farm Employment: 809 compared to 108,711 (0.74 percent). Agricultural Income: $10,616 compared to $4,133,271 (0.26 percent). Agricultural Output: $39,858 compared to $9,753,912 (0.41 percent). No significant effect.	Farm Employment: -1,253 compared to 108,711 (-1.15 percent). Agricultural Income: $-28,924 compared to $4,133,271 (-0.70 percent). Agricultural Output: $-105,968 compared to $9,753,912 (-1.09 percent). No significant effect.	Farm Employment: -3,376 compared to 108,711 (-3.11 percent). Agricultural Income: $-70,415 compared to $4,133,271 (-1.70 percent). Agricultural Output: $-258,916 compared to $9,753,912 (-2.65 percent). No significant effect.	Farm Employment: 1,574 compared to 108,711 (1.45 percent). Agricultural Income: $25,308 compared to $4,133,271 (0.61 percent). Agricultural Output: $93,861 compared to $9,753,912 (0.96 percent). No significant effect.	Farm Employment: 1,574 compared to 108,711 (1.45 percent). Agricultural Income: $25,311 compared to $4,133,271 (0.61 percent). Agricultural Output: $93,870 compared to $9,753,912 (0.96 percent). No significant effect.	Farm Employment: 1,574 compared to 108,711 (1.45 percent). Agricultural Income: $25,311 compared to $4,133,271 (0.61 percent). Agricultural Output: $93,870 compared to $9,753,912 (0.96 percent). No significant effect.
SOCIAL ISSUES AND ENVIRONMENTAL JUSTICE							
Social Issues	Small employment increase. No significant effect.	Small employment increase. No significant effect.	Small employment increase during construction. Small loss of jobs associated with OM&R and crop production. Overall, no significant effect.	Small employment increase during construction. Small loss of jobs associated with OM&R and crop production. Overall, no significant effect.	Small employment increase. No significant effect.	Small employment increase. No significant effect.	Small employment increase. No significant effect.
Environmental Justice	Small employment increase. No significant effect.	Small employment increase. No significant effect.	Small employment increase during construction. Small loss of jobs associated with OM&R and crop production. Overall, no significant effect.	Small employment increase during construction. Small loss of jobs associated with OM&R and crop production. Overall, no significant effect.	Small employment increase. No significant effect.	Small employment increase. No significant effect.	Small employment increase. No significant effect.

- Concerning groundwater, all of the action alternatives would have significant beneficial effects on bare-soil evaporation and on the undrained area affected by the shallow water table. The In-Valley/Drainage-Impaired Area Land Retirement Alternative would have significant beneficial effects on drinking water supplies.
- Air quality under the In-Valley/Water Needs and In-Valley/Drainage-Impaired Area Land Retirement Alternatives would benefit due to the amount of land retired/fallowed.
- Agricultural lands in production for the In-Valley Disposal Alternative and the three Out-of-Valley Disposal Alternatives would benefit, and the salt balance would benefit for all of the action alternatives.
- All of the action alternatives would increase prime farmland. Farmland of Statewide Importance would significantly benefit under the Out-of-Valley and In-Valley Disposal Alternatives. All other action alternatives would benefit salt sink acreages. Land use under the In-Valley Disposal Alternative and the Out-of-Valley Disposal Alternatives would benefit.

Significant adverse effects that may be unavoidable would occur to biological and to land and soil resources.

- The In-Valley Water Needs and In-Valley Drainage Impaired Area Retirement Alternatives would result in unavoidable significant effects to some foraging wildlife species due to loss of agricultural habitat from land retirement.
- All four In-Valley Alternatives would result in unavoidable adverse effects to waterbirds due to human activity, hazing, salt encrustation and toxicosis, and other physical/behavioral stresses.
- All of the action alternatives would have individual-level effects to State-listed special-status species from Se bioaccumulation in the San Joaquin Valley that are potentially unavoidable.
- The two Delta Disposal Alternatives have potentially unavoidable individual-level effects to the green sturgeon, a species of special concern or candidate for listing, due to Se bioaccumulation in the Bay-Delta.
- The In-Valley/Water Needs and In-Valley/Drainage-Impaired Area Land Retirement Alternatives would result in a mostly unavoidable loss of Farmlands of Statewide Importance due to the amount of land retired.
- The creation of the evaporation basins for all the In-Valley Alternatives would be an unavoidable adverse effect to land resources.
- Land retirement under the In-Valley/Water Needs and In-Valley/Drainage-Impaired Land Retirement Alternatives would result in an unavoidable adverse effect on land use.

Comprehensive summaries of environmental effects are contained in the text of the EIS at the end of each section for resources potentially affected by any of the alternatives. These summaries contain comparisons to existing conditions as well as to No Action. Only the comparisons to No Action provide determinations of significance.

2.14 REQUIRED APPROVALS AND PERMITS

Each action alternative would need several required permits and approvals for implementation pursuant to the San Luis Drainage Feature Re-evaluation. These permits and approvals would be needed for disposal and discharges, Bay/Delta/Coastal requirements, land use requirements, and additional environmental legislation and requirements. Section 4 and Appendix L, Regulatory Environment and Compliance Requirements, detail the extensive Federal, State, and local compliance actions, legislation, requirements, regulations, permits, licenses, and approvals that may be necessary for implementation of any of the action alternatives. Table 2.14-1 summarizes the number of required permits and approvals for each action alternative.

Table 2.14-1
Summary Count of Required Permits and Approvals That May be Necessary for SLDFR Alternative Implementation

Ocean Disposal Alternative	Delta Disposal Alternatives	In-Valley Alternatives
Disposal/Discharge-Related Requirements, Permits, and/or Approvals		
7	**10**	**14**
Bay/Delta/Coastal Requirements, Permits, and/or Approvals		
2	**2**	**0**
Land Use Requirements and Regional, County, and Local Requirements, Permits, and/or Approvals		
7	**7**	**7**
Additional Environmental Legislation and Requirements		
19	**19**	**19**

2.15 PREFERRED ALTERNATIVES

Two “preferred alternatives” are discussed in this section: the agency-preferred alternative and the environmentally preferred alternative.

Reclamation’s preferred alternative is the one that completes the action of providing drainage service and best meets the purpose of and need for this action. At this stage in the SLDFR Feasibility Study and its environmental review, Reclamation anticipates that its preferred alternative will be one of the three In-Valley/Land Retirement Alternatives or some variation of one of the three In Valley/Land Retirement Alternatives. Two of these three alternatives have been identified as having distinct advantages:

- The National Economic Development (NED) analysis completed to date for the SLDFR Feasibility Study indicates that the alternative with the greatest net benefit (benefits minus costs) to the United States as a whole, commonly called the NED alternative, is the In-Valley/Drainage-Impaired Area Land Retirement Alternative.
- The In-Valley/Water Needs Land Retirement Alternative, with its nearly 194,000 acres of land retirement primarily in Westlands Water District, is the closest to a “locally developed” alternative because it is consistent with key elements of the proposed Westside Regional Drainage Plan (SJRECWA et al. 2003).

All of the In-Valley Alternatives allow for flexibility in implementation including a phased approach for construction and mitigation (with the Northerly Area having collection and disposal components completed first) and the ability to evaluate and incorporate new technologies. Complete drainage service can begin sooner than for the Out-of-Valley Disposal Alternatives, which require completion of extensive pipelines for disposal to the Delta or Ocean. This flexibility is the principal reason for selection of one of the In-Valley Alternatives. Reclamation's preferred alternative will be selected for the Final EIS, following review of public comments on this Draft EIS and additional results from the pilot studies.

The **environmentally preferred alternative** is defined as the one that promotes the national environmental policy and causes the least damage to the biological and physical environment and that best protects, preserves, and enhances historic, cultural, and natural resources. Each of the action alternatives has some significant negative environmental effects; no single alternative is superior to the others. The In-Valley Alternatives would have major effects to migratory waterfowl from the evaporation basins, while the Delta Disposal Alternatives would cause some increases in salt and Se in the Delta. The Out-of-Valley Disposal Alternatives also have greater potential impact on cultural resources. Selection of an environmentally preferred alternative involves balancing effects on different resources, a judgment that would place higher value on some resources than others. (See Table ES-10 for a comparison of adverse effects.) Reclamation will continue to investigate the feasibility of mitigation and consider comments on the Draft EIS prior to designation of an environmentally preferred alternative no later than in the Final EIS.

SECTIONTHREE

SCOPE OF ANALYSIS

This section is an introduction to the subsequent sections on affected environment and environmental consequences for specific resources and other environmental concerns. It identifies the resources evaluated herein and resources not evaluated. Immediately following this section is Section 4, Regulatory Environment and Compliance Requirements. Detailed regulatory information is included in several of the affected environment sections of the resources being evaluated and in Appendix L.

3.1 RESOURCES TO BE EVALUATED

Each of the subsequent sections presents analyses of the resources or environmental concerns that potentially could be affected by No Action, In-Valley Disposal, and/or Out-of-Valley Disposal Alternatives. These resources are those determined to require analysis based on public scoping comments and the judgment of Reclamation's NEPA practitioners. Their location in the EIS is as follows:

- Surface Water Resources — Section 5
- Groundwater Resources — Section 6
- Biological Resources — Section 7
- Selenium Bioaccumulation — Section 8
- Geology and Seismicity — Section 9
- Energy Resources — Section 10
- Air Resources — Section 11
- Agricultural Production and Economics — Section 12
- Land and Soil Resources — Section 13

- Recreation Resources Section 14
- Cultural Resources Section 15
- Aesthetics Section 16
- Regional Economics Section 17
- Social Issues and Environmental Justice Section 18

For the environmental consequences evaluations, criteria for determining the significance of the effects are presented. Significance determinations are made for comparisons of the action alternatives to No Action. For comparisons to existing conditions, the effects are discussed but no significance determination is made by Reclamation. The comparisons to existing conditions are provided to facilitate use of this EIS by state and local agencies to meet the requirements of the California Environmental Quality Act (CEQA).

Each resource section concludes with a summary of environmental effects. The summary contains findings or statements of the effect and summary tables.

3.2 RESOURCES NOT EVALUATED IN DETAIL

The following resources were determined to be unlikely to be affected by the action alternatives.

3.2.1 Traffic and Transportation

Transportation/circulation system effects for any of the action alternatives are related primarily to construction of facilities rather than to the ongoing operation of those facilities. No long-term potential exists for significant changes in traffic at the site of any of the facilities, as none of the operations are labor intensive. Some of the linear conveyance facilities could occur in existing road rights-of-way, and encroachment permits would be required. As the permitting process proceeds for the subsequently approved project, traffic associated with construction and measures to avoid or minimize temporary disruptions to local and regional traffic, if any, would be identified and implemented through the construction contracts.

3.2.2 Noise

Noise impacts are assessed when an action has the potential to generate new or exacerbate existing sources of noise as measured at sensitive receptors (such as residential areas, hospitals, and schools) in the project vicinity. None of the facilities would introduce new or worsen existing noise-generating activities beyond short-term construction. Treatment facilities involving equipment would be contained within a structure and limited to sites in agricultural areas, away from noise-sensitive land uses, rather than placed in an urban area. Pumps associated with the collection and conveyance facilities are similar to existing facilities and would be located primarily in agricultural areas or along existing road right-of-ways.

3.2.3 Utilities and Public Services

The management of drainwater occurs separately from municipal and industrial water supply, wastewater, solid waste, and other public services and utilities. Consequently, the action alternatives do not have the potential to place additional demand on existing infrastructure other than the San Luis Drain. Operation of project facilities over the long-term does not introduce sufficient new jobs as to attract permanent residents to an area and indirectly affect other public services. Phasing of construction of facilities means that construction-related employment will be temporary and short-term, not affecting the need for services in local communities.

3.2.4 Indian Trust Assets

Reclamation reviewed the location of Native American rancherias, reservations, and public domain allotments in relation to each of the alternatives. No Native American lands were found to be in conflict with any of the alternative alignments. The Santa Rosa Rancheria is the only Native American land found in relatively close proximity to any alignment. This rancheria is southeast of the Lemoore Naval Air Station, about 8 miles east of the terminus of the In-Valley Disposal Alternative pipeline. Consequently, a separate analysis of Indian Trust Assets is not needed.

SECTIONFOUR

REGULATORY ENVIRONMENT AND COMPLIANCE REQUIREMENTS

Construction and operation of the alternatives under consideration would be subject to a variety of regulatory compliance actions that are in place to safeguard the human and biological environment. Table 4-1 provides a quick reference to the regulatory compliance actions that may apply to each of the alternatives. Many of the regulatory compliance actions would require Reclamation to obtain, or ensure that, the applicable approvals are obtained. The CALFED Bay-Delta Program is described at the end of this section.

Table 4-1
Federal, State, and Local Compliance Actions, Legislation, Requirements, Regulations, Permits, Licenses, and Approvals That May be Necessary for an Implementable Alternative Pursuant to the San Luis Drainage Feature Re-evaluation

Ocean Disposal Alternative	Delta Disposal Alternatives	In-Valley Disposal Alternatives
Environmental Compliance Regulations		
National Environmental Policy Act	National Environmental Policy Act	National Environmental Policy Act
California Environmental Quality Act	California Environmental Quality Act	California Environmental Quality Act
Biological Resource Legislation and Requirements		
Fish and Wildlife Coordination Act	Fish and Wildlife Coordination Act	Fish and Wildlife Coordination Act
Migratory Bird Treaty Act	Migratory Bird Treaty Act	Migratory Bird Treaty Act
Endangered Species Act	Endangered Species Act	Endangered Species Act
California Endangered Species Act	California Endangered Species Act	California Endangered Species Act
Magnuson-Stevens Fishery Conservation and Management Act	Magnuson-Stevens Fishery Conservation and Management Act	Magnuson-Stevens Fishery Conservation and Management Act

Table 4-1 (continued)

Ocean Disposal Alternative	Delta Disposal Alternatives	In-Valley Disposal Alternatives
California Fish and Game Code (Section 1601) Streambed Alteration Agreement	California Fish and Game Code (Section 1601) Streambed Alteration Agreement	California Fish and Game Code (Section 1601) Streambed Alteration Agreement
Executive Order 11990 (Protection of Wetlands)	Executive Order 11990 (Protection of Wetlands)	Executive Order 11990 (Protection of Wetlands)
Executive Order 13186 (Conservation of Migratory Birds)	Executive Order 13186 (Conservation of Migratory Birds)	Executive Order 13186 (Conservation of Migratory Birds)
Marine Mammal Protection Act	Marine Mammal Protection Act	
Disposal/Discharge-Related Requirements, Permits, and/or Approvals		
Clean Water Act	Clean Water Act	Clean Water Act
Rivers and Harbors Act of 1899	Rivers and Harbors Act of 1899	Rivers and Harbors Act of 1899
Safe Drinking Water Act	Safe Drinking Water Act	Safe Drinking Water Act
		Underground Injection Control Program
Resource Conservation and Recovery Act	Resource Conservation and Recovery Act	Resource Conservation and Recovery Act
California Porter-Cologne Water Quality Act	California Porter-Cologne Water Quality Act	California Porter-Cologne Water Quality Act
	California Toxic Pits Control Act	California Toxic Pits Control Act
	California Hazardous Waste Control Act	California Hazardous Waste Control Act
	California Hazardous Waste Management Act	California Hazardous Waste Management Act
		California Toxic Injection Well Control Act
		Federal and State Deep-Well Injection Regulations
		California Water Conservation and Water Bond Law
Surface Water Rights and Compliance	Surface Water Rights and Compliance	Surface Water Rights and Compliance
Groundwater Rights and Management and Compliance	Groundwater Rights and Management and Compliance	Groundwater Rights and Management and Compliance
Bay/Delta/Coastal Requirements, Permits, and/or Approvals		
Coastal Zone Management Act and Coastal Zone Act Reauthorization Amendments of 1990	Coastal Zone Management Act and Coastal Zone Act Reauthorization Amendments of 1990	
California Coastal Commission	San Francisco Bay Conservation and Development Commission	
Land Use Requirements and Regional, County, and Local Requirements, Permits, and/or Approvals		
California State Lands Commission Lease and Permit	California State Lands Commission Lease and Permit	California State Lands Commission Lease and Permit
California Department of Transportation Encroachment Permit	California Department of Transportation Encroachment Permit	California Department of Transportation Encroachment Permit

Table 4-1 (continued)

Ocean Disposal Alternative	Delta Disposal Alternatives	In-Valley Disposal Alternatives
California County Permits	California County Permits	California County Permits
Levee District Permits	Levee District Permits	Levee District Permits
Reclamation Board Encroachment Permit	Reclamation Board Encroachment Permit	Reclamation Board Encroachment Permit
State, Areawide, and Local Plan and Program Consistency	State, Areawide, and Local Plan and Program Consistency	State, Areawide, and Local Plan and Program Consistency
Coordination with related Federal, State, and Local Programs	Coordination with related Federal, State, and Local Programs	Coordination with related Federal, State, and Local Programs
San Joaquin Valley Air Pollution Control District Conservation Management Plans	San Joaquin Valley Air Pollution Control District Conservation Management Plans	San Joaquin Valley Air Pollution Control District Conservation Management Plans
Additional Environmental Legislation and Requirements		
Central Valley Project Improvement Act	Central Valley Project Improvement Act	Central Valley Project Improvement Act
Clean Air Act	Clean Air Act	Clean Air Act
National Historic Preservation Act	National Historic Preservation Act	National Historic Preservation Act
Wild and Scenic Rivers Act	Wild and Scenic Rivers Act	Wild and Scenic Rivers Act
California Wild and Scenic Rivers Act	California Wild and Scenic Rivers Act	California Wild and Scenic Rivers Act
Wilderness Act	Wilderness Act	Wilderness Act
Federal Water Project Recreation Act	Federal Water Project Recreation Act	Federal Water Project Recreation Act
Executive Order 11988 (Floodplain Management)	Executive Order 11988 (Floodplain Management)	Executive Order 11988 (Floodplain Management)
Executive Order 12898 (Environmental Justice)	Executive Order 12898 (Environmental Justice)	Executive Order 12898 (Environmental Justice)
Indian Trust Assets	Indian Trust Assets	Indian Trust Assets
Executive Order 13007 (Indian Sacred Sites on Federal Land)	Executive Order 13007 (Indian Sacred Sites on Federal Land)	Executive Order 13007 (Indian Sacred Sites on Federal Land)
American Indian Religious Freedom Act	American Indian Religious Freedom Act	American Indian Religious Freedom Act
Farmland Protection Policy Act and Farmland Preservation	Farmland Protection Policy Act and Farmland Preservation	Farmland Protection Policy Act and Farmland Preservation
Earthquake Hazards Reduction Act of 1977	Earthquake Hazards Reduction Act of 1977	Earthquake Hazards Reduction Act of 1977
National Earthquake Loss Reduction Program	National Earthquake Loss Reduction Program	National Earthquake Loss Reduction Program
Executive Order 12699 Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction	Executive Order 12699 Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction	Executive Order 12699 Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction
1998 California Building Code	1998 California Building Code	1998 California Building Code

Table 4-1 (concluded)

Ocean Disposal Alternative	Delta Disposal Alternatives	In-Valley Disposal Alternative
California Public Resources Code § 25523(a); 20 CCR § 1752(b) and (c); 1972 Alquist-Priolo Earthquake Fault Zoning Act (amended 1994)	California Public Resources Code § 25523(a); 20 CCR § 1752(b) and (c); 1972 Alquist-Priolo Earthquake Fault Zoning Act (amended 1994)	California Public Resources Code § 25523(a); 20 CCR § 1752(b) and (c); 1972 Alquist-Priolo Earthquake Fault Zoning Act (amended 1994)
California Public Resources Code Chapter 7.8, 1990 Seismic Hazards Mapping Act	California Public Resources Code Chapter 7.8, 1990 Seismic Hazards Mapping Act	California Public Resources Code Chapter 7.8, 1990 Seismic Hazards Mapping Act
Historic Structures – California Public Resources Code Section 5028	Historic Structures – California Public Resources Code Section 5028	Historic Structures – California Public Resources Code Section 5028

Table 4-2 provides an estimate of the complexity and difficulty for completion of regulatory compliance actions for the action alternatives.

Table 4-2
Relative Difficulty to Obtain Permits Ordered from Most Complex and Difficult to Least Complex and Difficult

Alternative	Ranking
Bay-Delta (Chipps Island)	Most complex
Bay-Delta (Carquinez Strait)	Second most complex
Ocean Disposal (Point Estero)	Third most complex
In-Valley Disposal/Land Retirement	Least complex

Appendix L describes the regulatory compliance actions identified in Table 4-1 in greater detail.

In addition to the regulatory activities listed in Table 4-1, the California Bay-Delta Authority was established to carry out the CALFED Bay-Delta Program. The Program's mission is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The primary objectives of the Program are to:

- Provide good water quality for all beneficial uses.
- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.
- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.
- Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of the Delta levees.

The above objectives are relevant to evaluation of alternatives considered in this EIS. For example, agricultural drainage discharges to the San Joaquin River or the Delta could affect the Bay-Delta water quality and ecological function. Land retirement, which is included in each of the action alternatives, would reduce the demand for irrigation water and the volume of drainwater requiring management and disposal.