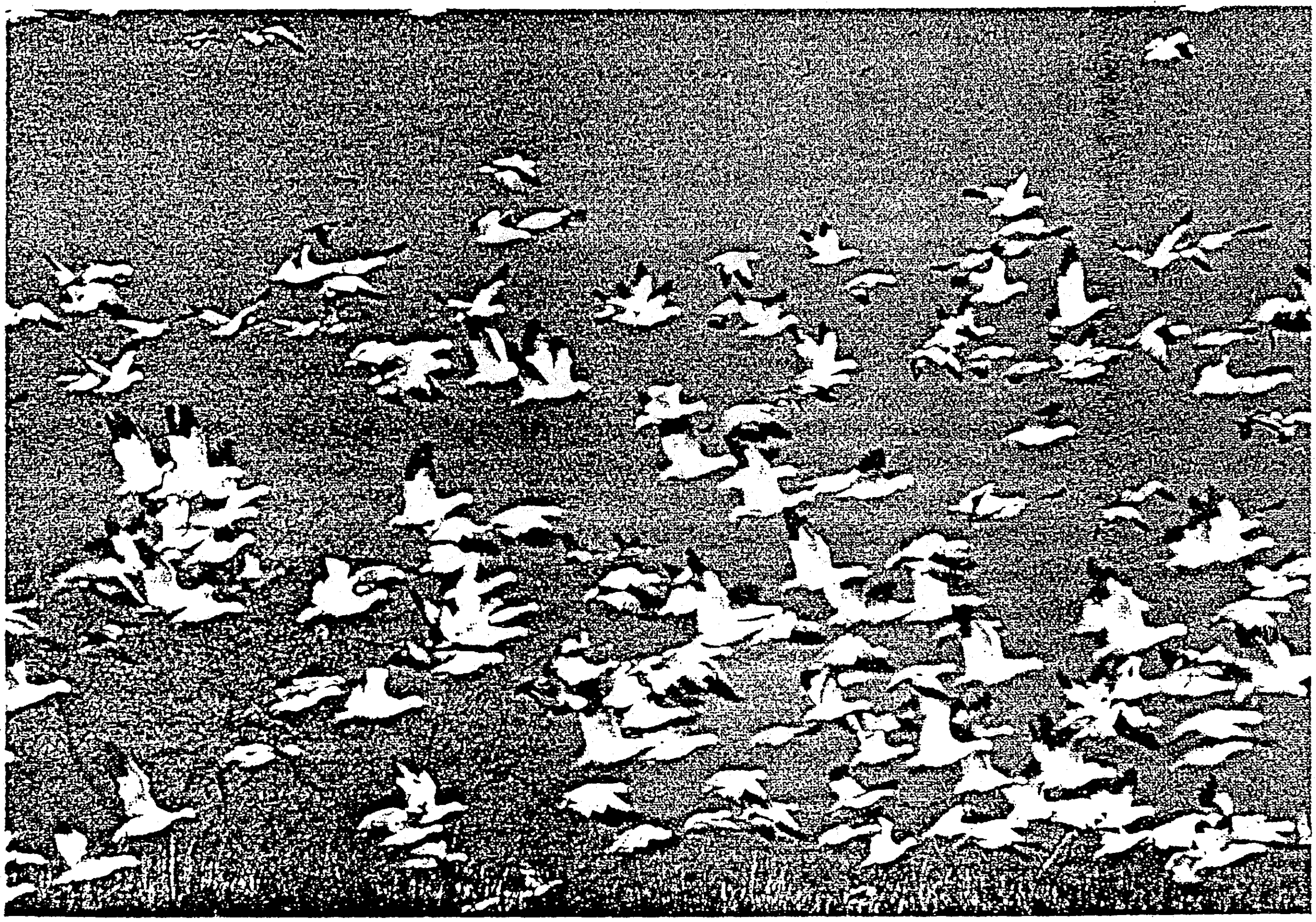
REPORT ON REFUGE WATER SUPPLY INVESTIGATIONS

Central Valley Hydrologic Basin, California



March 1989

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MID-PACIFIC REGION

THIS REPORT WAS PREPARED UNDER THE DIRECTION OF THE REGIONAL DIRECTOR, MID-PACIFIC REGION OF THE BUREAU OF RECLAMATION, PURSUANT TO FEDERAL RECLAMATION LAWS (ACT OF JUNE 17, 1902, 32 STAT. 388 AND ACTS AMENDATORY THEREOF OR SUPPLEMENTARY THERETO). THE PURPOSE OF THIS REPORT IS AS A PUBLIC INFORMATION DOCUMENT. THIS REPORT PROVIDES INFORMATION AND ALTERNATIVES FOR FURTHER CONSIDERATION BY THE BUREAU OF RECLAMATION, THE SECRETARY OF THE INTERIOR, AND OTHER FEDERAL AGENCIES. PUBLICATION OF THE FINDINGS AND RECOMMENDATIONS HEREIN SHOULD NOT BE CONSTRUED AS REPRESENTING EITHER THE APPROVAL OR DISAPPROVAL OF THE COMMISSIONER OF THE BUREAU OF RECLAMATION OR THE SECRETARY OF THE INTERIOR.

EXECUTIVE SUMMARY

INTRODUCTION

The wetlands of California's Central Valley provide critical habitat for migratory birds and for resident wildlife, including many threatened and endangered animal and plant species. The Central Valley is part of the Pacific Flyway, a migratory waterfowl route extending over Canada, the United States, and Mexico. Management of the Flyway is governed by international treaties between the United States, Mexico, and Japan. The Bureau of Reclamation (Reclamation) is the lead agency in a cooperative effort among Federal, State, and local agencies in planning for the development of dependable water supplies for California's Central Valley refuges.

This report presents an analysis of water needs and provides an array of potential water sources and delivery systems for providing a dependable supply of good quality water to ten National Wildlife Refuges (NWR), four State Wildlife Management Areas (WMA), and one privately managed wetland area (RCD) within the Central Valley hydrologic basin of California. The names and locations of these managed wetland areas (collectively referred to as refuges) are presented in Figure S-1.

The intended purpose of this document is to provide information and resource data which, when combined with appropriate information from related investigations discussed in this summary, will be the basis for selecting recommended plans for water delivery to each of the 15 refuges. Those plans together with appropriate environmental documentation will be presented in a Refuge Water Supply Planning Report, which is scheduled to be completed in November, 1989.

SCOPE OF STUDY

The scope of this study is to gather, update, and organize all existing and available information relative to current and desired water use, power needs, surface water delivery systems, groundwater availability, recreation and wildlife resources, and habitat management objectives for each of the 15 refuges. Based upon that information, alternative plans are to be formulated for each refuge to provide dependable water supplies under four water delivery options, as follows:

- Level 1 - Existing firm supply
- Level 2 - Current average annual water supply
- Level 3 - Supply for full use of existing development
- Level 4 - Supply for optimum habitat management

A recommended plan for water delivery to each refuge, using the information relative to water allocation and environmental impacts currently being developed in the Sacramento River and Delta Export Water Contracting Environmental Impact Statements (EIS's), will be selected from the alternatives and presented in the Refuge Water Supply Planning Report.

STUDY ORGANIZATION

Reclamation is the lead agency for this multi-agency study and is responsible for the preparation of this report and the forthcoming Refuge Water Supply Planning Report. The Fish and Wildlife Service, State Departments of Fish and Game and Water Resources, and California Waterfowl Association comprise the core group of agencies and organizations which participated on the planning team and provided technical expertise relative to water and wildlife resources. The Grassland Resource Conservation District has provided both information on privately operated wetlands and monetary contributions for planning efforts through the California Waterfowl Association.

PROBLEMS AND NEEDS

Background

The Pacific Flyway is the westernmost of four migratory waterfowl routes transecting the North American continent. The Pacific Flyway is unlike the others, however, in that most of the wintering waterfowl concentrate in a relatively small area: California's Central Valley. Historically, the Central Valley contained over 4 million acres of wetlands. However, through the conversion of those lands to other uses, the total available acres of wetlands have been reduced to approximately 300,000 acres. Federal National Wildlife Refuges and State Wildlife Management Areas comprise approximately one third of this acreage, with most of the remainder in private ownership.

Each year about 10 to 12 million waterfowl, along with other migratory birds, are estimated to winter in or pass through the Central Valley, more than in all of the other flyway states combined.

It is a popular misconception that wetland refuges are established and maintained primarily for the benefit of waterfowl (ducks, geese, and swans) and waterfowl hunters. While it is true that hunting is a popular activity at most refuges, such activity is tightly regulated. A portion of the revenue received from hunting activities is used to acquire land for migratory bird refuges and waterfowl production areas. It is important, however, to recognize that refuges also provide a multitude of other uses such as: sanctuaries for the purpose of resting, feeding, and breeding for millions of other migratory birds and resident wildlife; flood control; erosion control; nutrient cycling; groundwater recharge; and numerous recreation and educational opportunities.

RELATED INVESTIGATIONS

Present and future water development and use in the Central Valley is being redefined. Valley-wide studies underway by both Reclamation and the State of California are identifying and examining the agricultural, municipal, industrial, recreational, fish, wildlife, and water quality needs for the Central Valley's river basins. Over the next few years, 1987-1990, the State Water Resources Control Board will conduct hearings on the San Francisco Bay-Sacramento/San Joaquin Delta to receive evidence on present water use and future demand. The Board will determine beneficial and reasonable uses for the Central Valley's water supplies and develop water quality standards for the Bay and Delta accordingly.

Water Contracting EIS's

Reclamation is currently examining existing water use, in-basin needs, and future demands as part of its Sacramento River, American River, and Delta Export Water Contracting Environmental Impact Statements. These EIS's will assess all competing water demands and alternatives for contracting and distributing the uncommitted supply of the Central Valley Project in the Sacramento, American, and San Joaquin River Basins. Agricultural, municipal, industrial, fishery, wildlife, recreation, and navigational needs are being considered, as well as optimization of economic benefits and repayment of the project.

At the same time, a framework within which to coordinate the operations of the Central Valley and State Water Projects has now been effected. Public Law 99-546, enacted October 17, 1986, authorized the Secretary of the Interior to sign and implement the Coordinated Operations Agreement for the integrated, orderly and efficient operations of the Central Valley and State Water Projects.

In enacting the Coordinated Operation Agreement legislation, Congress recognized the significance of wildlife refuges in the overall picture of the Central Valley water use. By terms of the legislation, Reclamation is required to reserve 25 per cent of the remaining uncontracted yield of the Central Valley Project until 1 year after a report on refuge supply has been submitted to Congress.

Other Studies

Several other Reclamation studies and investigations related to increasing water supply, water quality, and water delivery are being conducted. The Offstream Storage Investigation is evaluating storage sites to increase water yield in the San Joaquin Valley. The use of wetlands for offstream storage is a component of this investigation. The San Joaquin Valley Conveyance Study is investigating methods to transport water to the Mid-Valley area of the San Joaquin Valley. The conjunctive use of surface and ground water is being investigated as a means to secure dependable water supplies and increasing Central Valley yield. The multi-agency San Joaquin Valley Drainage Program is conducting investigations to develop long-term solutions to drainage problems in the San Joaquin Valley.

FINDINGS

This report represents the most comprehensive source of up-to-date information on the refuges of the Central Valley available. Based on the information developed during this study, it is clear that each refuge requires a dependable supply of good quality water to facilitate proper wetland habitat management for the migratory birds of the Pacific Flyway and resident wildlife and flora. The amount of water that is ultimately recommended for each refuge will be based upon the information in this report, the findings of the Sacramento River and Delta Export Water Contracting EIS's, and the findings of the other related investigations described above. Those recommendations will be presented in the forthcoming Refuge Water Supply Planning Report.

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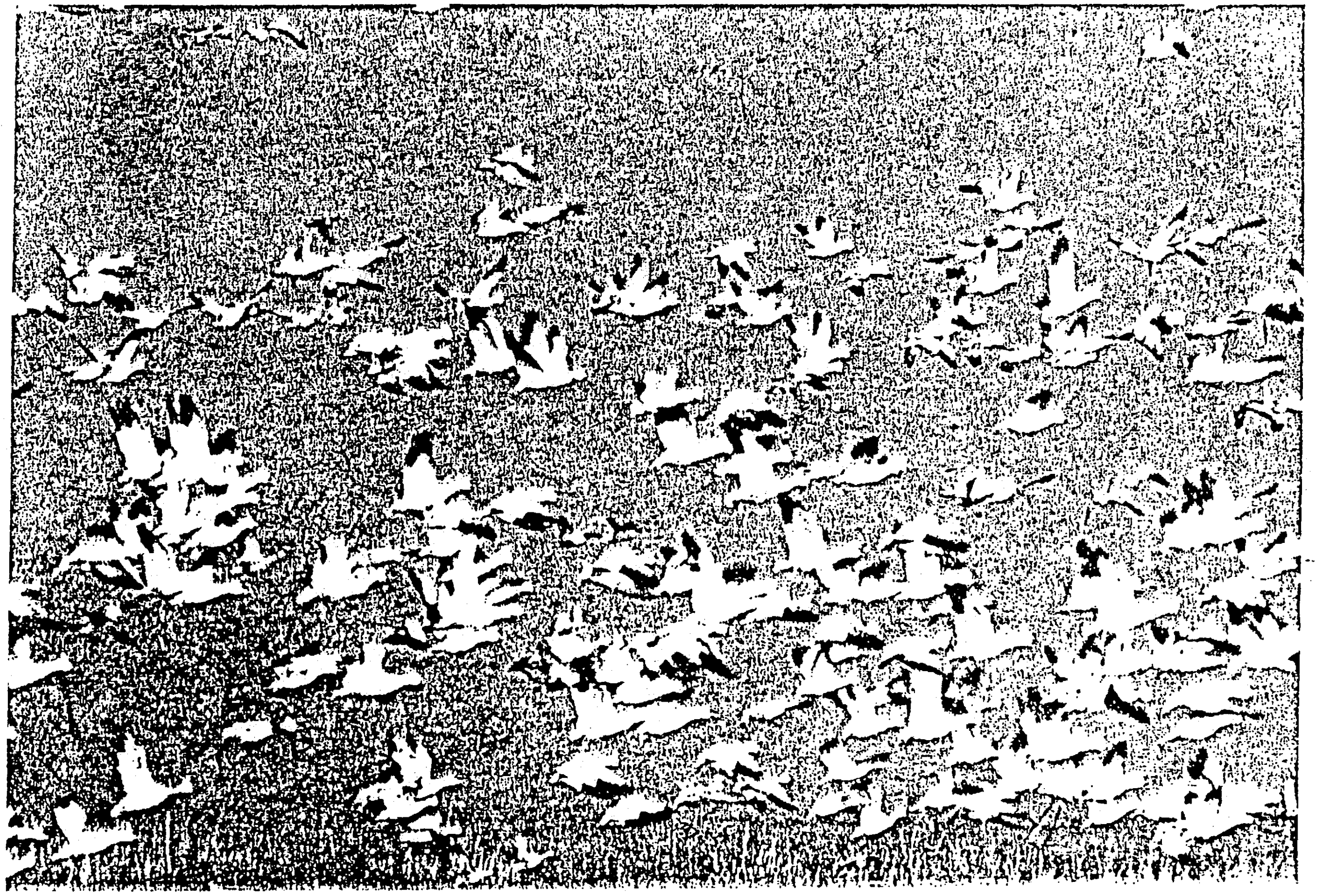

U.S. DEPARTMENT OF THE INTERIOR
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CHAPTER I

INTRODUCTION

A. STUDY AUTHORITY

The Refuge Water Supply Study is being conducted under the authority of the Reclamation Act of June 17, 1902 and Public Law 99-546 (Coordinated Operation Agreement).

B. PURPOSE, SCOPE, AND OBJECTIVES OF REFUGE WATER SUPPLY STUDY

The Bureau of Reclamation (Reclamation), assisted by the Fish and Wildlife Service (Service) and the California State Departments of Fish and Game (DFG) and Water Resources (DWR), is conducting the Refuge Water Supply Study. The purpose of the study is to investigate and identify potential water sources and delivery systems for providing a dependable water supply to ten national wildlife refuges (NWR), four State wildlife management areas (WMA), and private wetlands within the Grassland Resource Conservation District (GRCD), in California, as previously shown in Figure S-1. The Refuge Water Supply Study was initiated in October 1985 as an extension of the Central Valley Fish and Wildlife Management Study's special study on "Refuge Water Supply, Central Valley Hydrologic Basin, California (USBR, 1986a)." The Grassland Water District was also included in the report and shared in the costs through funding provided by the California Waterfowl Association.

The Refuge Water Supply Study was organized to meet the following primary objectives for each refuge:

1. Confirm and update monthly water requirements based on four water delivery regimes.

2. Determine resource response and recreation use for each water supply regime.

3. Determine groundwater quantity and quality and identify conjunctive use potential.

4. Determine contractual and physical capabilities of water and irrigation districts to deliver water on a monthly basis.

5. Provide preliminary designs and associated costs of delivery systems for each water regime.

6. Evaluate power requirements for delivery systems and wells under each water regime.

7. Develop alternative plans based on water regimes.

8. Develop environmental account for each plan.

This document is one part of the Refuge Water Supply Study, and is intended to provide information and resource data. This data, when combined with information form related investigations, will be the basis for selecting recommended plans for water delivery to each of the 15 refuges. The plans, together with appropriate environmental documentation, will be presented in the Refuge Water Supply Planning Report that is scheduled to be completed in November 1989.

C. DESCRIPTION OF STUDY AREA

The study area is located in California's Central Valley. This valley forms a cleft in the middle of California and is one of the world's largest valleys, over 400 miles long and 50 miles wide. Geologically, it is a trough between the Coast Ranges and the Sierra Nevada, with the Cascades bordering it on the north and the Tehachapi Range on the south. The valley drains through two great river systems which have created two distinct valleys: the Sacramento and the San Joaquin.

The Central Valley is the world's richest agricultural region. Rice and deciduous fruits are more commonly grown in the Sacramento Valley, while grapes and cotton characterize the more intensely developed San Joaquin Valley. Although two centuries ago most of the valley's land would have been considered semi-desert, it is now the richest agricultural region on earth, producing more than 200 crops and 25 percent of all table foods consumed in the United States. Agriculture is not the only industry in the Central Valley, but it dominates the social characteristics.

The Central Valley is one of the fastest growing regions in the United States. However, despite the fact that thousands of acres are lost each year to urban development, the valley has retained much of its rural atmosphere and cultural values.

The one resource conservation district and 14 Federal and State refuges discussed in this report are located in the Central Valley within the specific valleys and counties listed on the following page.

Refuge	County
Sacramento Valley	
Modoc NWR	Modoc
Sacramento NWR	Glenn
Delevan NWR	Colusa
Colusa NWR	Colusa
Sutter NWR	Sutter
Gray Lodge WMA	Butte
San Joaquin Valley	
Grassland RCD	Merced
Volta WMA	Merced
Los Banos WMA	Merced
Kesterson NWR	Merced
San Luis NWR	Merced
Merced NWR	Merced
Mendota WMA	Fresno
Pixley NWR	Tulare
Kern NWR	Kern

D. PROBLEMS AND NEEDS

The major issue addressed by the refuge study is the need to provide water to the refuges to maintain or enhance wildlife habitat within the Pacific Flyway. Wildlife habitat includes wetlands, riparian vegetation, and uplands. Since 1850, the amount of wetlands in the Central Valley has decreased from 4 million acres to about 300,000. Private hunting clubs own about two-thirds of this acreage. The remaining land is located in National Wildlife Refuges and State Wildlife Management Areas. During high flood years, the amount of wetlands may increase to 700,000 acres. However, management of existing wetland habitat during dry years is essential for consistent waterfowl populations, especially ducks and swans. Riparian woodlands provide nesting habitat, cover, and food areas for ducks, especially wood ducks. As with wetlands, the historical acreages of riparian woodlands have been reduced to 10 to 15 percent of the original acreages. To benefit waterfowl, the riparian vegetation cannot be located far distances away from wetlands.

Upland habitat is important for nesting cover, especially for resident dabbling ducks, such as mallards, gadwall, cinnamon teal, northern shoveler, and pintails. Large blocks of undisturbed upland vegetation adjacent to wetlands are preferred. However, birds will use vegetation found in fields and along fences, ditches, and levees, but nesting success is poor due to heavy predation.

The single most important role of the Central Valley wetlands and associated riparian and upland corridors is to provide wintering habitat. In August, the waterfowl population begins to increase to a peak of between 5 and 6 million birds in December. The population then declines to less than one million birds by March. Some of the most important species from a biological perspective (numbers or impact on the environment) and/or economic factors (consumptive uses) are tundra swans, lesser snow geese, Ross' geese, Pacific white-fronted geese, Canada geese, pintails, mallards, American wigeons, green-winged teal, shovelers, gadwalls, and canvasbacks. Other species that occur in significant numbers include wood ducks and ring-necked ducks. Redheads, cinnamon teals, common goldeneyes, buffleheads, mergansers, and lesser scaups are present in limited number. Most wintering waterfowl move among the wetlands in the Central Valley in response to weather changes, water conditions, food availability, and season.

The wetlands and associated habitat are also important to several Federal listed, proposed, and candidate threatened and endangered species, such as American pergrine falcon, bald eagle, Aleutian Canada goose, San Joaquin kit fox, giant garter snake, and white-faced ibis. In addition, these areas provide habitat for unique species such as yellow-billed cuckoo, white pelicans, common and snowy egrets, grebes, greater and lesser sandhill cranes, American bitterns, American avocets, black-necked stilts, common snipes, long-billed curlews, and tricolored blackbirds.

E. STUDY ORGANIZATION AND MANAGEMENT

The Refuge Water Supply Study is being conducted as an interdisciplinary, interagency investigation. Study organization and areas of responsibility are shown on Figure I-1. A glossary of terms used in this report is presented in Attachment A.

F. PUBLIC PARTICIPATION

The Refuge Water Supply issue has been long-standing and is of significant importance to refuge managers and the public, as the quality and quantity of water available to each refuge ultimately determines the desireability of habitat for migratory birds and resident wildlife. The degree to which these wetland areas are successfully managed is of biological, hydrological, economical, recreational, and educational importance to the state of California, as well as other states and countries along the Pacific Flyway.

Public interest in the development of dependable water supplies for Central Valley refuges is very high as evidenced by inquiry and participation in study activities by individuals, environmental, and wildlife organizations and representatives of the state and Federal legislature.

Since the initiation of the Refuge Water Supply Study in October 1985, numerous meetings have been held with cooperating agency staff and management, environmental and wildlife organizations, and water and irrigation districts to discuss study objectives, issues and concerns, and planning procedures. Two Public

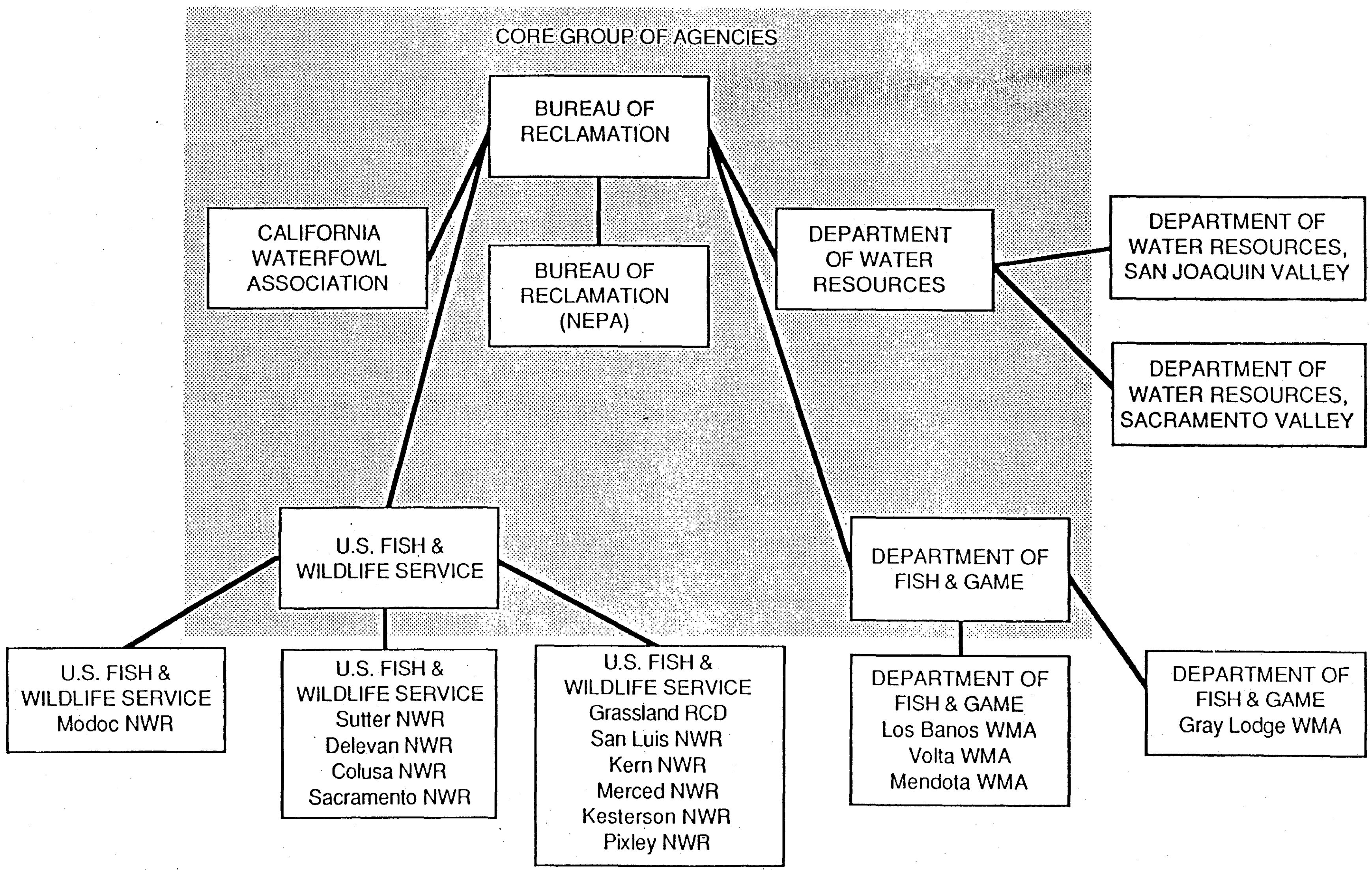


FIGURE I-1

REFUGE WATER SUPPLY INVESTIGATION
STUDY ORGANIZATION

Information Documents have been released to provide information on the progress of the study and to solicit public input on alternative water delivery plans and pertinent issues. Response has generally been favorable and supportive of the study. Public participation is discussed in greater detail in Chapter V, Consultation and Coordination.

G. COST SHARING

Preliminary informal discussions with the Service, DFG, and private organizations such as the California Waterfowl Association, Ducks Unlimited, and the Audubon Society indicate that there are substantial opportunities to obtain cost sharing funds to assist in the development of refuge water delivery facilities and perhaps to pay for annual water and power costs.

A letter of inquiry has been submitted to all agencies and organizations which may have an interest in assuring dependable supplies of water for refuges. The letter requests that potential funding sources and programs for this purpose be identified and asks for indication of intent to participate in a cost-sharing program. The replies to the inquiry will be included in an appendix to the Refuge Water Supply Planning Report.

H. RELATED INVESTIGATIONS

The Refuge Water Supply Study is one of numerous studies that have been conducted by various agencies and organizations addressing the problems of waterfowl management and loss of wetland habitat occurring in the Central Valley over the past quarter century. The relationship of the Refuge Water Supply Study to other ongoing Reclamation investigations is shown on Table I-1. These reports include ongoing studies by the State of California and private organizations. In addition, a considerable amount of legislation and programs affecting Central Valley habitat has been written.

1. Background to Present Study

A series of Reclamation studies have addressed fish and wildlife problems related to the Central Valley Project (CVP) or other water and land activities within the Central Valley. In 1978, as part of its Total Water Management Study for the Central Valley Basin of California, Reclamation published Working Document No. 12, "Fish and Wildlife Problems, Opportunities, and Solutions," a survey of major fish and wildlife problems and improvement opportunities within the geographical area encompassed by the CVP (USBR, 1978).

Based on the data developed in Working Document No. 12, Reclamation in 1979 initiated the Central Valley Fish and Wildlife Management Study, a broad-based, interagency, appraisal-level study to develop a comprehensive baseline on the Central Valley's fish and wildlife resources and to propose solutions to water-

TABLE I-1

RELATIONSHIP OF REFUGE WATER SUPPLY STUDY
TO OTHER INVESTIGATIONS

Study	Location	Purpose	Scope	Environmental Issues	Legal and Institutional Constraints
Refuge Water Supply Study and Planning Report	Central Valley	To investigate and identify potential water sources and delivery system for 15 wildlife areas and identify a preferred alternative(s) for providing a reliable water supply to each wildlife area within existing constraints.	Scope includes: (1) Analysis of resource responses to various quantities of water delivery. (2) development of water supply alternatives. Site specific and cumulative impacts will be addressed in appropriate water marketing environmental statement.	o Water quality o Endangered species o Preservation of wetlands o Impacts to Pacific Flyway	o Water rights o Contractual restrictions on CVP water and power availability o Legal review of water delivery authority.
Sacramento River Water Contracting Environmental Impact Statement	Sacramento River Basin	To address options for fulfilling both the near- and long-term Sacramento River are agricultural, municipal, and environmental water needs that could be serviced with CVP water from Shasta and Clair Engle Reservoirs, and cumulative impacts of meeting those needs.	Includes: (1) Water users in the Sacramento River CVP service area with needs for water that cannot be satisfied with safe yield ground water or enhanced conservation; (2) the direct, secondary, and cumulative impacts expected to occur as a result of a range of federal water marketing alternatives; (3) the conjunctive use aspect of the Refuge Water Supply Study and the cumulative impacts of providing water to the wildlife areas.	o Cumulative impacts to Delta o Altered flows o Fish migration & production o Bank protection o Riparian/wildlife habitat o Endangered species o Water quality	o Water rights transfers o CDA standards for Delta o Conjunctive use o Rate Setting policy
American River Water Contracting Environmental Impact Statement	American River Basin	To address options for meeting near- and long-term agricultural, municipal and environmental water needs in the American River Basin that could be served with CVP water and impacts on instream flows of meeting those needs.	Includes: (1) Water users in the American River service area, including downstream water uses; (2) cumulative impacts expected to occur as a result of a range of federal water marketing alternatives.	o Lower American River flows o Fish and wildlife o Water quality o Recreation o Delta	o Present water rights as affected by D-1400 and D-893
Delta-Export Water Contracting Environmental Impact Statement	CVP Service Area South of Delta	To identify water needs within the valley and analyze impacts of alternative marketing plans.	Full scope of study has not yet been identified. The full range of issues will be discussed in agency and public scoping meetings to be scheduled later in 1987. Valley refuges, Mid-Valley Canal, and wheeling of water through State of California plants are issues presently identified.	Full scope of environmental issues not yet identified. Issues will include impacts to the Delta and drainage	Unknown at this time
Consolidated and Expanded Place of use Environmental Impact Report	Existing and Potential CVP Service Area	To consolidate the CVP place of use and allow water from each permit area to be used consistent with existing water rights anywhere in the CVP; conform the purpose of use to allow a full range of uses in each of the user's water rights permits, expand the place of use to officially permit service to areas already being serviced outside the existing permitted place of use; and extend time required to complete water marketing.	Generic/programmatic overview of where the broader issues (Delta, future expansion) will be covered; detailed site-specific treatment of the potential impacts of Reclamation and/or SWRCB actions in the area.	o Relationship to other Reclamation petitions and water marketing program o Cumulative impacts on fish and wildlife o Impact of expansion o Impact of service areas outside expanded place of use	This is an EIR being prepared for the SWRCB's use. No new water deliveries by Reclamation into the expanded place of use until environmental compliance is completed for the specific place of use.
Offstream Storage Study	Potential Offstream Reservoir Sites	To provide additional water for the CVP and to evaluate methods to combine offstream storage with existing facilities to increase system capacity south of Delta and reduce independence on surface water development.	Scope includes: (1) New and previously examined offstream storage sites in the Central Valley; (2) Integration of waterfowl habitat return flows with agricultural deliveries.	o Additonal Delta imports o Water quality o Impacts to wildlife habitat o Threatened & endangered species o Drainage & instream flows	o CVP place of use o Corps permits o Additional point of diversion o Water quality & water rights o Groundwater management
San Joaquin Valley Drainage Program	Complete Watershed of the San Joaquin River, including the Tulare Lake Basin	To evaluate alternatives for the completion of drainage facilities of the San Luis Unit and adjoining Delta-Mendota Canal service area of the CVP.	Scope includes all areas potentially affected by discharge and management of agricultural drainage water from the San Joaquin Valley.	o Public health o Water quality o Agricultural productivity o Wetlands/wildlife habitat o Drainage transport & disposal o Water supply	o Water contracts o SWRCB regulations o Pacific Flyway treaties o Pulic health standards

related problems and issues. Two reports addressing waterfowl or waterfowl habitat were completed: New Waterfowl Habitat Potential within the Central Valley, California, September 1986 (USBR,1986d); and Refuge Water Supply, Central Valley Hydrologic Basin, California 1986 (USBR, 1986a). The latter study investigated and identified water needs and sources of dependable water supply for 12 refuges in the Central Valley and served as a primary resource document for water supply investigations presented in this report.

2. Other Reclamation Studies

The Refuge Water Supply Study interacts with many other water resource studies currently underway in the Central Valley. One of the most significant studies involves the preparation of Environmental Impact Statements (EISs) for water contracting of uncommitted CVP water in the Sacramento River Basin, American River Basin, and basins requiring delta export of water, including the San Joaquin, Santa Clara, and Pajaro valleys. These Water Contracting EIS's will address the options for fulfilling water needs for agricultural and municipal users as well as refuges. The Off-Stream Storage Investigation is evaluating plans for storage of surplus CVP water on the refuges. The San Joaquin Drainage Program is being conducted by an interagency group which includes Reclamation, Service, U.S. Geological Survey, DFG and DWR.

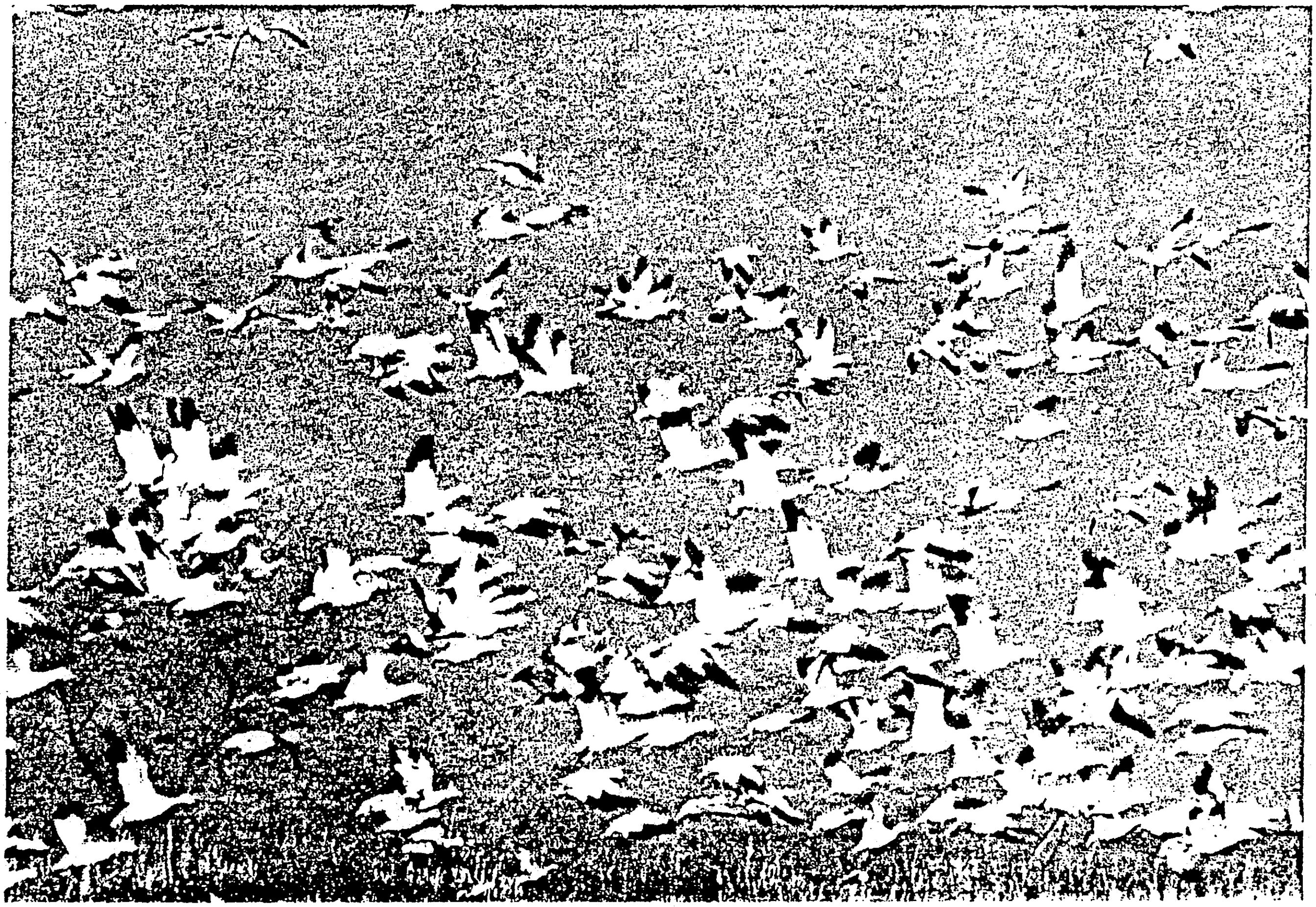
The National Environmental Policy Act (NEPA) requirements for cumulative impacts associated with water delivery and allocation to the refuge and wildlife management areas are being addressed in the Sacramento River and Delta Export Water Contracting EISs.

3. Coordinated Operation Agreement

On October 27, 1986, the President signed Public Law 99-546, which authorized the Secretary of the Interior to enter into and implement the Coordinated Operation Agreement between the Federal CVP and the State Water Project. The agreement allows coordination of the two projects to meet State Water Resources Control Board Decision 1485 water quality standards. Section 104 of the agreement stipulates that 25 percent of the firm yield of the Central Valley Project currently not committed under long-term contracts is to be reserved until one year after the Secretary of the Interior transmits a report on refuge water supply investigations in the Central Valley Basin to Congress.

CHAPTER II

Need for Action



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CHAPTER II

NEED FOR ACTION

A. INTRODUCTION

Waterfowl migration remains one of the marvels of nature. Twice each year, for millennia, millions of ducks and geese have flown from one end of the North American continent to the other following the same routes each year. The Central Valley lies at the southerly end of the Pacific Flyway migratory route, and in presettlement times, the valley's vast marshes and dense stands of tules and riparian vegetation provided ideal wintering habitat and attracted large numbers of waterfowl.

Today, most of the wetlands are gone due to land conversion to other uses. The birds, however, continue to fly their ancient routes and crowd into the remaining habitat to rest, feed, and nest. Since the turn of the century, the numbers of ducks and geese wintering in California has plummeted and the loss of wetlands has been a significant factor in the decline. As waterfowl habitat has been modified, Federal and State fish and wildlife agencies, private organizations, and hunting clubs have developed several managed areas for waterfowl and other wildlife by establishing National Wildlife Refuges, State Wildlife Management Areas, conservation areas, and hunting clubs. Despite extensive research conducted by Federal, State, and private entities, existing data are insufficient to completely quantify the relationship between waterfowl and habitat. The following key information relative to waterfowl is known:

1. Waterfowl populations in the Central Valley are below historical levels for most species.

2. Winter habitat can influence the distribution and abundance of wintering waterfowl.

3. Existing habitat can be enhanced.

4. The condition of waterfowl returning from wintering grounds can influence reproductive capability.

At the present time an opportunity exists to preserve and enhance wildlife in the Central Valley. As part of the preparation of the Water Contracting EISs currently underway, Reclamation is assessing the impacts of entering into long-term contracts for the remaining uncommitted yield of the Central Valley Project (CVP). Reclamation is evaluating the effects of allocating different amounts of water to meet the needs of wildlife refuges and wetlands. Following completion of the Refuge Water Supply Study and the Water Contracting EISs, Congress will have the opportunity to develop necessary legislation and/or provide opportunities for refuge water supplies.

This chapter addresses the existing conditions in the Central Valley--water shortages, diminishing habitat, and related problems--that are known to threaten the maintenance of the Pacific Flyway migratory route, as shown on Figure II-1. These needs reflect the data gathered as part of this study and represent a consensus among the biologists contacted within various agencies and organizations involved in waterfowl management.

B. IMPORTANCE OF THE CENTRAL VALLEY TO THE PACIFIC FLYWAY

Waterfowl migration to the Central Valley begins in August with the arrival of the first birds from the north. The number of wintering waterfowl rapidly increases over the late summer and fall and by late December as many as 10 to 12 million waterfowl have migrated to or through the valley for their winter sojourn. These birds include from 5 to 6 million ducks and geese who winter in the Central Valley. In addition, the Central Valley provides migration habitat for 1.3 million more ducks and geese which winter in Mexico.

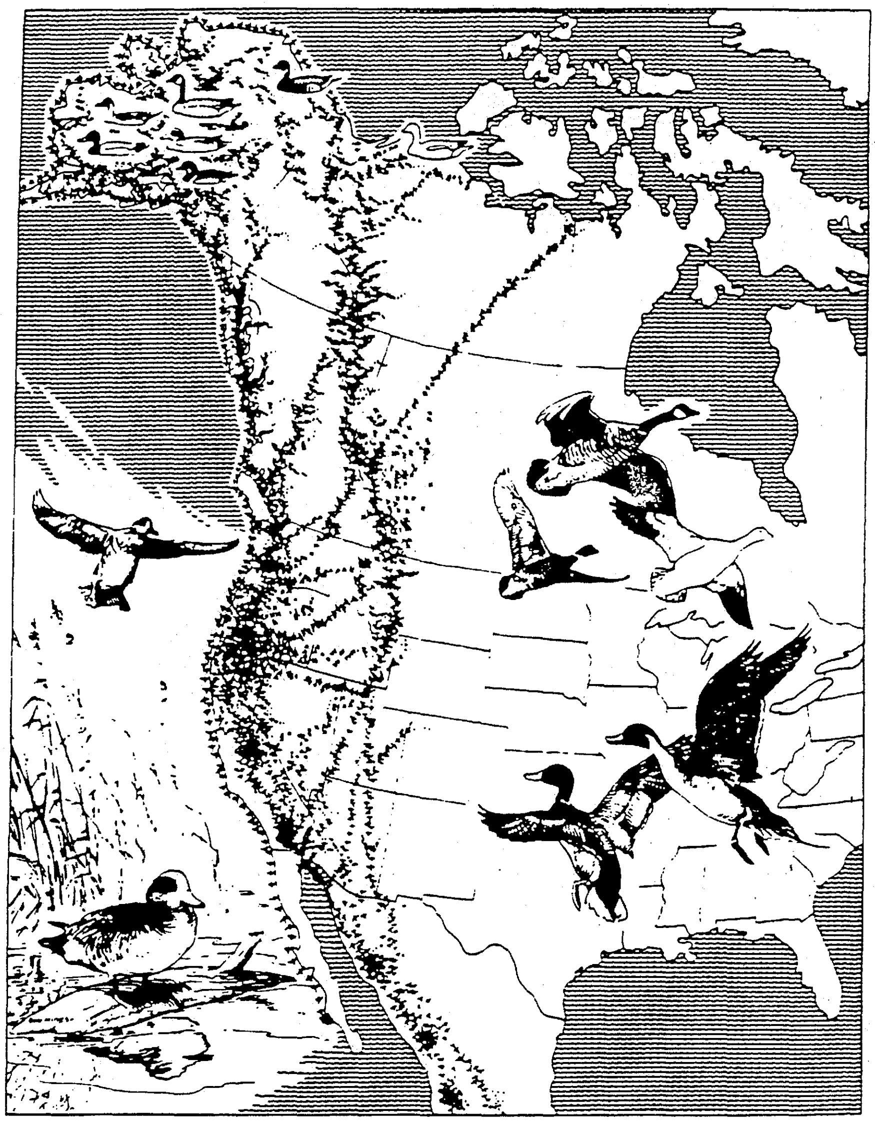
As shown on Figure II-2, the Central Valley is critical to the Pacific Flyway. Central Valley migrants represent about 15 to 20 percent of the total continental wintering waterfowl population and about 60 percent of the Pacific Flyway's waterfowl. Altogether, nearly 10 to 12 million waterfowl, along with millions of other water-related birds, annually winter in or pass through the Central Valley (Gilmer et al., 1982). Many waterfowl migrate through the valley en route to Mexico.

Maintenance of the Pacific Flyway for waterfowl depends largely on maintaining critical wetland wintering habitat in the Central Valley, about one-third of which is comprised of Federal and State wildlife areas. The Service ranks Central Valley wetland habitat as one of the top five habitats in the United States.

C. CENTRAL VALLEY WATERFOWL

The Central Valley of California has traditionally served as a major wintering ground for millions of migratory birds. Fall flights of waterfowl, shorebirds, raptors, and passerines return annually to the wetland, riparian, and grassland habitats of the valley.

Each year in early August the first flight of ducks from the northern breeding grounds begin arriving in the Central Valley. Substantial numbers of some species, including over 90 percent of California's wintering mallard duck population, are bred in California. Populations increase through fall and by late December peak between 5 and 6 million waterfowl, as shown in Figure II-3.



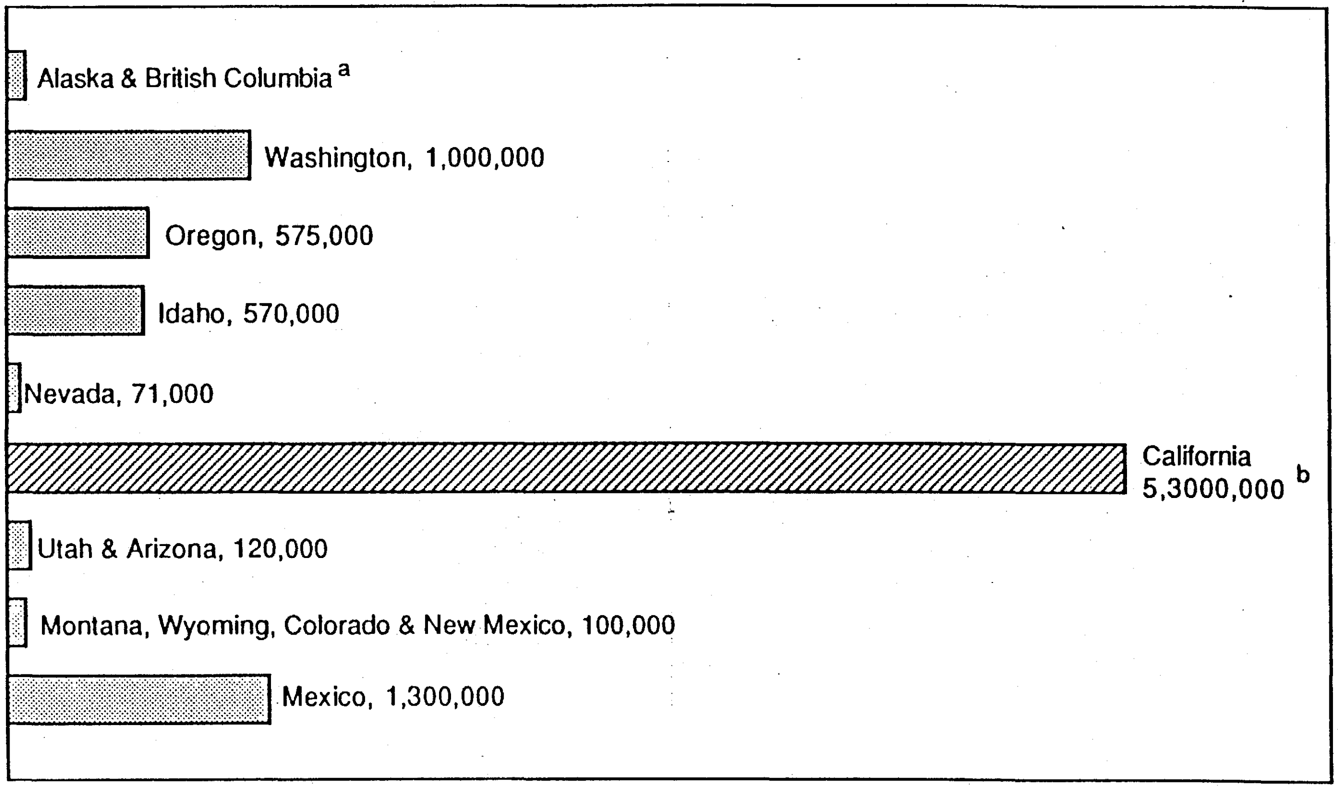
Courtesy of Fish & Wildlife Service

PACIFIC FLYWAY

The migration of waterfowl remains one of the marvels of Nature. Twice each year millions of ducks and geese fly from one end of the North American continent to the other, following the same routes each year. These migration routes are known as flyways, which are defined as definite geographic regions with breeding grounds in the north, wintering grounds in the south, and a system of migration routes between the two. There are four such flyways on the North American continent, each with its own population of ducks, geese, and other migratory birds.

The Pacific Flyway is the westernmost flyway and encompasses territory in three countries: northern and western Canada, Alaska and all states west of the Rocky Mountains in the United States, and western Mexico. Management of the flyway is governed by international treaties among the United States, Canada, Mexico, and Japan.

FIGURE II-1



Source: Sacramento Waterfowl Habitat Management Committee, undated

[a] Survey data incomplete
[b] The Sacramento Valley accounts for 56% of this total, or about 2,870,000 birds

FIGURE II–2

WINTERING WATERFOWL POPULATIONS FOR STATES AND COUNTRIES OF THE PACIFIC FLYWAY, 28-YEAR AVERAGE, 1954 TO 1981

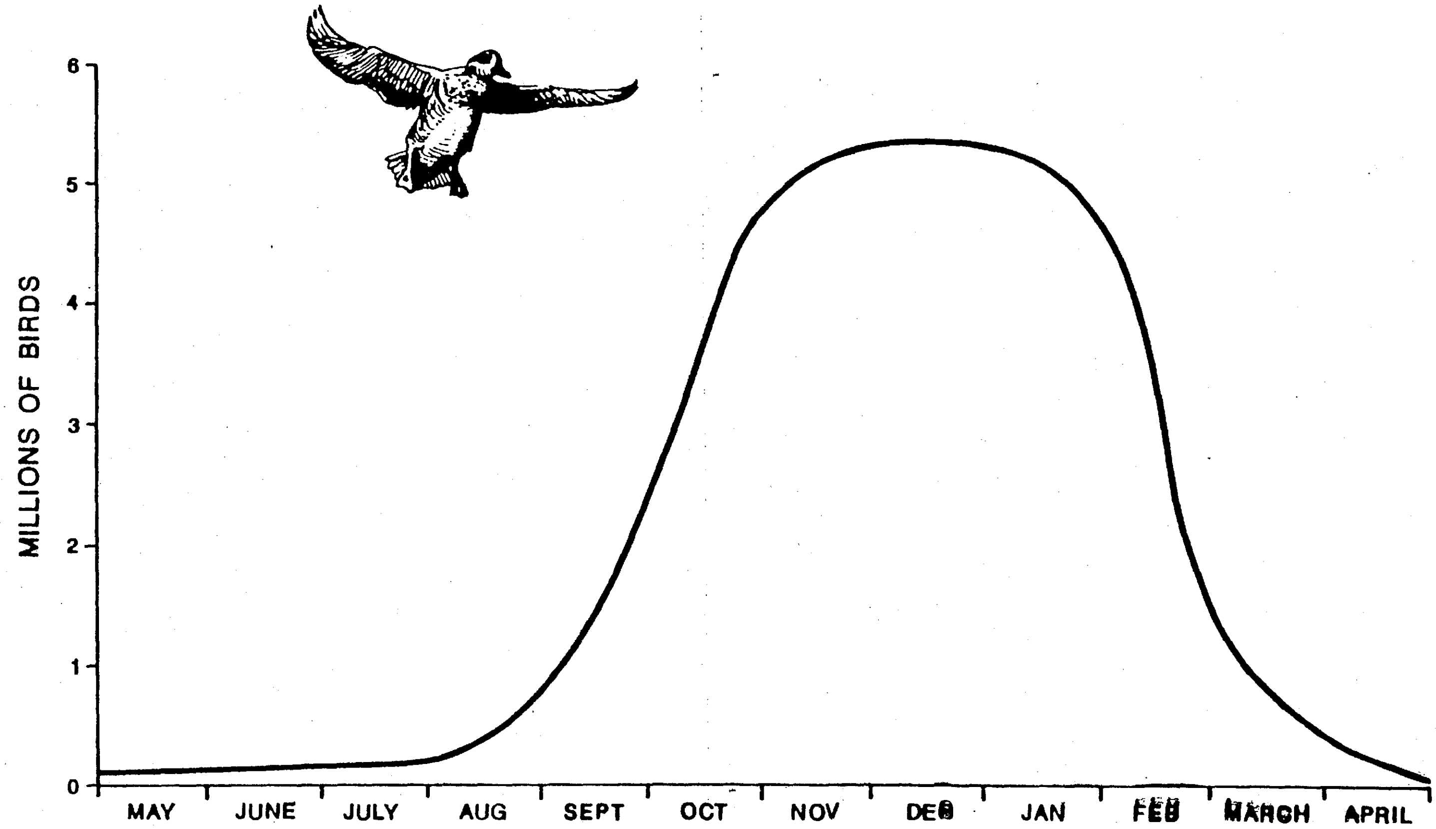


FIGURE II-3

APPROXIMATE PERIOD OF WATERFOWL USE
IN THE CENTRAL VALLEY

Waterfowl most common in the Central Valley are listed on Table II-1. Based on midwinter surveys (Pacific Flyway Study Committee, 1972-1981), a large percentage of the Pacific Flyway waterfowl population winters here. Major species include tundra swan (69 percent), Greater white-fronted geese (90 percent), cackling Canada geese (84 percent), pintails (76 percent), mallards (25 percent), northern shovelers (77 percent), greenwinged teal (47 percent), American widgeon (62 percent), gadwalls (50 percent), wood ducks (93 percent), and canvasbacks (44 percent). The entire continental population of tule white-fronted geese, endangered Aleutian Canada geese, and all but a fraction of Ross' geese winter in the Central Valley.

In recent years Pacific Flyway waterfowl numbers have declined. About 3.6 million ducks were counted in the Pacific Flyway in 1987 (Pacific Flyway Midwinter Waterfowl Survey--1987), which is the lowest population index since coverage was comparable in 1955. The latest index is 12 percent below 1986 and 9 percent fewer than the previous record low index of 1985. The 1987 index is 40 percent below the 10-year average (1977 - 1987) and 43 percent below the 32-year average. In number of ducks, the loss has been greatest in California.

Some of the waterfowl species that rely upon wetlands in the Valley include the Aleutian Canada goose, tule white-fronted goose, white-fronted goose, and Ross' goose. The Aleutian Canada goose is listed as a Federal endangered species because of its restricted breeding range and low numbers. Currently, nesting occurs only on a limited number of the Aleutian Islands of Alaska. The Aleutian Canada goose's breeding range was more extensive until trappers introduced artic foxes to the nesting islands. Extensive recovery efforts are under way to increase population levels by removing foxes from former nesting islands, protecting known staging and migration areas, and implementing hunting closures. Parts of the Colusa, Butte, and San Joaquin basins are closed to hunting of all Canada geese at varying times to protect the Aleutian Canada goose. If breeding populations are successfully established on several more of the Aleutian Islands and a sustaining population is achieved, this subspecies may be transferred to the threatened category and eventually taken off the endangered list.

The tule white-fronted goose is known with certainty to winter only in the Central Valley of California. The three small areas where the goose is known to winter are the Butte Creek Basin near Marysville, the Sacramento National Wildlife Refuge Complex near Willows, and the Suisun Marsh near Fairfield.

White-fronted and Ross' geese arrive in California in Mid-October. By November, they have moved to the Sacramento Valley relying on the existing refuges for loafing areas. The bulk of

TABLE II-1

MAJOR CENTRAL VALLEY WATERFOWL SPECIES

Coot

American (*Fulica americana*)

Ducks

Bufflehead (*Bucephala albeola*)
Canvasback (*Aythya valisineria*)
Gadwall (*Anas strepera*)
Goldeneye, Common (*Bucephala clangula*)
Mallard (*Anas platyrhynchos*)
Merganser
  Common (*Mergus merganser*)
  Hooded (*Lophodytes cucullatus*)
  Red-breasted (*Mergus serrator*)
Pintail, Northern (*Anas acuta*)
Redhead (*Aythya americana*)
Ring-necked Duck (*Aythya collaris*)
Ruddy Duck (*Oxyura jamaicensis*)
Scaup
  Greater (*Aythya marila*)
  Lesser (*Aythya affinis*)
Shoveler, Northern (*Anas clypeata*)
Teal
  Cinnamon (*Anas cyanoptera*)
  Green-winged (*Anas crecca*)
Wigeon, American (*Anas americana*)
Wood Duck (*Aix sponsa*)

Geese

Canada (*Branta canadensis*)[(a)]
Greater white-fronted (*Anser albifrons*)
Ross' (*Chen rossii*)
Snow, Lesser (*Chen caerulescens*)

Tundra Swan (*Cygnus columbianus*)

(a) The Aleutian Canada goose is classified as an endangered species. Almost the entire population of this species is believed to winter in the Central Valley. The cackling Canada goose is another unique subspecies whose populations have declined to relatively low levels and are now possibly threatened.

the Ross' geese move in December to the San Joaquin Valley, centering on Merced National Wildlife Refuge. In March, the geese head back to the Sacramento Valley en route to arctic breeding grounds in Canada.

In addition to waterfowl, millions of other water-related birds annually winter in or pass through the Central Valley. These birds originate in breeding habitats primarily in Alaska and the provinces and territories of western Canada.

The wetlands provide direct benefits to many species of raptors such as the northern harrier and swainsons, sharp-shinned, and red-tailed hawks. Other species, such as the bald eagle (a Federal endangered species) periodically visits valley refuges to feed and rest. Modoc National Wildlife Refuge often has numerous golden and bald eagles that spend their winters on the refuge feeding on sick and crippled waterfowl. The greater sandhill crane relies on refuges in the valley for feeding and sanctuary. Several refuges (Kern, Pixley, Modoc, Merced, San Luis national wildlife refuges) manage specific areas for this species.

D. RELATIONSHIP OF WATERFOWL TO WINTER HABITAT

The Pacific Flyway is unlike other North American flyways in that most wintering waterfowl are concentrated in the relatively small area of the Central Valley. The significance of wintering habitat has been increasingly recognized by research. Some waterfowl can occupy their wintering habitat for as long as eight months of the year, and many biologists believe that wintering habitat could be the single most important limiting factor for Pacific Flyway waterfowl (USBR, 1986a). To accurately determine the relationship of waterfowl to winter habitat, however, one must understand the factors that most limit waterfowl populations. Unfortunately, the effects of specific habitat components on waterfowl abundance and distribution are not yet well understood. While it is certain that the quantity and quality of wintering habitat can significantly influence the distribution and abundance of waterfowl, the degree which it does so is difficult to demonstrate quantitatively.

An ideal habitat fulfills all of a species' requirements, providing a balance of the food, shelter, water, and sanctuary which it needs to survive. The lack of any essential component can decrease a species' survival or decrease its reproductive success. Conversion of wetlands to other uses, inadequate water supplies, and changing agricultural practices are factors believed to be most limiting to waterfowl habitat. Water quality, disease, and food stress are factors believed to affect habitat quality. Many of these factors are interrelated and changing one factor will affect the others.

It is uncertain which winter habitat variable -- food, cover, sanctuary, or water conditions -- most limits population levels (Figure II-4). Habitat conditions influence the mortality and physical state of waterfowl surviving the winter. The number and condition of the survivors in turn determine their breeding success.

1. Impacts of Agricultural Practices

Various factors such as improved water management techniques and increased knowledge of plant and soil sciences have encouraged the transformation of land from mixed vegetation to monocultures in the production of commercial crops. Crop production has become more efficient thus reducing the amount of crops left in the fields which in the past has provided food for waterfowl.

Laser field leveling is an example of a change in agricultural practices that has affected the quantity and quality of waterfowl habitat. Poorly leveled fields of rice or other crops contain many small levees with vegetation for food and shelter, deep and shallow water, dry spots, and open water areas. These characteristics allow other water plants to grow with the rice and provide habitat diversity. The water plants, waste grain, and weed seeds provide food for waterfowl. In contrast, laser land leveling allows uniform application of water and rapid draining of the field without ponding. The rapid drainage reduces smartweed, millet, sedges, rumex, and similar water plants that are used as waterfowl food. Land leveling also reduces the number of levees which support habitat for food and cover.

E. SIGNIFICANCE OF WETLANDS

Waterfowl wintering in the Central Valley move among the wetlands of the Sacramento and San Joaquin Valleys, the Delta, and the Suisun Marsh in response to weather changes, water conditions, and food availability. Waterfowl distribution and movement patterns are largely predictable and change only during very wet years when the amount of habitat increases significantly because of flooding and ponding on agricultural lands and in flood bypasses.

Wetlands are among the most productive of all biological systems and their value cannot be overestimated. Destruction or lack of wetland habitat results in direct losses of species within the wetland itself and ultimately losses of species that normally forage in wetlands. Wetlands provide necessary habitat for many rare and endangered animal and plant species. More than half of all areas identified as critical habitat under provisions of the Federal Endangered Species Act involve weltand areas. In California, 55 percent of animal species designated as State threatened or endangered depend on wetland habitats for their survival.

Wetlands play an important role in flood control and groundwater recharge, improving water quality, and providing a multitude of recreational opportunities.

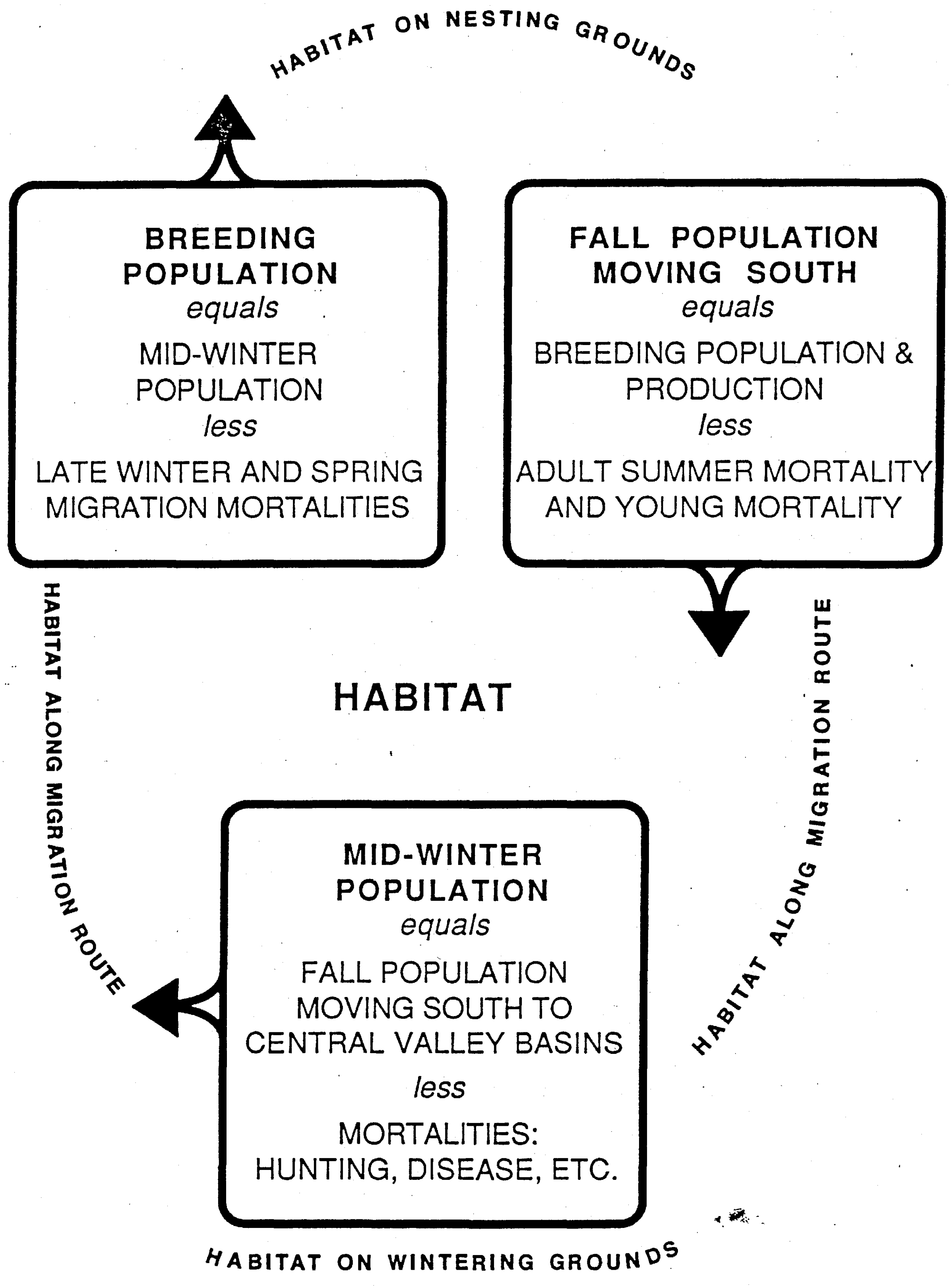


FIGURE II-4

FLOW DIAGRAM SHOWING HOW DIFFERENT LIMITING FACTORS AFFECT PACIFIC FLYWAY WATERFOWL POPULATION

1. Historical Loss of Wetlands

Before the intensive settlement of California in the 1800's, much of the Central Valley was subject to annual or periodic flooding caused by winter, spring, and early summer run-off and by floodwaters from the Sacramento and San Joaquin rivers and their tributaries. Depending on the time of year, flooding frequently turned parts of the valley into an inland sea, as the waters moved slowly toward the Delta.

These seasonal marshes resulted in the growth of dense stands of tules over large areas of the floodplain. Adjacent lands that were not inundated as frequently or were well drained supported stands of riparian woodlands. Areas of shallow or poor soils supported annual and perennial grasses and forbs. It is estimated that seasonal or permanent marshes or wetlands comprised about four million acres of valley lands and provided a haven to waterfowl migrating south for the winter. Wetlands lost since the 1850's are shown in Figure II-5, and a comparison of the current distribution of wetlands to those of the late 1880's on Figure II-6. The discovery of gold in 1849 and the subsequent influx of immigrants into the State brought dramatic changes in the valley's landscape. No habitat was more altered than the wetlands, which were significantly reduced as the Central Valley became more densely populated and flood control and agricultural development became the principal priority of valley residents. Major factors responsible for the loss of wetlands have been, (1) construction of thousands of miles of flood control levees and the subsequent conversion of natural wetlands to agricultural production and urban development; (2) dredging and filling of estuarine habitat for urban, industrial, and port development; (3) construction of flood control and water storage reservoirs; and (4) the channelization of thousands of miles of natural waterways.

Today, many of the remaining wetlands and associated fish and wildlife resources are being degraded by pollutants such as persistent pesticides, heavy metals, and toxic chemicals from urban, industrial, and agricultural sources and petrochemical spills from land based facilities, ships, and pleasure craft. Still other wetlands are degraded because of increasing salinity and the lack of adequate water supplies at appropriate times of the year.

As shown in Figure II-5, the greatest loss of wetlands occurred between 1906 and 1922, when approximately 2.5 million acres of wetlands were lost to levees, bypass channels, dams, towns, and croplands. Reduced habitat and a drought in the breeding grounds during the late 1920's and early 1930's resulted in a large reduction in the number of waterfowl in the Central Valley. Extensive crop damage occurred when the birds turned to grain fields and pastures for food. To alleviate crop damage and increase waterfowl numbers, the Department of Fish and Game established the first Waterfowl Management Area in 1929. The first National Wildlife Refuge was established in 1937.

Today only about 300,000 acres of the original acreage remains. About two-thirds is in private ownership, the remaining third is owned by the Federal and state governments as National Wildlife Refuges and Wildlife Management Areas, respectively.

Collectively, the ten Federal National Wildlife Refuges, four State Wildlife Management Areas, and resource conservation district investigated in this study total 168,477 acres.

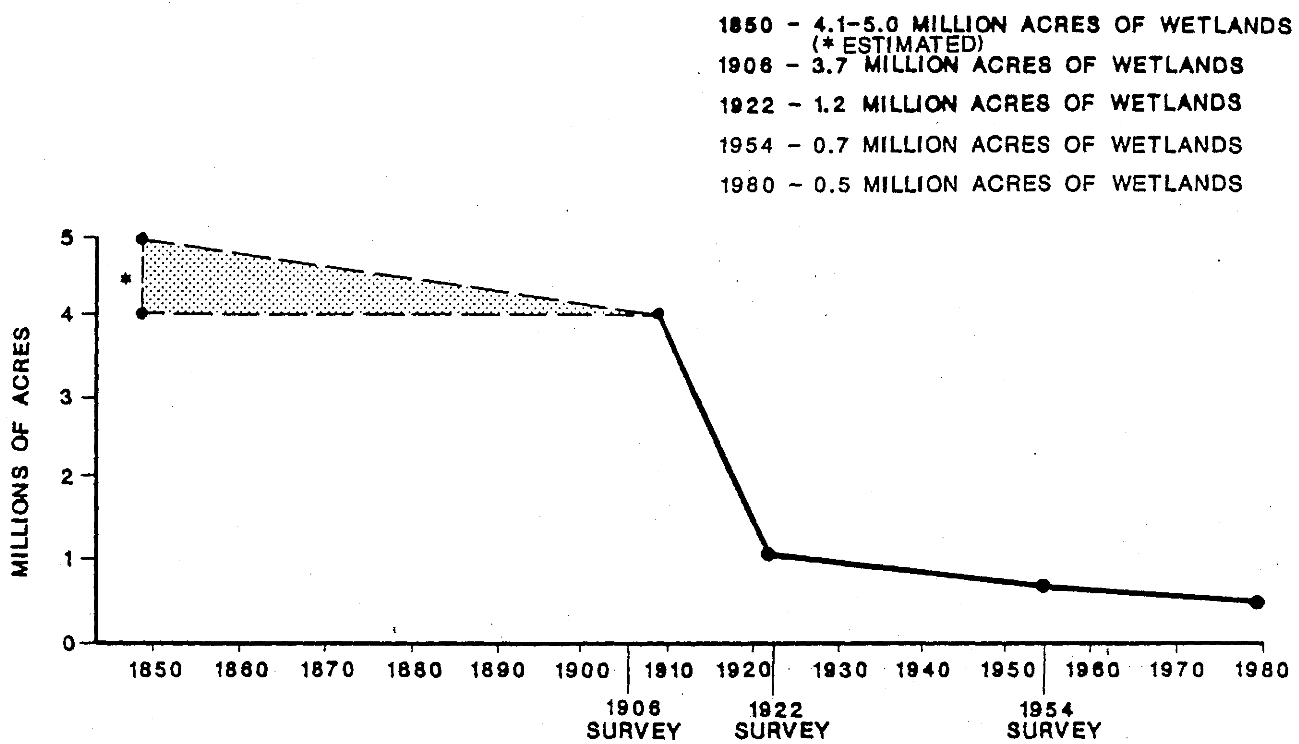
2. Other Habitat

In addition to wetlands, waterfowl habitat includes riparian vegetation. The single most important role for these areas is to provide wintering habitat. Riparian woodlands provide nesting habitat, cover, and food areas for ducks, especially wood ducks. As with wetlands, the historical acreages of riparian woodlands have been reduced to 10 to 15 percent of the original acreages, and only half of the remaining acreages are of good quality. To benefit waterfowl, the riparian vegetation cannot be located far distances away the wetlands.

F. WATER NEEDS

At the present time, approximately one percent of the total applied fresh water in California is used for wildlife areas. The water is used to flood ponds, create marshes, irrigate crops used for waterfowl, and maintain water in ponds and marshes. The majority of the water must be delivered in the fall and winter months to provide initial water and circulation water for wintering habitat. The balance is applied during the growing season to produce waterfowl food plants. If adequate water is not available, feed crops cannot be irrigated and waterfowl are crowded onto smaller areas. Stressful conditions lead to major outbreaks of waterfowl diseases, such as avian botulism and fowl cholera.

Dependable supplies of good quality water are necessary to preserve and increase wetlands and are vital to implementing a managed wetland concept. At the present time, inadequate water supply is a major factor limiting the quantity and quality of Central Valley waterfowl habitat and is a principal problem for the wildlife areas evaluated in this report. None of the refuges evaluated receive, on a yearly basis, the quantity of water required to operate optimally as determined by the Service and DFG; 8 of the 15 wetland areas studied have no existing dependable supply of water. Estimated annual water requirements at full development for these areas are shown in Figure II-7.



SOURCE: U.S. FISH AND WILDLIFE SERVICE, PORTLAND, OREGON

FIGURE II-5

HISTORICAL LOSSES OF WETLANDS IN CALIFORNIA

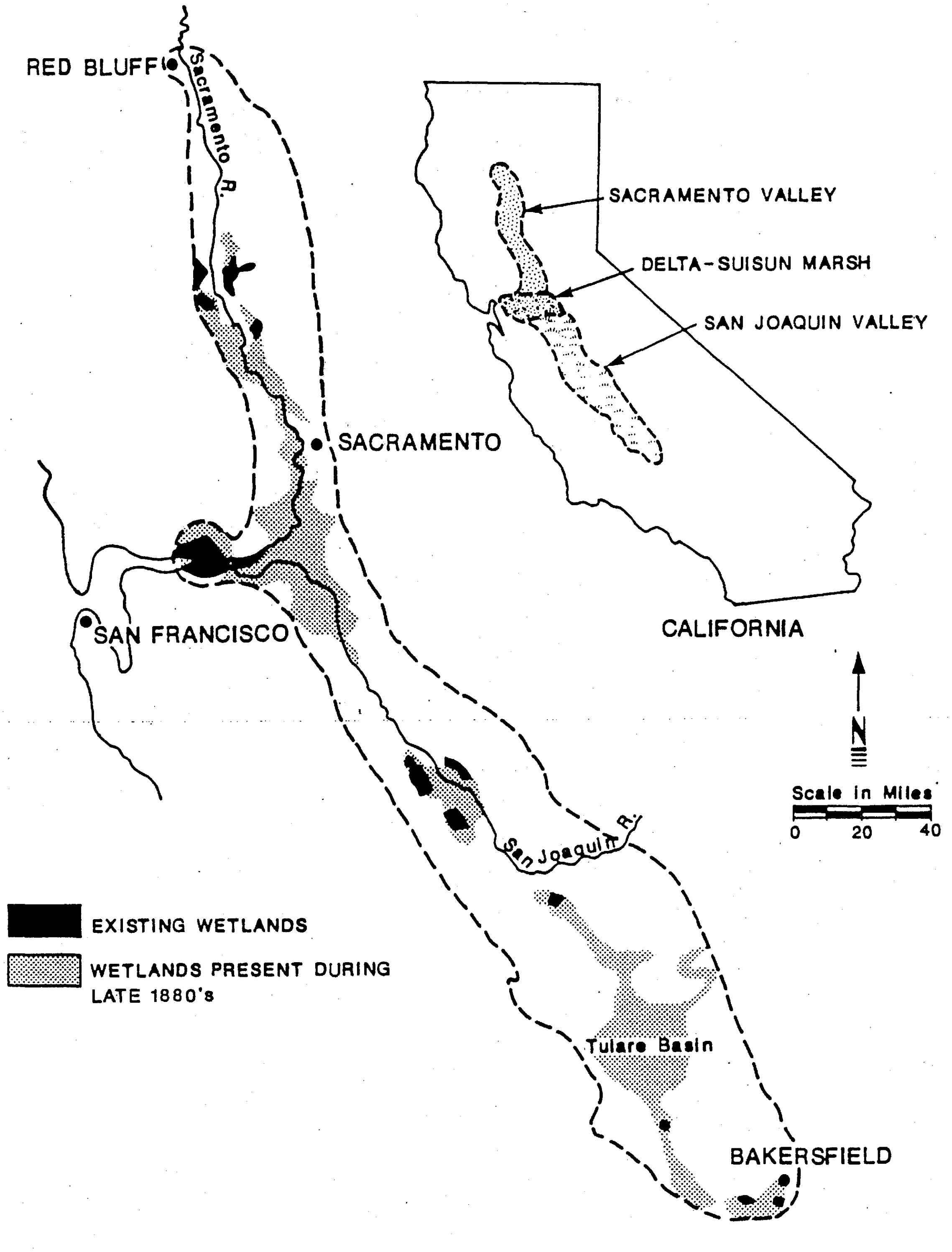


FIGURE II-6

CURRENT DISTRIBUTION OF WETLANDS COMPARED WITH LATE 1880'S

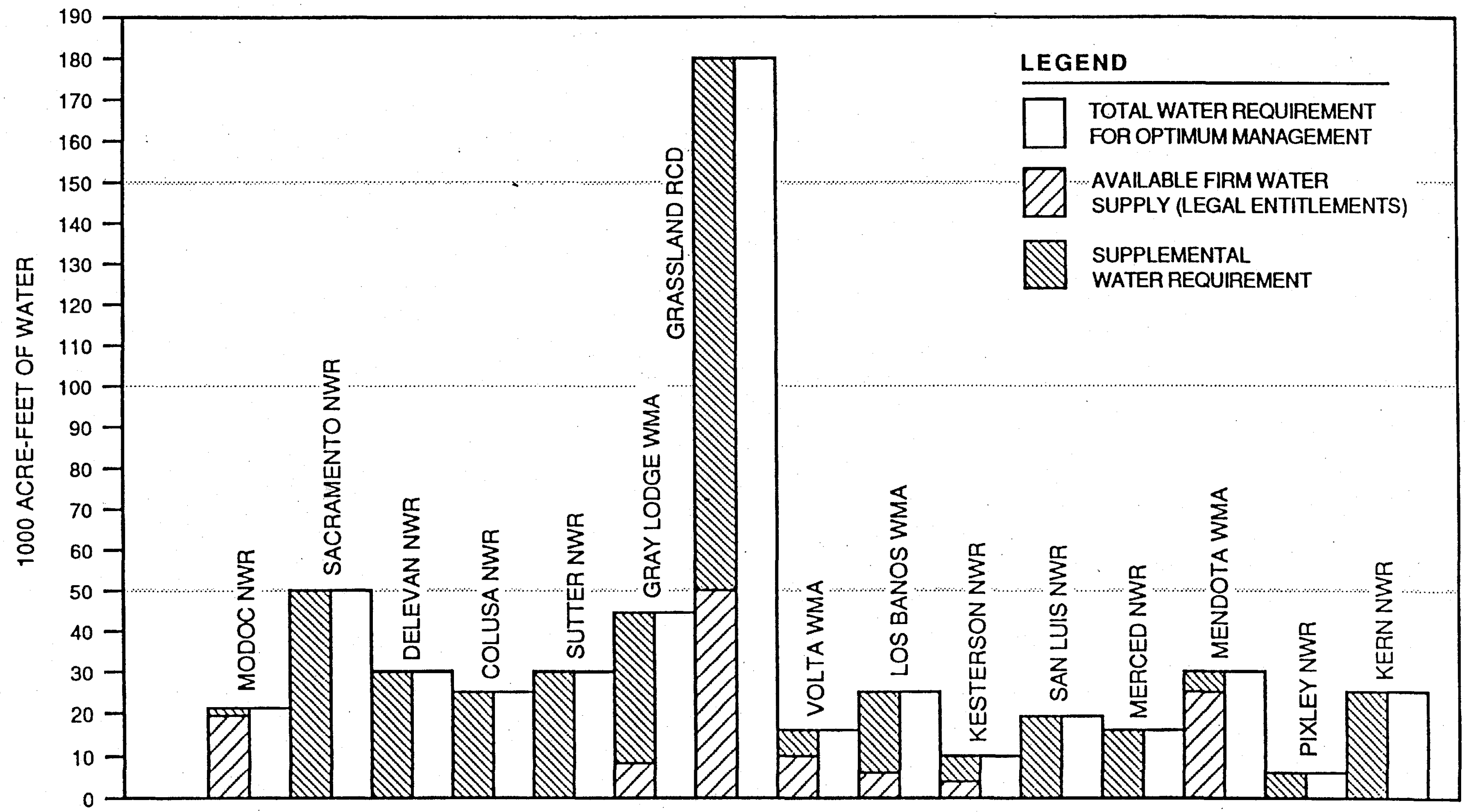


FIGURE II-7

ESTIMATED ANNUAL SUPPLEMENTAL/FIRM WATER REQUIREMENTS AT OPTIMUM MANAGEMENT

TABLE II-2

REFUGE WATER SUPPLY NEEDS

Refuge	Level 1 (ac-ft)	Level 2 (ac-ft)	Level 3 (ac-ft)	Level 4 (ac-ft)
Modoc NWR	18,550	18,550	19,500	20,550
Sacramento NWR	0	46,400	50,000	50,000
Delevan NWR	0	20,950	25,000	30,000
Colusa NWR	0	25,000	25,000	25,000
Sutter NWR	0	23,500	30,000	30,000
Gray Lodge WMA	8,000	35,400	41,000	44,000
Total Sacramento Valley	26,550	169,800	190,500	199,550
Grassland RCD[a]	50,000	125,000	180,000	180,000
Volta WMA	10,000	10,000	13,000	16,000
Los Banos WMA	6,200	16,670	22,500	25,000
Kesterson NWR	3,500	3,500	10,000	10,000
San Luis NWR	0	13,350	19,000	19,000
Merced NWR	0	13,500	16,000	16,000
Mendota WMA	25,463[b]	18,500	24,000	29,650
Pixley NWR	0	1,280	3,000	6,000
Kern NWR	0	9,950	15,050	25,000
Total San Joaquin Valley	95,163	211,750	302,550	326,650
TOTAL	**121,713**	**381,550**	**493,050**	**526,200**

Water Supply Level 1: Existing firm water supply

Water Supply Level 2: Current average annual water deliveries

Water Supply Level 3: Full use of existing development

Water Supply Level 4: Optimum management

(a) As of 1985, Grassland Resource Conservation District no longer receives agricultural drainage flows due to water quality concerns.

(b) Only 18,500 ac-ft can be delivered to the Mendota WMA without modifications of existing facilities.

San Luis 5650 Kesterson 6500

Also – Freitas has received full level 4 since 1990

Volta gets 3000 AF+ / replacement

Mendota 9694

As demands for fresh water increase throughout the Central Valley, the historical supplies of surface water, groundwater, and agricultural return flows are diminishing. The increasing cost of irrigation water is causing farmers to use their available supplies more carefully. This water conservation results in reduced availability and quality of agricultural return flows. Where poor quality agricultural return flows are used for wetland water supplies, problems have developed, and in some areas agricultural return flows are no longer considered acceptable as a water supply source. To supplement surface water supplies, groundwater is available for irrigation in certain refuges.

Although groundwater is generally not sufficient to provide the entire amount of refuge water, it could provide a supplemental supply as part of a conjunctive use program. A conjunctive use program is the joint management of surface water and groundwater supplies. These programs are developed by determining the water needs, then estimating the safe yield of the aquifer and the amount of surface supplies available. The purpose of a conjunctive use program is to more effectively utilize the water resources. By using surface water and groundwater conjunctively, groundwater overdraft can be minimized and the total available supply will become more reliable. Implementation of a conjunctive use program will require construction of dual surface water and groundwater supply facilities. In dry years, full needs would be met with groundwater. In wet years, full needs would be met with surface water supplies. The primary disadvantage of dual systems compared to typical firm yield systems is that both the surface water and groundwater supply facilities must be sized to deliver full needs. The Water Contracting EISs will evaluate impacts associated with implementation of a conjunctive use program for the refuges. Preliminary calculations developed for the Water Contracting EISs indicate that the groundwater facilities would be used an average of five out of every ten years.

Four water delivery levels were identified for each refuge as part of this study, as shown on Table II-2. These water delivery levels were used as the basis for evaluation of existing and proposed water supply and conveyance plans, as discussed in Chapter IV of this report. The difference between water supplies for optimum management (Level 4) and the existing average annual water deliveries (Level 2) are related to habitat diversity, duration of late winter flooding, brood water, and pond areas. Table II-3 displays the irrigated wildlife habitat, bird-use days, and public-use days under Levels 2 and 4. Bird-use days are the total of all birds, including wading and shore birds, waterfowl, upland game birds, and threatened and endangered species.

TABLE II-3

SUMMARY OF WILDLIFE RESOURCE IMPACTS
FOR SELECTED WATER SUPPLY LEVELS

Refuge	Water Supply Level 2	Water Supply Level 4
Modoc NWR		
Habitat Acreage	6,181	6,181
Bird Use Days	3,356,000	3,567,500 (a)
Public Use Days	14,300	14,300
Sacramento NWR		
Habitat Acreage	7,147	7,225
Bird Use days	56,024,300	56,850,300
Public Use Days	39,200	39,500
Delevan NWR		
Habitat Acreage	3,980	4,740
Bird Use Days	35,478,100	42,245,100
Public Use Days	7,800	8,800
Colusa NWR		
Habitat Acreage	3,356	3,396
Bird Use Days	28,106,100	31,090,100
Public Use Days	7,200	7,200
Sutter NWR		
Habitat Acreage	1,985	2,435
Bird Use Days	15,817,100	19,410,100
Public Use Days	3,100	3,600
Gray Lodge WMA		
Habitat Acreage	8,400	8,400
Bird Use Days	58,300,000	72,300,000
Public Use Days	165,200	200,500
Grassland RCD		
Habitat Acreage	56,000	56,000
Bird Use Days	127,210,000	159,250,000
Public Use Days	109,000	136,000

TABLE II-3

SUMMARY OF WILDLIFE RESOURCE IMPACTS
FOR SELECTED WATER SUPPLY LEVELS
(Continued)

Refuge	Water Supply Level 2	Water Supply Level 4
Volta WMA		
Habitat Acreage	3,000	3,000
Bird Use Days	25,000,000	28,100,000
Public Use Days	7,000	13,000
Los Banos WMA		
Habitat Acreage	3,208	3,208
Bird Use Days	23,768,000	26,869,000
Public Use Days	34,400	39,200
Kesterson NWR		
Habitat Acreage	497	1,420
Bird Use Days	3,757,900	7,157,400
Public Use Days	2,100	3,500
San Luis NWR		
Habitat Acreage	3,030	3,550
Bird Use Days	13,362,100	19,927,200
Public Use Days	22,400	35,100
Merced NWR		
Habitat Acreage	700	1,200
Bird Use Days	7,522,400	9,808,100
Public Use Days	2,800	10,200
Mendota WMA		
Habitat Acreage	9,440	9,440
Bird Use Days	2,600,000	12,200,000
Public Use Days	14,800	22,500
Pixley NWR		
Habitat Acreage	0	1,600
Bird Use Days	6,000	4,193,400
Public Use Days	300	10,300

TABLE II-3

SUMMARY OF WILDLIFE RESOURCE IMPACTS
FOR SELECTED WATER SUPPLY LEVELS
(Continued)

Refuge	Water Supply Level 2	Water Supply Level 4
Kern NWR		
Habitat Acreage	2,800	7,000
Bird Use Days	7,197,500	72,996,000
Public Use Days	6,700	15,500

(a) Water Supply Level 2: Current average annual water deliveries.
Water Supply Level 4: Optimum management.

NOTES: Although the total habitat acreage is not proposed to change for several refuges, the habitat quality would improve with additional water supplies.

Longer winter flooding periods at areas with high protein food sources, such as invertebrates, could improve conditions for breeding ducks and will increase their survival rate. If water continues to be available in the spring, the condition of brood ponds could be improved and the overall resident waterfowl populations could be increased. Additional water also could increase the amount of vegetation at the pond edges. A pond that has a larger perimeter could provide more feeding areas. In addition, if the area is properly irrigated, more seeds will be produced.

G. CONVEYANCE

In addition to water supply allocations, refuge water deliveries depend on conveyance facilities and delivery agreements with local water or irrigation districts. At the present time, contractual agreements with these districts are the principal means of conveying water to the refuges. Conveyance systems for some refuges are inadequate to deliver the water needed for optimum refuge operation. Some existing refuge delivery systems need to be improved to increase winter deliveries of water. Some of the water districts that could supply water to the refuges discontinue operations in November to allow for maintenance of the canals. Improvements to existing conveyance facilities could reduce winter maintenance requirements. In addition, water supplies are interrupted during the winter to allow operation of flood control facilities or to allow fish migration. Coordination with those activities are also being investigated. The Refuge Water Supply Investigations evaluated numerous alternatives to increase the winter deliveries from existing water supplies.

H. POWER NEEDS

All Central Valley refuges have electrical pumping power requirements. Private utilities supply the electrical power to each refuge. The type of pumping facilities at each refuge depends on whether it pumps groundwater or surface water. Some refuges pump both groundwater and surface water.

For those refuges that pump large amounts of water, the cost of power has become a major budget item. The cost has become a constraint on the full use of available water at many San Joaquin Valley refuges and Gray Lodge WMA. Under current rate structures, pumping additional groundwater is not considered practical by managing agencies because of the formidable costs.

In several areas, lowered groundwater levels have raised pumping costs. In many cases the cost of electrical power has increased to the point where pumping has been reduced to meet budget constraints.

The CVP could provide inexpensive power to the refuges, but whether the authorization exists to provide project power for fish and wildlife use is being examined. The electric power that the CVP powerplants generate is dedicated first to meeting the power requirements of the CVP facilities, or project-use power requirements. After project-use requirements are met, remaining power is used to provide commercial power to preferential customers.

Power generation rates at CVP powerplants are directly related to demands for CVP water. Recognizing that these water demands would be seasonal, CVP powerplants were designed to provide peaking power during summer months. Because peaking power alone cannot satisfy the power requirements of the CVP power customers and because peaking power is more efficiently used when integrated with a baseload power, the Reclamation entered into Contract 14-06-200-2498A (Contract 2498A) with the Pacific Gas & Electric Company (PG&E). The Western Area Power Administration, U.S. Department of Energy, (Western) administers this contract which provides for integrated operations of CVP powerplants and the PG&E system as well as certain transmission services.

The Reclamation instructions limit the allocation of project-use power to facilities that are directly involved in the conveyance or delivery of water. Contract 2948A defines many of the conditions for delivery of power for both project-use and preference customers. The contract specifies that transmission services will be limited to project-use and preference customers loads within the wheeling boundary. All of the refuges considered in this report, except Modoc NWR, are within the wheeling boundaries.

Transmission of power to preference customers is restricted to entities that have monthly maximum demands of 500 kilowatts or more for three consecutive months. For project-use customers, wheeling is restricted to facilities with a maximum demand of 100 kilowatts or more for three consecutive months. In addition, PG&E is not required to deliver power at a voltage of less than 2 kilovolts. PG&E has interpreted these restrictions to mean that the 500 kilowatts and 100 kilowatts loads have to be situated at the same meter. Therefore, a project-use or preference customer could qualify for wheeling by purchasing or constructing distribution lines that interconnect enough portions of their loads to have a power load requirement that would exceed the preference customer limit.

Contract 2948A requires project-use pumping plants to be operated to the maximum extent practical outside of the PG&E peak-load period. When plants are operated on-peak, CVP powerplants must supply the project-use power directly. Therefore, if the refuges were to receive project-use power, the on-peak power use would be minimized.

A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver power to the refuges is currently being examined and will be detailed in the Refuge Water Supply Planning Report.

If it is determined that the refuges do not qualify for CVP project-use power, the refuges could apply for a CVP preference power allocation. There are many more requests for preference power than supply. The existing CVP power supply has been allocated and committed to CVP preference power customers through contracts. Some of the contracts expire in 1994. A marketing plan is being developed for future contracts that will be signed in 1994. The potential is not high for refuges to become CVP preference customers until after 1994. Based on the response to the request made by the Service in 1981 for a CVP preference power allocation, it is not certain that the refuges will receive CVP power in 1994. In 1981, the Service applied to receive CVP power for the national wildlife refuges in the Central Valley as well as for the Coleman National Fish Hatchery. Only the request for the fish hatchery was granted. DFG also applied to receive CVP power for the Gray Lodge Wildlife Management Area. This request also was not granted.

Another potential source of power for the refuges is the Pacific Northwest. This power would be transmitted to California over the transfer capability of the California-Oregon Transmission Project (COTP) which is in the advance planning stage. Under provisions of Title III of the Energy and Water Development Appropriation Act for fiscal year 1985 (P.L. 98-360) and the February 7, 1986 memorandum of the decision of the Secretary of Energy, Western will have access to 6.25 percent of the COTP transfer capability, approximately 100 megawatts. This transfer capability is reserved for use by Western for the Department of Energy Laboratories and Federal wildlife refuges. If construction of the COTP is implemented as currently planned, northwest power supplies could be available to the refuges by the early 1990's. To utilize or receive the benefit of the impact of such power, the Federal wildlife refuges will need to make utility agreements with Western and perhaps other utilities, such as PG&E.

I. RESOURCES CAPABILITY

Current annual average water deliveries to the 15 wildlife areas under study total 381,550 acre-feet, as summarized Table II-2. For optimal management, however, these areas can use up to 526,200 acre-feet annually, as determined by the Service and DFG.

During normal or above average rainfall years, surface water sources present the most dependable source of water to the wildlife areas. This supply, along with a developed groundwater pumping program at those refuges where it is feasible or practical will permit the areas to be managed as desired. The extent to which each area will reach its goal of optimum management of wetland habitat will depend on the allocation of water to each area from the CVP Water Contracting EISs.

The primary source of surface water which could be made available for wildlife area use is from the CVP through conveyance systems such as the Tehama-Colusa Canal, Delta-Mendota Canal, and the California Aqueduct. To a lesser extent, opportunities to obtain water from the State Water Project and local water districts also exist. Direct diversions from the Sacramento, Feather, and San Joaquin Rivers also may occur.

Groundwater is a potential source of water at most wildlife areas; however, with the exception of Gray Lodge Wildlife Management Area and Merced National Wildlife Refuge, none of the areas rely on groundwater as a principal source because of the current availability of less expensive surface water.

In the San Joaquin Valley, groundwater overdraft occurs in the San Joaquin River and Tulare Lake basins. Groundwater quality may make the water unusable. However, the groundwater situation varies from site to site, and groundwater cannot be overlooked as a potential supply. In many cases, groundwater could serve as a supplemental supply to other water supply alternatives.

One disadvantage to relying solely on groundwater is the rate of pump delivery. A limited groundwater pumping rate constrains effective wildlife management because rapid filling of marsh areas in the fall is often necessary. Therefore, numerous pumps are needed to provide the peak flow.

Historically, agricultural return water has been a source of water supply to several wildlife areas. Because of recent water quality concerns, particularly in the San Joaquin Valley, future use of this water remains questionable.

J. CAPACITY AVAILABLE IN EXISTING FACILITIES AND TIMING OF DELIVERIES

In addition to local conveyance capacity problems, the regional conveyance system to export water from the Delta to the San Joaquin Valley also has capacity limitations. Existing available capacity in the Delta-Mendota Canal above existing deliveries is approximately 250,000 acre-feet. The requests for additional water supplies to be exported from the Delta were collected by Reclamation for the Water Contracting EISs, and exceed 3,000,000 acre-feet. If water was to be provided to some or all of these requestors, this water would need to be conveyed through the Delta-Mendota Canal or parallel conveyance system. Regional conveyance options for export water from the Delta will be discussed in the Delta Export Water Contracting EIS and the San Joaquin Conveyance Study. The options include: 1) limiting Delta exports to 250,000 acre-feet, 2) using the California Aqueduct as allowed under the provisions of the Coordinated Operation Agreement, 3) expansion of the Delta-Mendota Canal and Tracy Pumping Plant, or 4) construction of a parallel conveyance facility. Similar capacity limitations occur on the Friant-Kern Canal.

Several public interest groups in California are concerned about increased transfer of water from the Delta. The Sierra Club, Planning and Conservation League, Environmental Defense Fund, and the Audobon Society have expressed the preference to preserve river flows in the Delta for environmental protection and enhancement rather than exporting water out of the area, and may oppose any project or plan that could reduce Delta flows from current levels during certain portions of the year.

CHAPTER III

Development of Alternative Plans

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MID-PACIFIC REGION

CHAPTER III

DEVELOPMENT OF ALTERNATIVE PLANS

A. PLAN FORMULATION

Each refuge has its own unique set of problems and needs. Some of the refuges need additional water during the fall and winter. Other refuges need better quality water than is currently provided. Most of the refuges currently rely upon intermittent water supplies, agricultural return flows, or runoff available only during wet weather periods.

To develop alternatives for dependable water supplies, the study team members met with wildlife managers and representatives of local water and irrigation districts. Based on these discussions and field visits, potential alternatives were developed for each refuge for different water supply levels. As discussed in Chapter II, Water Supply Level 1 is the existing firm water supply that is provided through surface water rights or long-term water contracts. Water Supply Level 2 represents the current average annual water delivery. Water Supply Level 3 represents the amount of water needed for full use of the existing developed lands on the refuge. Water Supply Level 4 represents the amount of water that wetland managers estimate to be necessary for optimum management of all lands within the existing refuge boundary.

Level 1 is considered to be the No Action Alternative and does not require any additional facilities or water supplies. Generally, new or enhanced facilities are not required to meet Level 2. However, Level 2 alternatives were developed for several of the refuges because some of the existing water supplies may not be available during certain portions of the year. For example, several refuges in the Sacramento Valley cannot receive water during the winter with existing facilities.

Following the identification of water supply levels and facility alternatives, the study team members met with the refuge wildlife managers and representatives of the water and irrigation districts to determine 1) the available capacity of the existing conveyance facilities, 2) the potential for extending the time period in which districts would convey water to accommodate fall and winter deliveries to the refuges; 3) the acceptability of the proposed improvements to the water and irrigation districts, 4) the feasibility of developing conveyance agreements, and 5) the local costs for similar types of construction. Through this process, alternatives were developed and modified for each refuge. The alternatives for each refuge are described in Chapter IV and summarized in Table III-1.

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES

Refuge	Level 1	Level 2	Level 3	Level 4
Modoc NWR	None	2A. Rehabilitate Well	3A. Rehabilitate Well	4A. Construct Wells, Rehabilitate Dam on Pit River.
				4B. Construct Wells in the Godfrey Tract.
Sacramento NWR	None	2A. Construct Pipeline from Tehama-Colusa Canal.	3A. Construct Pipeline from Tehama-Colusa Canal.	4A. Construct Pipeline from Tehama-Colusa Canal.
		2B. Deliver CVP Water through Kanawha WD.	3B. Deliver CVP Water through Kanawha WD.	4B. Deliver CVP Water through Kanawha WD.
		2C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	3C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	4C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.
		2D. Delivery CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	3D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	4D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.
		2E. Implement a Conjunctive Use Plan.	3E. Implement a Conjunctive Use Plan.	4E. Implement a Conjunctive Use Plan.
Delevan NWR[a]	None	2A. Convey Water from Sacramento NWR.	3A. Convey Water from Sacramento NWR	4A. Construct Pump Station on 2047 Drain
		2B. Construct Crossover on GCID Lateral 41-1.	3B. Construct Crossover on GCID Lateral 41-1.	4B. Construct Siphons Under the MID Canal
		2C. Improve Hunter's Creek No. 2 Diversion Weir.	3C. Improve Hunter's Creek No. 2 Diversion Weir.	4C. Implement a Conjunctive Use Plan.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	
Colusa NWR[a]	None	2A. Construct Weir on 2047 Drain and replace Davis Weir.	3A. Construct Weir on 2047 Drain and replace Davis Weir.	4A. Construct Facilities to Serve Tracts 4, 7, 9, and 11.
		2B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	3B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	4B. Implement a Conjunctive Use Plan.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Sutter NWR	None	2A. Deliver Water from Thermalito Afterbay through Butte Creek.	3A. Deliver Water from Thermalito Afterbay through Butte Creek.	4A. Deliver Water from Thermalito Afterbay through Butte Creek.
		2B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.	3B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.	4B. Delivery Water from Thermalito Afterbay through Wadsworth Canal.
		2C. Obtain Water from Sutter Extension Water District.	3C. Obtain Water from Sutter Extension Water District.	4C. Obtain Water from Sutter Extension Water District.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Gray Lodge WMA	None	2A. Construct Ditch from Cherokee Canal.	3A. Construct Ditch from Cherokee Canal.	4A. Construct Ditch from Cherokee Canal.
		2B. Construct Canal from Thermalito Afterbay.	3B. Construct Canal from Thermalito Afterbay.	4B. Construct Canal from Thermalito Afterbay.
		2C. Improve BWGID System.	3C. Improve BWGID System.	4C. Improve BWGID System.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Grassland Resource Conservation District	None	2A. Convey Water Under the Zahm-Sansoni-Nelson Plan.	3A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue.	4A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue.
		2B. Utilize the Wolfson Bypass.	3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.
		2C. Implement a Conjunctive Use Plan.		
Volta WMA	None	None	3A. Construct Turnouts at Main Canal and Upgrade Outtakes.	4A. Construct Turnouts at Main Canal and Upgrade Outtakes.
			3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Los Banos WMA[b]	None	2A. Reconstruct SLCC Facilities.	3A. Reconstruct SLCC Facilities.	4A. Reconstruct SLCC Facilities.
		2B. Implement a Conjunctive Use Plan.	3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.
Kesterson NWR[b]	None	2A. Rehabilitate Santa Fe Canal.	3A. Extend Eagle Ditch into Refuge.	4A. Extend Eagle Ditch into Refuge.
			3B. Extend West Side Ditch to Eagle Ditch.	4B. Extend West Side Ditch to Eagle Ditch.
			3C. Convey Water from Garzas Creek to Los Banos Creek.	4C. Convey Water from Garzas Creek to Los Banos Creek.
			3D. Utilize Mud Slough.	4D. Utilize Mud Slough.
			3E. Extend Santa Fe Canal.	4E. Extend Santa Fe Canal.
			3F. Implement a Conjunctive Use Plan.	4F. Implement a Conjunctive Use Plan.
San Luis NWR[b]	None	2A. Enlarge and Line SLCC Facilities.	3A. Enlarge and Line SLCC Facilities.	4A. Enlarge and Line SLCC Facilities.
		2B. Construct Lift Pumps to Utilize San Joaquin River Water.	3B. Construct Lift Pumps to Utilize San Joaquin River Water.	4B. Construct Lift Pumps to Utilize San Joaquin River Water.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Merced NWR	None	2A. Utilize the East Side Bypass	3A. Extend Casebeer Lateral to Refuge Boundary.	4A. Extend Casebeer Lateral to Refuge Boundary.
		2B. Implement a Conjunctive Use Plan	3B. Extend Casebeer Lateral to Deadman Creek.	4B. Extend Casebeer Lateral to Deadman Creek.
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
			3D. Utilize Treated Wastewater from the Merced Treatment Plant.	

TABLE III-1

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Mendota WMA	None	None	3A. Change Operation of Mendota Pool	4A. Change Operation of Mendota Pool
			3B. Extend WWD Laterals 4 and 6 to Refuge	4B. Extend WWD Laterals 4 and 6 to Refuge
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Pixley NWR	None	None	3A. Obtain Friant-Kern Canal Water via Deer Creek.	4A. Obtain Friant-Kern Canal Water via Deer Creek.
			3B. Utilize Mid-Valley Canal Water via Deer Creek.	4B. Utilize Mid-Valley Canal Water via Deer Creek.
			3C. Obtain CVP Water via the California Aqueduct.	4C. Obtain CVP Water via the California Aqueduct.
			3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Kern NWR	None	2A. Transport CVP Water through the BVWSD Facilities.	3A. Transport CVP Water through the BVWSD Facilities.	4A. Transport CVP Water through the BVWSD Facilities.
		2B. Transport State Water Project Water through the LHWSD Facilities.	3B. Transport State Water Project Water through the LHWSD Facilities.	4B. Transport State Water Project Water through the LHWSD Facilities.
		2C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	3C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	4C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.

(a) All of the alternatives for these refuges require implementation of Alternatives 2A, 2B, 2C, 2D, or 2E for Sacramento NWR.

(b) All of the alternatives for these refuges require implementation of Alternatives 2A or 2B for Grassland Resource Conservation District.

With Level 1, the No Action Alternative, only 7 of the 15 refuges have existing dependable water rights or long-term water contracts, and only Modoc National Wildlife Refuge has dependable water rights for more than 50 percent of the Level 4 water supply. Therefore, under the No Action Alternative, eight refuges would not receive firm water and six refuges would not receive adequate supplies of dependable water.

Currently, many of the refuges receive surplus water through temporary agreements or from agricultural return flows. Following the completion of the Water Contracting EISs, the surplus water may be delivered elsewhere under long-term agreements. In addition, water conservation methods may be implemented in the future which will reduce the amount of agricultural return flows available to the refuges.

B. PLAN EVALUATION AND SELECTION CRITERIA

As part of this report, alternatives were developed for each water supply level. The alternatives were evaluated with respect to many factors, including:

- o Availability of Water Supply
- o Ability to Convey Water
- o Need for New Conveyance Agreements
- o Type of Water Supply (Fresh Water, Groundwater, or Agricultural Return Flows)
- o Operational Flexibility
- o Wildlife Habitat
- o Public Use
- o Total Annual Costs
- o Impacts to Fish and Wildlife Resources
- o Ease of Implementation

The alternative plans also will be evaluated as part of the Water Contracting EISs. The evaluation will include regional analyses. The results of the evaluation will be used to determine the actual water supply level that will be available to each refuge.

Reclamation requested from the Service and DFG a prioritized list of refuges within the Sacramento Valley and the San Joaquin Valley to receive water. Both agencies indicated that their priorities for water supply were Water Supply Level 4 through Water Supply Level 1, with Water Supply Level 4 being the highest priority. The replies did not include priorities for specific refuges.

1. Cost Estimates

Appraisal level cost estimates were developed using cost curves, simple sketches, and general design criteria. Unit costs were developed in coordination with Reclamation and the Service and included in Appendix F. The cost estimates presented in this report are to be used only as an aid in comparing the alternatives, and are not to be considered to be representative of more detailed material quantity and unit price cost estimates. The cost estimates represent average costs for project facilities that may be designed and have construction managed by a private engineering consultant, and are not intended to be used in lieu of detailed quantity and unit price estimates.

2. Economic Analyses

The benefits derived from recreation opportunities were based upon consumptive and non-consumptive uses created as a result of providing the wildlife refuges various water supplies. Public-use days were estimated by refuge managers. Wildlife refuges are unique areas that are intensively managed as waterfowl feeding and resting sites. Portions of the wildlife refuges are also specifically set aside for hunting and are managed particularly for that purpose. Hunting is allowed only on designated days, with a regulated number of hunters. As a result of this type of management and a lack of available land with public hunting access, these public shooting areas are highly valued and heavily used. In addition to consumptive recreation activities, non-consumptive recreation activities such as bird watching may be expected to occur at the wildlife refuges. Consequently, a high quality, specialized type of recreation experience can be obtained at these refuge areas.

The recreation benefits were calculated using values developed by Reclamation, and summarized in Tables III-2 and III-3. As part of the preparation of the Water Contracting EISs, more detailed economic evaluations will be conducted.

Because the values developed in the Water Contracting EISs may be significantly different than the economic values presented in Tables III-2 and III-3, the economic analyses was not completed for each of the alternatives. Instead, the change in bird use days and public use days per additional acre-foot of water was used to compare alternatives. The incremental costs per 1000 bird use days were determined for each refuge by dividing the increase in total annual costs, as compared to the No Action Alternative, by the increase in bird use days, as compared to the No Action Alternative. The incremental costs per public use days were determined for each refuge by dividing the increase in total annual costs, as compared to the No Action Alternative, by the increase in public use days, as compared to the No Action Alternative.

3. Environmental Analyses

The alternatives considered in this study primarily involve construction of weirs, turnouts, pumps, connecting canals, and wells. Most of these facilities would be constructed in or near existing canals and ditches which are periodically cleaned by the local irrigation districts. The connecting canals would mostly be constructed across currently tilled areas. Therefore, the

TABLE III-2
COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
MODOC NWR			
Water Needs (ac-ft)	18,550	18,550	--
Public Use Days			
Consumptive	6,430	6,430	--
Non-Consumptive	7,870	7,870	--
Total	14,300	14,300	--
Benefit Value (c)			
Consumptive	$ 41,800	$ 41,800	$ --
Non-Consumptive	43,300	43,300	--
Total	$ 85,100	$ 85,100	$ --
Public Use Days/Acre-Foot			
Consumptive	0.35	0.35	--
Non-Consumptive	0.42	0.42	--
Total	0.77	0.77	--
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 2.25	--
Non-Consumptive	2.33	2.33	--
Total	$ 4.58	$ 4.58	--
SACRAMENTO NWR			
Water Needs (ac-ft)	0	50,000	50,000
Public Use Days			
Consumptive	--	6,300	6,300
Non-Consumptive	--	32,900	32,900
Total	--	39,200	39,200
Benefit Value (c)			
Consumptive	$ --	$ 40,950	$ 40,950
Non-Consumptive	--	180,950	180,950
Total	$ --	$221,900	$221,900
Public Use Days/Acre-Foot			
Consumptive	--	0.13	0.13
Non-Consumptive	--	0.66	0.66
Total	--	0.79	0.79

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.82	$ 0.82
Non-Consumptive	--	3.62	3.62
Total	$ --	$ 4.44	$ 4.44
DELEVAN NWR			
Water Needs (ac-ft)	0	20,950	20,950
Public Use Days			
Consumptive	--	5,600	5,600
Non-Consumptive	--	2,200	2,200
Total	--	7,800	7,800
Benefit Value (c)			
Consumptive	$ --	$ 36,400	$ 36,400
Non-Consumptive	--	12,100	12,100
Total	$ --	$ 48,500	$ 48,500
Public Use Days/Acre-Foot			
Consumptive	--	0.27	0.27
Non-Consumptive	--	0.11	0.11
Total	--	0.38	0.38
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.74	$ 1.74
Non-Consumptive	--	0.58	0.58
Total	$ --	$ 2.32	$ 2.32
COLUSA NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	3,100	3,100
Total	--	7,200	7,200
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	17,050	17,050
Total	$ --	$ 43,700	$ 43,700

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.16	0.16
Non-Consumptive	--	0.12	0.12
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.07	$ 1.07
Non-Consumptive	--	0.68	0.68
Total	$ --	$ 1.75	$ 1.75
SUTTER NWR			
Water Needs (ac-ft)	0	23,500	23,500
Public Use Days			
Consumptive	--	3,100	3,100
Non-Consumptive	--	--	--
Total	--	3,100	3,100
Benefit Value (c)			
Consumptive	$ --	$ 20,150	$ 20,150
Non-Consumptive	--	--	--
Total	$ --	$ 20,150	$ 20,150
Public Use Days/Acre-Foot			
Consumptive	--	0.10	0.10
Non-Consumptive	--	--	--
Total	--	0.10	0.10
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.67	$ 0.67
Non-Consumptive	--	--	--
Total	$ --	$ 0.67	$ 0.67
GRAY LODGE WMA			
Water Needs (ac-ft)	8,000	35,400	27,400
Public Use Days			
Consumptive	20,800	29,800	9,000
Non-Consumptive	83,300	135,400	52,100
Total	104,100	165,200	61,100

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value (c)			
Consumptive	$135,200	$ 193,700	$ 58,500
Non-Consumptive	458,150	744,700	286,550
Total	$593,350	$ 938,400	$345,050
Public Use Days/Acre-Foot			
Consumptive	2.6	0.84	-1.76
Non-Consumptive	10.41	3.82	-6.59
Total	13.01	4.66	-8.35
Benefit Value/Acre-Foot			
Consumptive	$ 16.9	$ 5.47	$ -11.43
Non-Consumptive	57.27	21.04	-36.23
Total	$ 74.17	$ 26.51	$ -47.66
GRASSLAND RCD			
Water Needs (ac-ft)	50,000	125,000	75,000
Public Use Days			
Consumptive	60,000	70,000	10,000
Non-Consumptive	31,000	39,000	8,000
Total	91,000	109,000	18,000
Benefit Value (c)			
Consumptive	$390,000	$455,000	$ 65,000
Non-Consumptive	170,500	214,500	44,000
Total	$560,500	$669,500	$109,000
Public Use Days/Acre-Foot			
Consumptive	1.2	0.56	-0.64
Non-Consumptive	0.62	0.31	-0.31
Total	1.82	0.87	-0.95
Benefit Value/Acre-Foot			
Consumptive	$ 7.80	$ 3.64	$ -4.16
Non-Consumptive	3.41	1.72	-1.69
Total	$ 11.21	$ 5.36	$ -5.85

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
VOLTA WMA			
Water Needs (ac-ft)	10,000	16,000	6,000
Public Use Days			
Consumptive	3,900	3,900	--
Non-Consumptive	3,100	3,100	--
Total	7,000	7,000	--
Benefit Value (c)			
Consumptive	$ 25,350	$ 25,300	$ --
Non-Consumptive	17,050	17,050	--
Total	$ 42,400	42,400	--
Public Use Days/Acre-Foot			
Consumptive	0.39	0.24	-0.15
Non-Consumptive	0.31	0.19	-0.12
Total	0.70	0.43	-0.27
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 1.58	$ -0.67
Non-Consumptive	1.71	1.07	-0.64
Total	$ 3.96	$ 2.65	$ -1.31
LOS BANOS WMA			
Water Needs (ac-ft)	6,200	16,670	10,470
Public Use Days			
Consumptive	2,200	3,400	1,200
Non-Consumptive	11,600	31,000	19,400
Total	13,800	34,400	20,600
Benefit Value (c)			
Consumptive	$ 14,300	$ 22,100	$ 7,800
Non-Consumptive	63,800	170,500	106,700
Total	$ 78,100	$192,600	$114,500
Public Use Days/Acre-Foot			
Consumptive	0.35	0.20	-0.15
Non-Consumptive	1.87	1.86	-0.01
Total	2.22	2.06	-0.16

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value/Acre-Foot			
Consumptive	$ 2.31	$ 1.33	$ -0.98
Non-Consumptive	10.29	10.23	-0.06
Total	$ 12.6	$ 11.56	$ -1.04
KESTERSON NWR			
Water Needs (ac-ft)	3,500	3,500	--
Public Use Days			
Consumptive	1,800	1,800	--
Non-Consumptive	300	300	--
Total	2,100	2,100	--
Benefit Value (c)			
Consumptive	$ 11,700	$ 11,700	$ --
Non-Consumptive	1,650	1,650	--
Total	$ 13,350	$ 13,350	---
Public Use Days/Acre-Foot			
Consumptive	0.51	0.51	--
Non-Consumptive	0.09	0.09	--
Total	0.60	0.60	--
Benefit Value/Acre-Foot			
Consumptive	$ 3.34	$ 3.34	$ --
Non-Consumptive	0.09	0.09	--
Total	$ 3.43	$ 3.43	$ --
SAN LUIS NWR			
Water Needs (ac-ft)	0	13,350	13,350
Public Use Days			
Consumptive	--	3,800	3,800
Non-Consumptive	--	18,600	18,600
Total	--	22,400	22,400
Benefit Value (c)			
Consumptive	$ --	$ 24,700	$ 24,700
Non-Consumptive	--	102,300	102,300
Total	$ --	$127,000	$127,000

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.28	0.28
Non-Consumptive	--	1.39	1.39
Total	--	1.67	1.67
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.85	$ 1.85
Non-Consumptive	--	7.67	7.67
Total	$ --	$ 9.52	$ 9.52
MERCED NWR			
Water Needs (ac-ft)	0	13,500	16,000
Public Use Days			
Consumptive	--	900	900
Non-Consumptive	--	1,900	1,900
Total	--	2,800	2,800
Benefit Value (c)			
Consumptive	$ --	$ 5,850	$ 5,850
Non-Consumptive	--	10,450	10,450
Total	$ --	$ 16,300	$ 16,300
Public Use Days/Acre-Foot			
Consumptive	--	0.07	0.07
Non-Consumptive	--	0.14	0.14
Total	--	0.21	0.21
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.43	$ 0.43
Non-Consumptive	--	0.77	0.77
Total	$ --	$ 1.20	$ 1.20
MENDOTA WMA			
Water Needs (ac-ft)	18,500	18,500	--
Public Use Days			
Consumptive	12,200	12,200	--
Non-Consumptive	2,600	2,600	--
Total	14,800	14,800	--

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
Benefit Value (c)			
Consumptive	$ 79,300	$ 79,300	$ --
Non-Consumptive	14,300	14,300	--
Total	$ 93,600	$ 93,600	$ --
Public Use Days/Acre-Foot			
Consumptive	0.66	0.66	---
Non-Consumptive	0.14	0.14	--
Total	0.70	0.70	--
Benefit Value/Acre-Foot			
Consumptive	$ 4.29	$ 4.29	$ --
Non-Consumptive	0.77	0.77	--
Total	$ 5.06	$ 5.06	$ --
PIXLEY NWR			
Water Needs (ac-ft)	0	1,280	1,280
Public Use Days			
Consumptive	--	3,300	3,300
Non-Consumptive	300	2,000	1,700
Total	300	5,300	1,600
Benefit Value (c)			
Consumptive	$ --	$ 21,450	$ 21,450
Non-Consumptive	1,650	11,000	9,350
Total	$ 1,650	$ 32,450	$ 30,800
Public Use Days/Acre-Foot			
Consumptive	--	2.58	2.58
Non-Consumptive	--	1.56	1.56
Total	--	4.14	4.14
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 16.76	$ 16.76
Non-Consumptive	--	8.60	8.60
Total	$ --	$ 25.36	$ 25.36

TABLE III-2

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 2
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 2 (b)	Differences Between Water Supply Levels 2 and 1
KERN NWR			
Water Needs (ac-ft)	0	9,950	9,950
Public Use Days			
Consumptive	--	1,900	1,900
Non-Consumptive	300	4,800	4,500
Total	300	6,700	6,400
Benefit Value (c)			
Consumptive	$ --	$ 12,350	$ 12,350
Non-Consumptive	1,650	26,400	24,750
Total	$ 1,650	$ 38,750	$ 37,100
Public Use Days/Acre-Foot			
Consumptive	--	0.19	0.19
Non-Consumptive	--	0.48	0.48
Total	--	0.67	0.67
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.24	$ 1.24
Non-Consumptive	--	2.65	2.65
Total	$ --	$ 3.89	$ 3.89

(a) Supply Level 1: Existing firm water supply
(b) Supply Level 2: Current average annual water deliveries
(c) Values from U.S. Forest Service Publication, RPA Update, 1985, adjusted for 1987 costs

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
MODOC NWR			
Water Needs (ac-ft)	18,550	20,550	2,000
Public Use Days			
Consumptive	6,430	6,430	--
Non-Consumptive	7,870	7,870	--
Total	14,300	14,300	--
Benefit Value (c)			
Consumptive	$ 41,800	$ 41,800	$ --
Non-Consumptive	43,300	43,300	--
Total	$ 85,100	$ 85,100	$ --
Public Use Days/Acre-Foot			
Consumptive	0.35	0.35	--
Non-Consumptive	0.42	0.42	--
Total	0.77	0.77	--
Benefit Value/Acre-Foot			
Consumptive	$ 2.25	$ 2.25	$ --
Non-Consumptive	2.33	2.33	--
Total	$ 4.58	$ 4.58	$ --
SACRAMENTO NWR			
Water Needs (ac-ft)	0	50,000	50,000
Public Use Days			
Consumptive	--	6,500	6,500
Non-Consumptive	--	33,000	33,000
Total	--	39,500	39,500
Benefit Value (c)			
Consumptive	$ --	$ 42,250	$ 42,250
Non-Consumptive	--	181,500	181,500
Total	$ --	$223,750	$223,750
Public Use Days/Acre-Foot			
Consumptive	--	0.13	0.13
Non-Consumptive	--	0.66	0.66
Total	--	0.79	0.79

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.85	$ 0.85
Non-Consumptive	--	3.63	3.63
Total	$ --	$ 4.48	$ 4.48
DELEVAN NWR			
Water Needs (ac-ft)	0	30,000	30,000
Public Use Days			
Consumptive	--	6,200	6,200
Non-Consumptive	--	2,200	2,200
Total	--	8,400	8,400
Benefit Value (c)			
Consumptive	$ --	$ 40,300	$ 40,300
Non-Consumptive	--	12,100	12,100
Total	$ --	$ 52,400	$ 52,400
Public Use Days/Acre-Foot			
Consumptive	--	0.21	0.21
Non-Consumptive	--	0.07	0.07
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.34	$ 1.34
Non-Consumptive	--	0.40	0.40
Total	$ --	$ 1.74	$ 1.74
COLUSA NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	3,100	3,100
Total	--	7,200	7,200
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	17,050	17,050
Total	$ --	$ 43,700	$ 43,700

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.16	0.16
Non-Consumptive	--	0.12	0.12
Total	--	0.28	0.28
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.07	$ 1.07
Non-Consumptive	--	0.68	0.68
Total	$ --	$ 1.75	$ 1.75
SUTTER NWR			
Water Needs (ac-ft)	0	30,000	30,000
Public Use Days			
Consumptive	--	3,600	3,600
Non-Consumptive	--	--	--
Total	--	3,600	3,600
Benefit Value (c)			
Consumptive	$ --	$ 23,400	$ 23,400
Non-Consumptive	--	--	--
Total	$ --	$ 23,400	$ 23,400
Public Use Days/Acre-Foot			
Consumptive	--	0.12	0.12
Non-Consumptive	--	--	--
Total	--	0.12	0.12
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.78	$ 0.78
Non-Consumptive	--	--	--
Total	$ --	$ 0.78	$ 0.78
GRAY LODGE WMA			
Water Needs (ac-ft)	8,000	44,000	36,000
Public Use Days			
Consumptive	20,800	32,500	11,700
Non-Consumptive	83,300	168,000	84,700
Total	104,100	200,500	96,400

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value (c)			
Consumptive	$135,200	$ 211,250	$ 76,050
Non-Consumptive	458,150	924,000	465,850
Total	$593,350	$ 435,250	$541,900
Public Use Days/Acre-Foot			
Consumptive	2.6	0.74	-1.86
Non-Consumptive	10.41	3.08	-6.59
Total	13.01	4.56	-8.45
Benefit Value/Acre-Foot			
Consumptive	$ 16.90	$ 4.80	$ -12.10
Non-Consumptive	57.27	21.00	-36.27
Total	$ 74.17	$ 25.80	$ -48.37
GRASSLAND RCD			
Water Needs (ac-ft)	50,000	180,000	130,000
Public Use Days			
Consumptive	60,000	80,000	20,000
Non-Consumptive	31,000	56,000	25,000
Total	91,000	136,000	45,000
Benefit Value (c)			
Consumptive	$390,000	$520,000	$130,000
Non-Consumptive	201,500	308,000	106,500
Total	$591,500	$828,000	$236,500
Public Use Days/Acre-Foot			
Consumptive	1.2	0.44	-0.76
Non-Consumptive	0.62	0.31	-0.31
Total	1.82	0.7[illegible]	-1.07
Benefit Value/Acre-Foot			
Consumptive	$ 7.80	$ 2.89	$ -4.91
Non-Consumptive	4.03	1.71	-2.32
Total	$ 11.83	$ 4.60	$ -7.23

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
VOLTA WMA			
Water Needs (ac-ft)	10,000	16,000	6,000
Public Use Days			
Consumptive	3,900	7,400	3,500
Non-Consumptive	3,100	5,600	2,500
Total	7,000	13,000	6,000
Benefit Value (c)			
Consumptive	$ 25,350	$ 48,100	$ 22,750
Non-Consumptive	17,050	30,800	13,750
Total	$ 42,400	$ 78,900	$ 36,500
Public use Days/Acre-Foot			
Consumptive	0.39	0.46	0.07
Non-Consumptive	0.31	0.35	0.04
Total	0.70	0.81	0.11
Benefit Value/Acre-Foot			
Consumptive	$ 2,54	$ 3.01	$ 0.47
Non-Consumptive	1.71	1.92	0.21
Total	$ 4.25	$ 4.93	$ 0.68
LOS BANOS WMA			
Water Needs (ac-ft)	6,200	25,000	18,800
Public Use Days			
Consumptive	2,200	4,200	2,000
Non-Consumptive	11,600	35,000	23,400
Total	13,800	39,200	25,400
Benefit Value (c)			
Consumptive	$ 14,300	$ 27 300	$ 13,000
Non-Consumptive	63,800	192,500	128,700
Total	$ 78,100	$219,800	$141,700
Public Use Days/Acre-Foot			
Consumptive	0.35	0.17	-0.18
Non-Consumptive	1.87	1.40	-0.47
Total	2.22	1.57	-0.65

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value/Acre-Foot			
Consumptive	$ 2.31	$ 1.09	$ -1.22
Non-Consumptive	10.29	7.70	-2.59
Total	$ 12.60	$ 8.79	$ -3.81
KESTERSON NWR			
Water Needs (ac-ft)	3,500	10,000	6,500
Public Use Days			
Consumptive	1,800	1,900	100
Non-Consumptive	300	1,600	1,300
Total	2,100	3,500	1,400
Benefit Value (c)			
Consumptive	$ 11,700	$ 12,350	$ 650
Non-Consumptive	1,650	8,800	7,150
Total	$ 13,350	$ 21,150	$ 7,800
Public Use Days/Acre-Foot			
Consumptive	0.51	0.19	-0.32
Non-Consumptive	0.09	0.16	0.07
Total	0.60	0.35	-0.25
Benefit Value/Acre-Foot			
Consumptive	$ 3.34	$ 1.24	$ -2.10
Non-Consumptive	0.47	0.88	0.41
Total	$ 3.81	$ 2.12	$ -1.69
SAN LUIS NWR			
Water Needs (ac-ft)	0	19,000	19,000
Public Use Days			
Consumptive	--	4,100	4,100
Non-Consumptive	--	31,000	31,000
Total	--	35,100	35,100
Benefit Value (c)			
Consumptive	$ --	$ 26,650	$ 26,650
Non-Consumptive	--	170,500	170,500
Total	$ --	$197,150	$197,150

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS FOR WATER SUPPLY LEVELS 1 AND 4 (Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Public Use Days/Acre-Foot			
Consumptive	--	0.22	0.22
Non-Consumptive	--	1.63	1.63
Total	--	1.85	1.85
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 1.40	$ 1.40
Non-Consumptive	--	8.96	8.97
Total	$ --	$ 10.37	$ 10.37
MERCED NWR			
Water Needs (ac-ft)	0	16,000	16,000
Public Use Days			
Consumptive	--	900	900
Non-Consumptive	--	9,300	9,300
Total	--	10,200	10,200
Benefit Value (c)			
Consumptive	$ --	$ 5,850	$ 5,850
Non-Consumptive	--	51,150	51,150
Total	$ --	$ 57,000	$ 57,000
Public Use Days/Acre-Foot			
Consumptive	--	0.06	0.06
Non-Consumptive	--	0.58	0.58
Total	--	0.64	0.64
Benefit Value/Acre-foot			
Consumptive	$ --	$ 0.37	$ 0.37
Non-Consumptive	--	3.19	3.19
Total	$ --	$ 3.56	$ 3.56
MENDOTA WMA			
Water Needs (ac-ft)	18,500	29,650	11,150
Public Use Days			
Consumptive	12,200	15,800	3,600
Non-Consumptive	2,600	6,700	4,100
Total	14,800	22,500	7,700

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
Benefit Value (c)			
Consumptive	$ 79,300	$102,700	$ 23,400
Non-Consumptive	14,300	36,850	22,500
Total	$ 93,600	$139,550	$ 45,950
Public Use Days/Acre-Foot			
Consumptive	0.65	0.53	-0.12
Non-Consumptive	0.14	0.23	0.09
Total	0.79	0.76	-0.03
Benefit Value/Acre-Foot			
Consumptive	$ 4.29	$ 3.46	$ -0.83
Non-Consumptive	0.77	1.24	0.47
Total	$ 5.06	$ 4.70	$ -0.36
PIXLEY NWR			
Water Needs (ac-ft)	0	6,000	6,000
Public Use Days			
Consumptive	--	6,500	6,500
Non-Consumptive	300	3,800	3,500
Total	300	10,300	10,000
Benefit Value (c)			
Consumptive	$ --	$ 42,250	$ 42,250
Non-Consumptive	1,650	20,900	19,250
Total	$ 1,650	63,150	$ 61,500
Public Use Days/Acre-Foot			
Consumptive	--	1.08	1.08
Non-Consumptive	--	0.63	0.63
Total	--	1.71	1.71
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 7.04	$ 7.04
Non-Consumptive	--	3.48	3.48
Total	$ --	$ 10.52	$ 10.52

TABLE III-3

COMPARISON OF RECREATIONAL BENEFITS
FOR WATER SUPPLY LEVELS 1 AND 4
(Continued)

	Water Supply Level 1 (a)	Water Supply Level 4 (b)	Differences Between Water Supply Levels 4 and 1
KERN NWR			
Water Needs (ac-ft)	0	25,000	25,000
Public Use Days			
Consumptive	--	3,100	3,100
Non-Consumptive	300	12,400	12,100
Total	300	15,500	15,200
Benefit Value (c)			
Consumptive	$ --	$ 20,150	$ 20,150
Non-Consumptive	1,650	68,200	66,550
Total	$ 1,650	$ 88,350	$ 86,700
Public Use Days/Acre-Foot			
Consumptive	--	0.12	0.12
Non-Consumptive	--	0.50	0.50
Total	--	0.62	0.62
Benefit Value/Acre-Foot			
Consumptive	$ --	$ 0.81	$ 0.81
Non-Consumptive	--	2.73	2.73
Total	$ --	$ 3.54	$ 3.54

(a) Supply Level 1: Existing firm water supply
(b) Supply Level 4: Optimum management
(c) Values from U.S. Forest Service Publication, RPA Update, 1985, adjusted for 1987 costs

construction impacts would be limited. The regional impacts and the impacts of providing water to the refuges as compared to other potential water users will be evaluated in the Water Contracting EISs.

Wildlife-use days for each of the water supply levels were estimated by refuge managers. The estimated wildlife-use days were used to evaluate the overall impacts of various alternatives. All of the alternative plans would benefit waterfowl and riparian species at the refuges to some degree, as discussed in Chapter IV. However, flooding of upland areas may adversely impact habitat for some upland wildlife and plants. The alternative plans that would allow longer seasons for water conveyance by the local irrigation districts may also maintain riparian habitat along the unlined conveyance canals.

4. Social Analyses

The social analyses are primarily related to regional impacts of providing water to the refuges as compared to other water users. Other social impacts are related to increased public use and construction of the selected plans. Public use would increase under most of the alternative plans. The construction activities would probably be completed within one season by construction workers who reside in the general area of the refuges.

5. Public Involvement

The Refuge Water Supply Study is being conducted in cooperation with the Service, the California Waterfowl Association, DWR, DFG, as well as numerous water and irrigation districts which would be affected by refuge water deliveries. Public interest in the development of dependable refuge water supplies is very high based on the number of inquiries and the participation in study activities by individuals, environmental and wildlife organizations, and representatives of state and Federal legislatures.

Since the initiation of this study in October 1985, numerous meetings have been held with cooperating agency staff and management, environmental and wildlife organizations, and water and irrigation districts to discuss study objective, issues and concerns, and planning procedures. Two public information documents have been released to provide information on the progress of the study and to solicit public input on alternative water delivery plans and pertinent issues. Response has generally been favorable and supportive of the study.

The role of the public in the study has been primarily to provide input to the planning team through meetings and responses to newsletter requests for submittal of comments.

A newsletter, dated January 1986, was prepared by Reclamation and distributed to agencies, organizations, and interested individuals.

The letter delineated the necessity for the study and the efforts to bring all the interested parties into the planning process. A figure showing the breakdown of the core group of agencies involved in planning the study was presented along with a map depicting the location of all the refuges and their water needs. A comment sheet was provided to allow the public an opportunity to submit comments on their concerns and significant issues that needed to be studied.

A second newsletter was released in July 1987 which presented alternative plans and indicated, among other things, the interest this study generated by showing a picture of the representatives of the California Waterfowl Association and the Grassland Water District presenting a check for $30,000 to Reclamation Regional Director David Houston as a contribution to the study. The public was also provided a comment sheet in this letter.

A draft plan of study was prepared in January of 1986 to provide a framework for studies and to delineate the goals of the study. This plan was then used as a guideline in developing alternatives to provide adequate water supplies for the refuges. A preliminary findings memorandum was prepared in March 1987 updating the study findings to date and recommending the continuance of the study and the preparation of a draft planning report.

In January 1987, Reclamation held a workshop in Los Banos, California, on the refuge water supply investigations. The purpose of the workshop was to discuss potential water sources and delivery and removal systems and the possibility of offstream storage for those private, State and Federal wetlands within the Grassland Resource Conservation District. The 22 participants represented Federal and State agencies; water, drainage, and irrigation districts; and wildlife and land management organizations.

CHAPTER IV

Refuge Plans

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MID-PACIFIC REGION

CHAPTER IV

REFUGE PLANS

This chapter presents discussions of the land and water resources for each of the 15 managed wetland areas investigated. In addition, alternative plans to provide water supplies are provided. These plans were developed following extensive investigations of each area, and using the evaluation criteria provided in the previous chapter.

Selected plans will be presented in the Refuge Water Supply Planning Report and will be based on the findings of investigations presented in this report, as well as those of the Water Contracting EIS's.

Due to the complexity and amount of information developed under this study, 15 separate subchapters were prepared for Chapter IV to facilitate their review. The areas are presented in respect to their general geographical location, as shown in Figure IV-1.

- Chapter IV A - Modoc National Wildlife Refuge
- Chapter IV B - Sacramento National Wildlife Refuge
- Chapter IV C - Delevan National Wildlife Refuge
- Chapter IV D - Colusa National Wildlife Refuge
- Chapter IV E - Sutter National Wildlife Refuge
- Chapter IV F - Gray Lodge Wildlife Management Area
- Chapter IV G - Grassland Resource Conservation District
- Chapter IV H - Volta Wildlife Management Area
- Chapter IV I - Los Banos Wildlife Management Area
- Chapter IV J - Kesterson National Wildlife Refuge
- Chapter IV K - San Luis National Wildlife Refuge
- Chapter IV L - Merced National Wildlife Refuge
- Chapter IV M - Mendota Wildlife Management Area
- Chapter IV N - Pixley National Wildlife Refuge
- Chapter IV O - Kern National Wildlife Refuge

Conjunctive use was evaluated for each of the refuges. Under conjunctive use alternatives, surface water would be used for the entire refuge water supply during wet years when adequate surface water supplies were available. During drought years, groundwater would be used for the entire refuge water supply. During other years, a combination of surface water and groundwater supplies may be used. The primary disadvantage of conjunctive use programs is that both surface water and groundwater systems must be sized to deliver full water needs, resulting in large, less frequently used facilities and associated higher costs. Most of the refuges would require construction of wells to provide groundwater to the refuges, as well as construction of surface water conveyance system improvements.

One possible method to reduce the size and number of groundwater facilities would be to construct regional well-fields and artificial recharge facilities in areas where groundwater basin characteristics are suitable. The regional basins would be operated like surface water reservoirs with surplus water stored underground during wet years for use in dry years. Water pumped from the well field would be diverted into regional conveyance facilities, along with available surface water, to provide a firm supply to requestors. It may be possible to locate well fields strategically with respect to conveyance facilities to best use existing capacity and reduce the need for additional capacity. Conveyance capacity in regional conveyance facilities is normally underutilized during off-peak water use periods and would be utilized to convey intermittent water to artificial recharge basins. In addition to recharge basins, reregulation storage would be required to deliver water at the time and place needed.

Another method to reduce the size and number of groundwater facilities would be to pump groundwater from on-refuge wells on a year-round basis. The savings in reservoir releases could be used to provide supplemental surface water to the refuges.

However, additional planning studies would be required prior to implementation of any of these plans. Therefore, for the purposes of this report, the conjunctive use alternatives evaluated the number of wells required to provide each refuge with peak month water demands for each water supply level. If regional well fields or year-round pumping was implemented, the total number of wells could be significantly reduced.

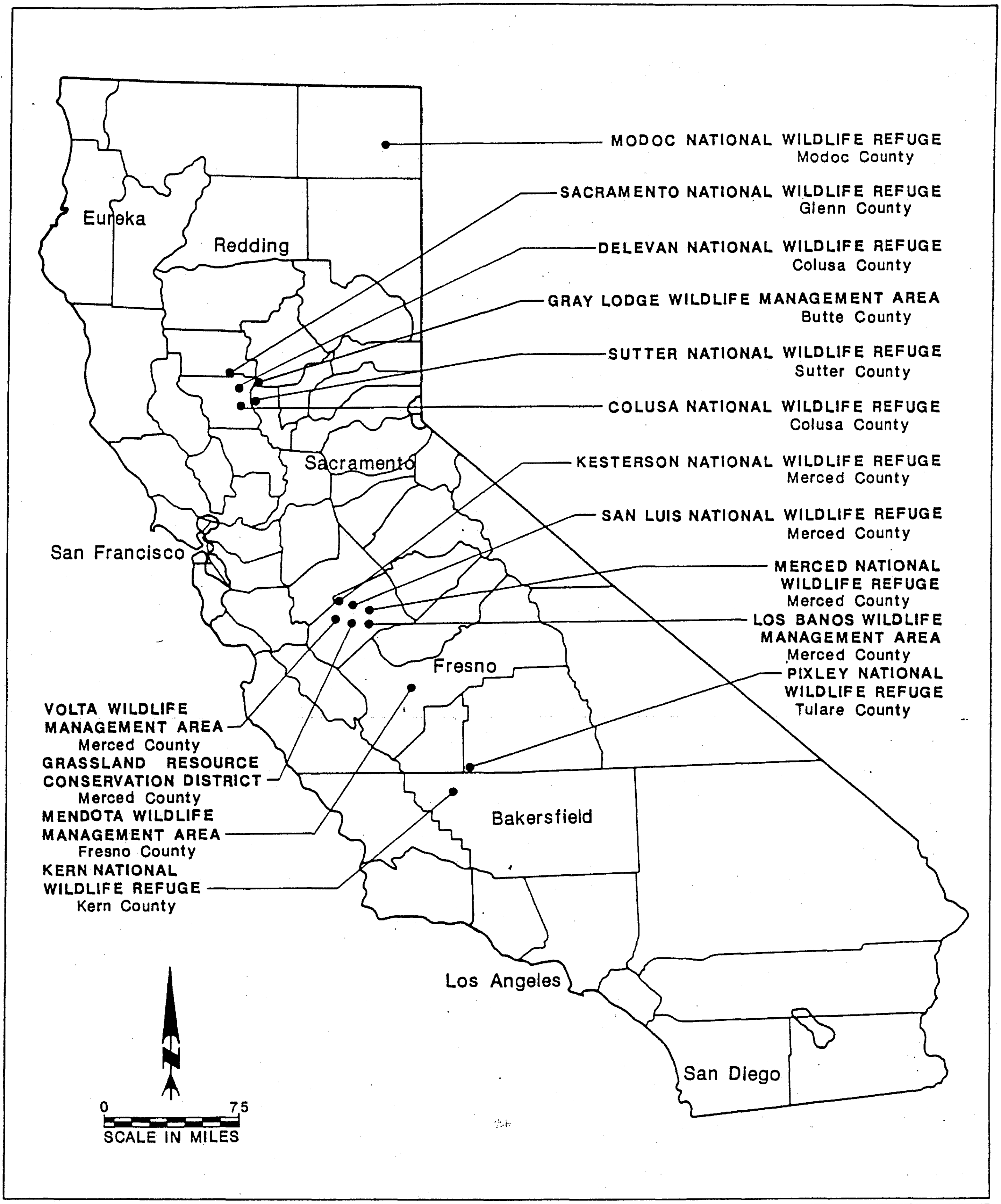


FIGURE IV-1

STUDY AREA AND REFUGE LOCATION MAP

CHAPTER IV A

MODOC NATIONAL WILDLIFE REFUGE

Modoc National Wildlife Refuge (Refuge) was authorized by the Migratory Bird Conservation Commission in 1959 and is currently managed by the Service. The original 5,966-acre tract was acquired in 1961 and subsequently expanded to 6,283-acres. The Refuge is located in Modoc County, south of Alturas in the Pit River Valley which is part of the Sacramento River Valley hydrologic basin. The North and South Forks of the Pit River merge near the northwest corner of the Refuge, as shown in Figure IV A-1.

Historically, the Refuge has been an important area for waterfowl migrating between the Malheur National Wildlife Refuge in the Harney Basin of Oregon and the Central Valley of California.

Water applied on the Refuge is used to irrigate grain crops, flood ponds and meadows, maintain pond levels, and circulate pond water. Typically, grain is planted on about 500 acres to provide forage for waterfowl. Cattle graze on part of the Refuge following the harvest. Most ponds remain flooded year-round to accommodate a large flock of Canada geese and other resident waterfowl. Nesting islands are constructed and maintained within the ponds. Occasionally, the water levels are withdrawn to allow repairs of dikes and water-control structures and rehabilitation of the nesting islands.

A. WATER RESOURCES

In general, the Refuge receives adequate water supply in most years to maintain existing wetlands. The Refuge receives water from the South Fork Pit River, Dorris Reservoir, and Pine Creek. The Refuge has the right to divert 18,550 acre-feet of water from the South Fork Pit River, North Fork Pit River, and Pine Creek. Dorris Reservoir impounds water from Pine Creek and North Fork Pit River via Parker Creek. Water quality is good for irrigation and wildlife. However, an adequate water supply is not available during August when the ponds need to be flooded, especially in the western portion of the Refuge along the South Fork of the Pit River.

1. Surface Waters

The South Fork Pit River flows are regulated by West Valley Creek Reservoir. The water is diverted to the Refuge at South Fork Dam and Sharkey Dam to irrigate the southern portion of the Refuge. Most of the water eventually returns to the river. That portion of the Refuge adjacent to the South Fork Pit River was part of the Dorris Ranch prior to acquisition by the Federal government. The Dorris Ranch was not part of the South Fork Pit River Decree No. 3273 which defines the water rights; therefore, the water rights are undefined. This water has been used on riparian land when water is available in that portion of the river. All natural flows in the South Fork Pit River are allocated upstream of the Refuge except during the spring high flow period.

Dorris Reservoir, which is partially located within the Refuge boundaries, also provides a significant portion of the Refuge water supply. The reservoir stores water from runoff and snowmelt from Parker Creek, Pine Creek, and Stockdill Slough watersheds. The Refuge has a total storage and diversion right of 11,100 acre-feet of surplus water from the reservoir. This water right includes 6,100 acre-feet from Parker Creek under the North Fork Pit River Decree and Application 1321, 800 acre-feet from Stockdill Slough under the North Fork Pit River Decree and Application 1042, 3,100 acre-feet from Pine Creek under the Pine Creek Agreement and Applications 760 and 1042, and 1,100 acre-feet from Pine Creek under Appropriative License 4822 and Application 12263. The water is generally available during any season if the rights of other users have been met.

Under the North Fork Pit River Decree (Decree 4074), the Refuge has the right to divert 12.66 cfs of fourth class priority water at Diversion Point 142 from September 30 to April 1. An additional 37.98 cfs used to be diverted whenever the flow in the North Fork exceeds 52.08 cfs. However, this additional diversion has been withdrawn since Hughes Dam was destroyed in 1939.

Additionally, the Refuge diverts water directly from Pine Creek to irrigate 340 acres of refuge land known as the Pine Creek Field, which is located at elevations above the diversion from Dorris Reservoir. Under the Pine Creek Agreement, the Refuge has the right to divert 10 cfs of first priority water and 20 cfs of second priority water from Pine Creek to irrigate 2,700-acres of land between April 1 and September 30. This agreement also states that the Dorris Ranch be allowed to divert 3.78 cfs or one-half of the Pine Creek flow, whichever is less, until the amount available from the North Fork Pit River decreases below 37.98 cfs. At that time, the amount of water diverted from Pine Creek can be increased up to one-half of the flow in Pine Creek. The agreement also gives the Refuge the right to divert 0.34 cfs of the first priority water and 0.45 cfs of second priority water from Pine Creek at Diversion Point 1 to irrigate 72 acres in the southern half of the southwestern quarter.

The Refuge does not have any water rights on the Pit River. All claims and water rights along the Pit River for the northwestern portion of the Refuge, also known as the Godfrey Tract, were sold in 1919. During wet years, surplus water is available during July and August for storage on the Refuge under the State Water Resources Control Board Decision 990.

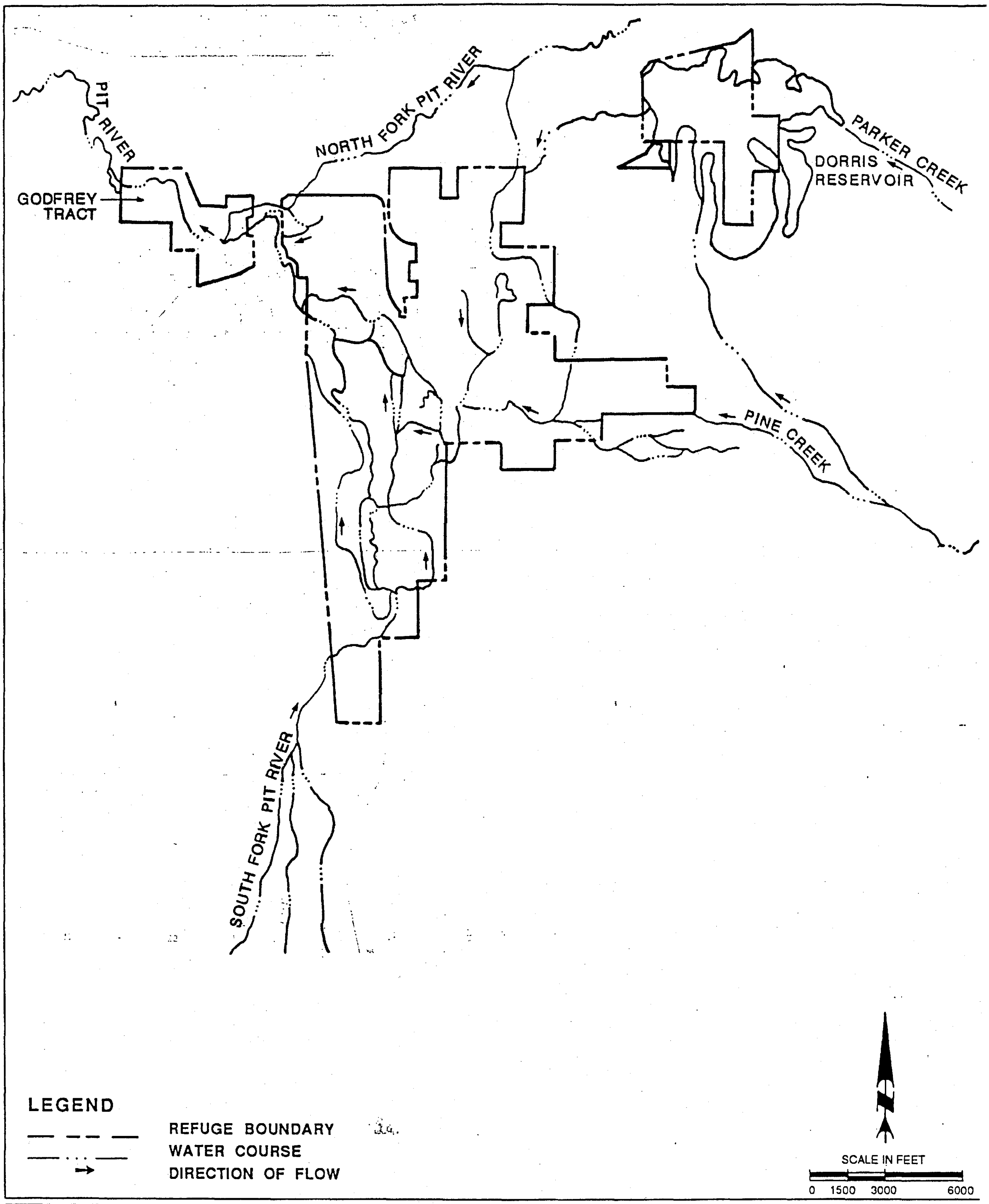


FIGURE IV A-1

MODOC NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

2. Water Conveyance Facilities

Water is diverted at various locations from the South Fork of the Pit River and is used primarily on the west side of the Refuge. Land which is located along Pine Creek at elevations above Dorris Reservoir is irrigated with water diverted directly from Pine Creek. Most of the water from Pine Creek is transported through a ditch to Dorris Reservoir from November through April. The eastern and central portions of the Refuge receives water directly from Dorris Reservoir or from the Dorris Reservoir Canal located downstream of the reservoir. All surface waters are delivered by gravity flow.

3. Groundwater

The Refuge is located in the Alturas Groundwater Basin, which consists of volcanic and sedimentary formations. The principal water bearing deposits are included within the moderately consolidated Alturas Formation, which consists of moderately consolidated beds of tuff, ashy sandstone, and diatomite. This formation is separated into an upper and lower member by a Plio-Pleistocene basalt and the Warm Springs tuff member. Buried lava flows may yield more groundwater than other formations. Volcanic uplands surrounding the Refuge serve as recharge areas for the moderate to highly permeable aquifers of the Alturas Formation. Groundwater movement is from the mountains towards the valley floor. Groundwater movement along the valley floor is north towards Alturas. Groundwater often exists near the land surface. Groundwater levels in the vicinity of the Refuge are about 50 feet below the ground surface with slightly lower levels north of the Refuge towards Alturas. Most wells in the vicinity of the Refuge were drilled to depths of 250 to 350 feet (DWR, 1986a). Previous investigations have estimated that these wells should produce 300 to 1,000 gallons of water per minute. The groundwater quality has alkaline tendencies, but appears to be adequate for irrigation and waterfowl use (Service, 1978; DWR, 1986a).

The Refuge currently has one well. In the past, this well has not been used due to high power costs, and as a result, the pump has become inoperable. The pump would need to be rehabilitated to be used in the future. Reclamation estimates that the safe yield of the Refuge is 2,200 acre-feet. Portions of the Refuge in the Godfrey Tract and along the most easterly boundaries may be underlain by thinner permeable formations and may have lesser amounts of water.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 20,550 acre-feet of water would be required for full developement and optimum management of the entire Refuge. For the purpose of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV A-1. Each of the water supply levels provide a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (18,550 acre-feet)

Since this level represents the existing firm water supply, existing facilities would be used to provide a dependable conveyance system for the Refuge. Therefore, no alternatives were developed for Level 1. Water would not be available for the Godfrey Tract due to lack of facilities. During the month of August in all years and during drought years water may not be available in the central portion of the Refuge.

2. Delivery Alternative for Level 2 (18,550 acre-feet)

Under normal conditions, the surface waters are adequate to supply 18,550 acre-feet of water each year. However, during years which are drier than normal, adequate water is not available in the fall. This alternative would ensure delivery of average annual flows during dry years.

Alternative 2A - Rehabilitate Well. The existing well would be rehabilitated and used in dry years at the end of the summer and fall seasons to provide additional water (approximately 490 acre-feet) to portions of the Refuge when adequate water does not flow in the South Fork of the Pit River. During years when surplus water is available on the South Fork of the Pit River, the well would not be needed. This alternative would not require additional water rights or contracts. The location of the existing well is indicated in Figure IV A-2.

3. Delivery Alternative for Level 3 (19,500 acre-feet)

Under this level, existing conveyance facilities would be used to fully serve the currently developed portions of the Refuge. The additional water would be used to extend the duration of flooding to earlier in the spring and later in the fall. However, additional water supplies would be required through the aquisition of water rights or the use of groundwater. Because aquisition of new water rights may be difficult, the alternative for Level 3 would be similar to Alternative 2A.

TABLE IV A-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE MODOC NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	1,030	1,030	1,080	1,140
February	1,130	1,130	1,190	1,250
March	840	840	880	930
April	1,990	1,990	2,090	2,210
May	2,430	2,430	2,550	2,690
June	2,600	2,600	2,730	2,880
July	2,110	2,110	2,220	2,340
August	2,320	2,320	2,450	2,570
September	1,990	1,990	2,090	2,210
October	920	920	970	1,020
November	590	590	620	650
December	600	600	630	660
Total	18,550	18,550	19,500	20,550

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Source: Doug Weinrich, Ecological Services, USFWS, 1987

Alternative 3A - Rehabilitate Well. The existing well would be rehabilitated and used to extend the duration of flooding and increase circulation on the reservoir. The well would provide 950 acre-feet of water.

4. Delivery Alternatives for Level 4 (20,550 acre-feet)

New facilities would be constructed to serve the western portion of the Refuge (Godfrey Tract) which is currently not developed. Two alternatives have been developed to provide water to the western portion of the Refuge under Level 4. Both alternatives would require implementation of Alternative 3A.

Alternative 4A - Construct Wells and Rehabilitate Dam Structure on Pit River. This alternative would allow diversion of additional water from the Pit River to the Godfrey Tract. The additional water could be obtained from wells or from unappropriated water which is only available during wet years. The wells would be located in the central portion of the Refuge, however, the exact location of the wells is not known at this time. During years when surplus water is available on the Pit River, the wells may not be needed.

Four 600 gpm wells would be constructed to a depth of 600 feet. The new wells would be located in the general vicinity of the existing well to reduce the cost of placing the electrical distribution facilities underground. The water would be discharged into ditches which would transfer the flow to the South Fork Pit River for continued flow into the Pit River. An existing dam on the Pit River would be rehabilitated to allow transfer of water to the Godfrey Tract, as indicated in Figure IV A-2.

A potential consideration under this alternative would be the use of groundwater in the central portion of the Refuge and use of surface water on the Godfrey Tract. This would require transfer of the place of diversion from the South Fork Pit River water to the Pit River. However, the transfer of the place of diversion probably could not be implemented because the existing water rights are for the use of the water on specific lands in the central portion of the Refuge.

Alternative 4B - Construct Wells in the Godfrey Tract. Water wells would be constructed in the Godfrey Tract to provide an additional 2,000 acre-feet per year with a maximum of 280 acre-feet in June. However, the water bearing formations are not extensive in this area and the maximum well production may be limited to 50 gpm (DWR,1986a). As a result, the wells may not produce adequate water supplies. In addition, the aquifer may be connected to the surface waters. Therefore, if large amounts of water are withdrawn from the Godfrey Tract, the stream flows may decrease.

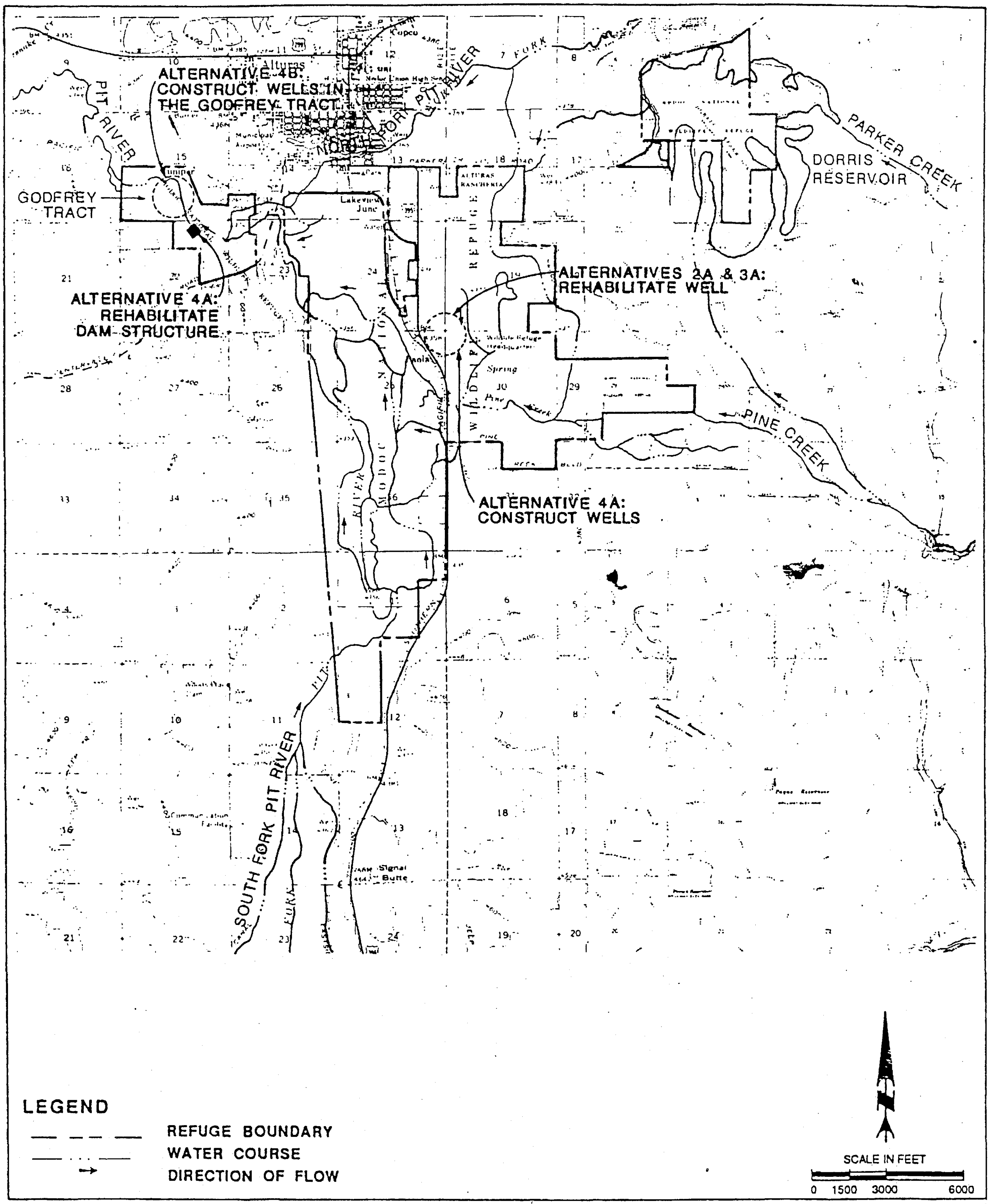


FIGURE IV A-2

MODOC NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

JMM

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to criteria outlined in Chapter III.

There are no facilities alternatives necessary for Level 1.

Alternatives 2A and 3A would provide supplemental water for the central portion of the Refuge when adequate water is not available from the South Fork Pit River.

Alternatives 4A and 4B would supply water to the Godfrey Tract. Alternative 4A would require construction and operation of wells and a dam structure. In addition, implementation of Alternative 4A would require approvals from the State Water Resources Control Board and State Department of Water Resources to convey water through the South Fork Pit River and Pit River to the western portion of the Refuge. This alternative also would require implementation of Alternative 3A.

Alternative 4B would only require construction and operation of wells. However, these wells would be located in areas which may not have sufficient water bearing formations. Therefore, adequate water may not be provided under this alternative. This alternative would require implementation of Alternative 3A.

C. COSTS AND ECONOMIC ANALYSIS

Costs for alternative plans to provide adequate water supplies under water delivery Levels 2, 3, and 4 are presented in Table IV A-2. The construction costs include factors to cover engineering, contingencies, and overhead costs. The operation costs only represent the incremental cost to provide additional water. The costs do not include the cost to provide water under Level 1. During the advanced planning phase, these costs will be refined further.

Improvements described under the alternatives plans to provide Levels 2, 3, or 4 would result in additional money being spent in the economy of Modoc County during construction. The construction could be completed within one summer season by construction workers who reside in Modoc County.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 3,356,000 use-days based upon the annual average use from 1981 through 1985. Approximately 68 and 32 percent of the bird use are by ducks and geese, respectively, including many species which nest on the Refuge. Fish and wildlife resources associated with the Refuge are presented in Table IV A-3. The listed threatened and endangered species associated with the Refuge are the bald eagle, <u>Haliaeetus</u>

TABLE IV A-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

MODOC NWR

Items	Alternatives 2A	3A	4A	4B
Additional Water (ac-ft)	490	950	2,000	2,000
Construction Cost				
Wells	$ 16,500	$ 16,500	$186,000 (a)	$963,200 (b)
Dams/Diversion Structures	---	---	20,000	---
Subtotal	$ 16,500	$ 16,500	$206,000	$963,000
Other Costs	---	---	16,500 (c)	26,500 (c)
Total (d)	$ 16,500	$ 16,500	$222,500	$979,000
Annualized Construction Costs (8.87%, 30 yrs)	$ 1,590	$ 1,590	$ 21,410	$ 94,180
Additional Annual Costs				
Operation & Maintenance (e)	$ 650	$ 650	$ 2,600	$ 27,500
Power	1,960 (f)	3,800 (f)	4,200 (g)	4,200 (g)
Subtotal	$ 2,610	$ 4,450	$ 6,800	$ 31,700
Other Costs	---	---	4,450 (c)	4,450 (c)
Total (d)	$ 2,610	$ 4,450	$ 11,250	$ 36,150
Total Annual Costs	$ 4,200	$ 6,040	$ 32,660	$130,330
Cost/Additional Acre-Foot	$ 8.60	$ 6.40	$ 16.40	$ 65.20

Notes: Alternative 2A: Rehabilitate Well
Alternative 3A: Rehabilitate Well
Alternative 4A: Construct Wells and Rehabilitate Dam Structure on Pit River
Alternative 4B: Construct Wells in the Godfrey Tract.

(a) 4 Wells, 600-feet deep, 40-foot lift.
(b) 43 Wells, 200-feet deep, 40-foot lift.
(c) Alternatives 4A and 4B would require implementation of Alternative 3A.
(d) The cost for Water Supply Level 1 is not included.
(e) Basis for O&M costs are discussed in Appendix F.
(f) Unit Pumping Cost = $4/af.
(g) Unit Pumping Cost = $2.10/af.

TABLE IV A-3

FISH AND WILDLIFE RESOURCES

MODOC NWR

Ducks

Common Merganser	Northern Shoveler[a]	Ring-necked Duck
Mallard[a]	Pintail[a]	Common Golden eye
Gadwall[a]	Wood Duck	Barrow's Golden eye
American Wigeon[a]	Redhead[a]	Bufflehead
Green-winged Teal[a]	Canvasback[a]	Ruddy Duck[a]
Blue-winged Teal[a]	Lesser Scaup	Cinnamon Teal[a]

Geese and Swans

Snow Goose	Canada Goose[a]
Ross Goose	Cackling Goose
White-fronted Goose	Tundra Swan

Coots

American Coot[a]

Shore and Wading Birds

Double-crested Cormorant	Virginia Rail[a]	Common Snipe[a]
White Pelican	Sora[a]	Long-billed Dowitcher
American Bittern[a]	Wilson's Phalarope[a]	Least Sandpiper
Least Bittern	American Avocet[a]	Greater Yellowlegs
Great Blue Heron	Lesser Sandhill Crane	Solitary Sandpiper
Great (Common) Egret[a]	Pied-billed Grebe[a]	Willet[a]
Snowy Egret	Western Grebe[a]	Spotted Sandpiper[a]
Black-Crowned Night Heron[a]	Eared Grebe[a]	Black-bellied Plover
Greater Sandhill Crane[a]	Black-Necked Stilt[a]	Horned Grebe

TABLE IV A-3

FISH AND WILDLIFE RESOURCES

MODOC NWR
(Continued)

Upland Game		
Ring-necked Pheasant[a]	California Quail[a]	
Raptorial Birds		
Turkey Vulture	Swainson's Hawk	Long-eared Owl[a]
Northern Harrier[a]	Rough-legged Hawk	Short-eared Owl
Cooper's Hawk	American Kestrel (Sparrow Hawk)[a]	Flammulated Owl
Red-tailed (Harlan) Hawk[a]	Barn Owl[a]	Great Horned Owl[a]
Bald Eagle		Golden Eagle
Fish		
Bass	Catfish	Brown Bullhead
Suckers	Brook Trout	
Chubs	Rainbow Trout	
Furbearers		
Muskrats	Mink	Beaver
Skunk	Coyote	Raccoon
Badger	Weasel	

Notes:

(a) Birds nesting on refuge

Source: USFWS computerized annual printout for NWR Birds, Department of Interior, USFWS (RF11650-2 9-79) (July 1973 to June 1974, NWRS Public Use Report (1)) and refuge records.

leucocephalus and the peregrine falcon, Falco peregrinus anatum. Candidate species associated with the Refuge include the white-faced ibis, Plegadis chichi; tricolored blackbird, Agelaius tricolor; and prostrate buckwheat, Erigonum prociduum, as listed in Table IV A-4.

Alternatives 2A and 3A would improve the viability of the vegetation during drought years in the central portion of the Refuge. Alternatives 4A and 4B would improve habitat in the western portion of the Refuge. The water would be used to flood an additional 70 acres of seasonal wetlands, provide 120 acres of seasonal marsh, and improve management of 50 to 80 acres of emergents. The improved habitat would increase the number of nesting pairs of waterfowl and upland birds. The number of wildlife and recreational use days also would increase under Level 3, as indicated in Table IV A-5.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species of birds and would improve habitat that could be used by the white-faced ibis. However, the candidate plant, prostrate buckwheat, may be impacted under implementation of Alternatives 4A or 4B by the flooding of upland areas in the western portion of the Refuge. Detailed field investigations would be necessary prior to the design phase of the project. Implementation of the alternative plans would result in overall beneficial environmental effects.

The No Action Alternative would result in the management of the Refuge under the current water supply and conditions. The Godfrey Tract would not be developed in accordance with the management plan under the No Action Alternative.

E. SOCIAL ANALYSIS

The social consequences of any of the alternatives would be similar because public use would not change.

F. POWER ANALYSIS

Pacific Power and Light Company serves the Refuge. If CVP project-use power were determined to be available, the Refuge may not be able to receive the CVP power, as Pacific Gas & Electric Company (PG&E) has entered into an agreement with Reclamation to convey CVP power to CVP customers within a specified area, also known as a "wheeling area". The Refuge is located outside of this area. However, a similar agreement has been negotiated with PG&E to convey power to the Truckee-Donner Public Utility District which also is located outside of the wheeling area and the PG&E service area. That agreement provided for PG&E to supply CVP power through the PG&E-Sierra Pacific Power Company intertie. Therefore, an agreement would be needed to allow PG&E to convey the power through an intertie with Pacific Power and Light Company. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

TABLE IV A-4

FEDERAL LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

MODOC NWR

Listed Species

Birds

Bald eagle, *Haliaeetus leucocephalus* (E)
Peregrine Falcon, *Falco peregrinus anatum* (E)

Proposed Species

None

Candidate Species

Birds

White-faced ibis, *Plegadis chihi* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Plants

Prostrate buckwheat, *Erigonum prociduum* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV A-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

MODOC NWR

	No Action Alternative	Alternatives			
		2A	3A	4A	4B
Habitat Acres					
Wetlands	1,278	1,278	1,478	1,668	1,668
Uplands	3,403	3,403	3,203	2,943	2,943
Croplands & Others	1,500	1,500	1,500	1,570	1,570
Bird Use Days					
Ducks	1,980,000	1,980,000	2,080,000	(a)	(a)
Geese	953,000	953,000	978,000		
Others	423,000	423,000	509,500		
Total	3,356,000	3,356,000	3,567,500		
Public Use Days					
Consumptive	6,430	6,430	6,430	6,430	6,430
Non-Consumptive	7,870	7,870	7,870	7,870	7,870
Total	14,300	14,300	14,300	14,300	14,300
Total Annual Cost	--	$ 4,200	$ 6,040	$ 32,660	$130,400
Incremental Cost/Additional 1000 Bird Use Days	N/A	N/A	$ 28.60	(a)	(a)
Incremental Cost/Addition Public Use Day	N/A	N/A	N/A	(a)	(a)

Note: Alternative 2A: Rehabilitate Well
Alternative 3A: Rehabilitate Well
Alternative 4A: Construct Wells and Rehabilitate Dam Structure on Pit River
Alternative 4B: Construct Wells in the Godfrey Tract

(a) Data not available for Level 4.

G. PERMITS

Construction of the wells under Alternative 2A, 3A, 4A, or 4B and the rehabilitation of the dam under Alternative 4A would require several permits. Modoc County would issue permits for well construction.

Rehabilitation of the dam on the Pit River would require approvals from Modoc County, DWR, State Water Resources Control Board, DFG, and State Lands Commission. Modoc County would issue a permit for construction along the banks of the Pit River and South Fork Pit River to ensure that existing drainage facilities would not be adversely affected. Alternative 4A also would require approvals from DWR and State Water Resources Control Board for water transfer through the South Fork Pit River to the Pit River and diversion from the Pit River. A Stream Alteration Permit from DFG and Corps of Engineers permits would be required for construction of the dam rehabilitation measures. A permit also may be needed from the State Lands Commission for construction within the banks of the Pit River.

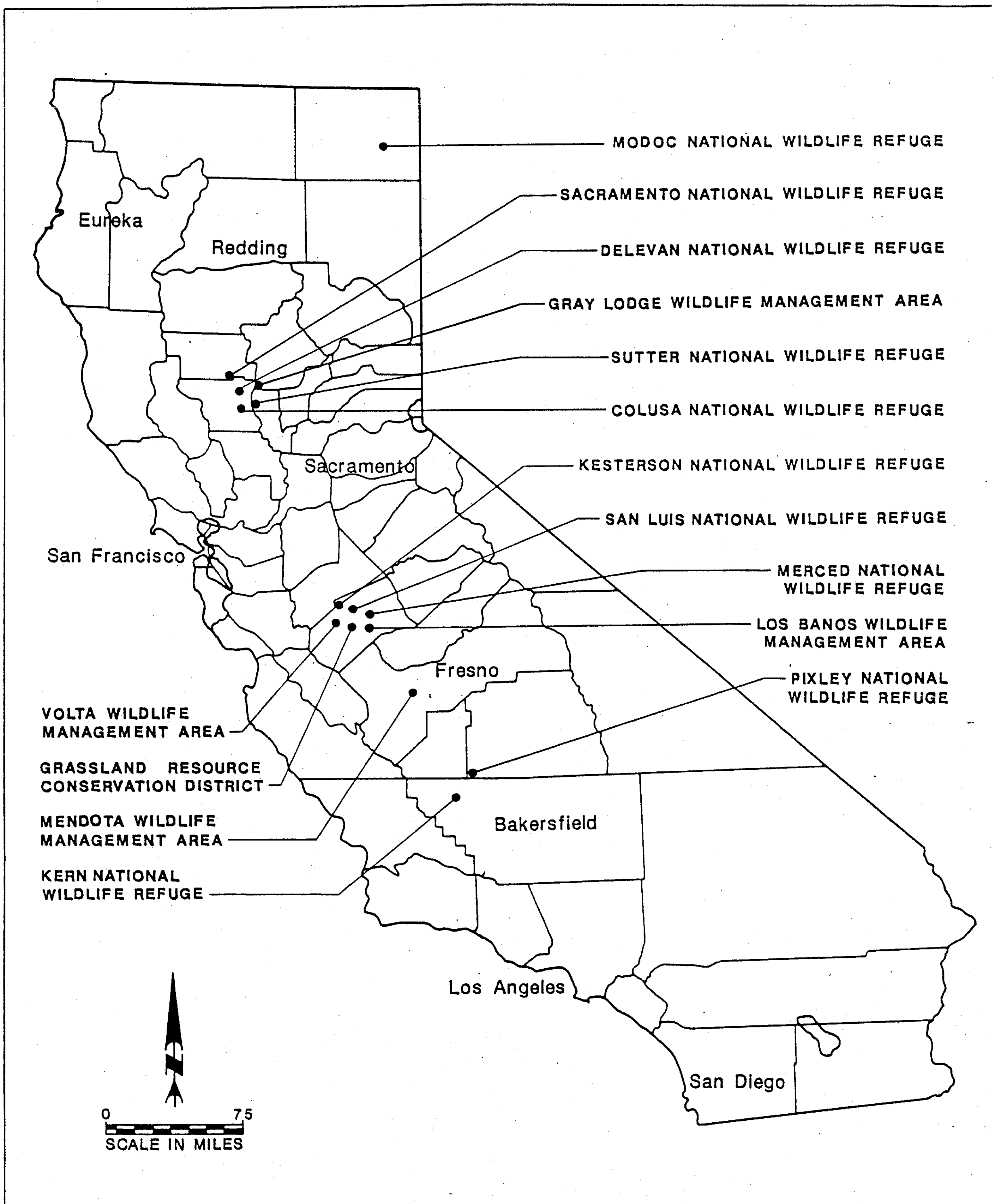


FIGURE S-1

STUDY AREA AND REFUGE LOCATION MAP

TABLE S-1

REFUGE WATER SUPPLY NEEDS

Refuge	Level 1 (ac-ft)	Level 2 (ac-ft)	Level 3 (ac-ft)	Level 4 (ac-ft)
Modoc NWR	18,550	18,550	19,500	20,550
Sacramento NWR	0	46,400	50,000	50,000
Delevan NWR	0	20,950	25,000	30,000
Colusa NWR	0	25,000	25,000	25,000
Sutter NWR	0	23,500	30,000	30,000
Gray Lodge WMA	8,000	35,400	41,000	44,000
Total Sacramento Valley	26,550	169,800	190,500	199,550
Grassland RCD[a]	50,000	125,000	180,000	180,000
Volta WMA	10,000	10,000	13,000	16,000
Los Banos WMA	6,200	16,670	22,500	25,000
Kesterson NWR	3,500	3,500	10,000	10,000
San Luis NWR	0	13,350	19,000	19,000
Merced NWR	0	13,500	16,000	16,000
Mendota WMA	25,463[b]	18,500	24,000	29,650
Pixley NWR	0	1,280	3,000	6,000
Kern NWR	0	9,950	15,050	25,000
Total San Joaquin Valley	95,163[b]	211,750	302,550	326,650
TOTAL	**121,713[b]**	**381,550**	**493,050**	**526,200**

Water Supply Level 1: Existing firm water supply

Water Supply Level 2: Current average annual water deliveries

Water Supply Level 3: Full use of existing development

Water Supply Level 4: Optimum management

(a) As of 1985, Grassland Resource Conservation District no longer receives agricultural drainage flows due to water quality concerns.

(b) Only 18,500 ac-ft can be delivered to Mendota WMA without modifications of existing facilities.

Problems

The importance of the remaining Central Valley Wetlands to the Pacific Flyway cannot be overstated. Wintering habitat is the single most important limiting factor for waterfowl using the Flyway. The Fish and Wildlife Service has ranked Central Valley wetland habitat fourth out of 33 on the national habitat priority scale, with a highest priority designation for wintering habitat preservation nationally.

As demands for fresh water increase throughout the Central Valley, available supplies of surface water, groundwater, and agricultural return flows are expected to diminish. It is a consensus among refuge managers and wildlife biologists that without a dependable supply of water to maintain Central Valley refuge wetland habitat, waterfowl numbers could be significantly reduced in the near future.

Currently, only seven of the 15 refuges studied are receiving a firm water supply. Only Mendota Wildlife Management Area has a firm supply in the amount considered necessary for the proper management of existing wetlands and facilities within the refuge boundaries. The remaining refuges must depend on the sources mentioned above and run-off available only during wet weather periods to meet refuge needs. The amount of water available to the refuges varies each year and commonly is not delivered at the time of year desired for appropriate wetland management. Typically, the refuges receive water only after all the agricultural, municipal and industrial demands are fulfilled. The pumping of groundwater could, in part, alleviate the problem of water shortages; however, the costs of pumping have been prohibitive.

Needs

The refuges of the Central Valley need to obtain dependable supplies of good quality water, delivered on a timely basis, to preserve critical wetland habitat for the migratory birds of the Pacific Flyway. The existing water deliveries and supplemental water requirements for each refuge are presented in Table S-1.

Each refuge has its own unique set of problems and needs. Some require additional water during the fall and winter months, some need summer supplies, while others need better quality water than is currently provided. The alternative plans for water delivery were based upon each refuge's needs and represent extensive field investigations. They were developed based upon criteria such as, availability of water, operational flexibility, conjunctive use possibilities, ease of implementation, costs, and potential environmental impacts. Additional alternatives or modifications to alternatives presented in this report may be developed during the preparation of the Refuge Water Supply Planning Report.

Table S-2 provides a summary of alternatives developed for each refuge.

TABLE S-2

SUMMARY OF DELIVERY ALTERNATIVES

Refuge	Level 1	Level 2	Level 3	Level 4
Modoc NWR	None	2A. Rehabilitate Well	3A. Rehabilitate Well	4A. Construct Wells, Rehabilitate Dam on Pit River.
				4B. Construct Wells in the Godfrey Tract.
Sacramento NWR	None	2A. Construct Pipeline from Tehama-Colusa Canal.	3A. Construct Pipeline from Tehama-Colusa Canal.	4A. Construct Pipeline from Tehama-Colusa Canal.
		2B. Deliver CVP Water through Kanawha WD.	3B. Deliver CVP Water through Kanawha WD.	4B. Deliver CVP Water through Kanawha WD.
		2C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	3C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.	4C. Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal.
		2D. Delivery CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	3D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.	4D. Deliver CVP Water from Tehama-Colusa Canal to GCID Lateral 35-C.
		2E. Implement a Conjunctive Use Plan.	3E. Implement a Conjunctive Use Plan.	4E. Implement a Conjunctive Use Plan.
Delevan NWR[a]	None	2A. Convey Water from Sacramento NWR.	3A. Convey Water from Sacramento NWR	4A. Construct Pump Station on 2047 Drain
		2B. Construct Crossover on GCID Lateral 41-1.	3B. Construct Crossover on GCID Lateral 41-1.	4B. Construct Siphons Under the MID Canal
		2C. Improve Hunter's Creek No. 2 Diversion Weir.	3C. Improve Hunter's Creek No. 2 Diversion Weir.	4C. Implement a Conjunctive Use Plan.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	
Colusa NWR[a]	None	2A. Construct Weir on 2047 Drain and replace Davis Weir.	3A. Construct Weir on 2047 Drain and replace Davis Weir.	4A. Construct Facilities to Serve Tracts 4, 7, 9, and 11.
		2B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	3B. Convey CVP Water through Zumwalt Farms and Glenn-Colusa ID.	4B. Implement a Conjunctive Use Plan.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	

TABLE S-2

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Sutter NWR	None	2A. Deliver Water from Thermalito Afterbay through Butte Creek. 2B. Delivery Water from Thermalito Afterbay through Wadsworth Canal. 2C. Obtain Water from Sutter Extension Water District. 2D. Implement a Conjunctive Use Plan.	3A. Deliver Water from Thermalito Afterbay through Butte Creek. 3B. Delivery Water from Thermalito Afterbay through Wadsworth Canal. 3C. Obtain Water from Sutter Extension Water District. 3D. Implement a Conjunctive Use Plan.	4A. Deliver Water from Thermalito Afterbay through Butte Creek. 4B. Delivery Water from Thermalito Afterbay through Wadsworth Canal. 4C. Obtain Water from Sutter Extension Water District. 4D. Implement a Conjunctive Use Plan.
Gray Lodge WMA	None	2A. Construct Ditch from Cherokee Canal. 2B. Construct Canal from Thermalito Afterbay. 2C. Improve BWGID System. 2D. Implement a Conjunctive Use Plan.	3A. Construct Ditch from Cherokee Canal. 3B. Construct Canal from Thermalito Afterbay. 3C. Improve BWGID System. 3D. Implement a Conjunctive Use Plan.	4A. Construct Ditch from Cherokee Canal. 4B. Construct Canal from Thermalito Afterbay. 4C. Improve BWGID System. 4D. Implement a Conjunctive Use Plan.
Grassland Resource Conservation District	None	2A. Convey Water Under the Zahm-Sansoni-Nelson Plan. 2B. Utilize the Wolfson Bypass. 2C. Implement a Conjunctive Use Plan.	3A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue. 3B. Implement a Conjunctive Use Plan.	4A. Construct Turnouts on Delta-Mendota Canal at Almond Drive and Russell Avenue. 4B. Implement a Conjunctive Use Plan.
Volta WMA	None	None	3A. Construct Turnouts at Main Canal and Upgrade Outtakes. 3B. Implement a Conjunctive Use Plan.	4A. Construct Turnouts at Main Canal and Upgrade Outtakes. 4B. Implement a Conjunctive Use Plan.

TABLE S-2

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Mendota WMA	None	None	3A. Change Operation of Mendota Pool	4A. Change Operation of Mendota Pool
			3B. Extend WWD Laterals 4 and 6 to Refuge	4B. Extend WWD Laterals 4 and 6 to Refuge
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Pixley NWR	None	None	3A. Obtain Friant-Kern Canal Water via Deer Creek.	4A. Obtain Friant-Kern Canal Water via Deer Creek.
			3B. Utilize Mid-Valley Canal Water via Deer Creek.	4B. Utilize Mid-Valley Canal Water via Deer Creek.
			3C. Obtain CVP Water via the California Aqueduct.	4C. Obtain CVP Water via the California Aqueduct.
			3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.
Kern NWR	None	2A. Transport CVP Water through the BVWSD Facilities.	3A. Transport CVP Water through the BVWSD Facilities.	4A. Transport CVP Water through the BVWSD Facilities.
		2B. Transport State Water Project Water through the LHWSD Facilities.	3B. Transport State Water Project Water through the LHWSD Facilities.	4B. Transport State Water Project Water through the LHWSD Facilities.
		2C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	3C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.	4C. Transport CVP Water through the Friant-Kern Canal and Poso Creek.
		2D. Implement a Conjunctive Use Plan.	3D. Implement a Conjunctive Use Plan.	4D. Implement a Conjunctive Use Plan.

(a) All of the alternatives for these refuges require implementation of Alternatives 2A, 2B, 2C, 2D, or 2E for Sacramento NWR.

(b) All of the alternatives for these refuges require implementation of Alternatives 2A or 2B for Grassland Resource Conservation District.

TABLE S-2

SUMMARY OF DELIVERY ALTERNATIVES
(Continued)

Refuge	Level 1	Level 2	Level 3	Level 4
Los Banos WMA[b]	None	2A. Reconstruct SLCC Facilities.	3A. Reconstruct SLCC Facilities.	4A. Reconstruct SLCC Facilities.
		2B. Implement a Conjunctive Use Plan.	3B. Implement a Conjunctive Use Plan.	4B. Implement a Conjunctive Use Plan.
Kesterson NWR[b]	None	2A. Rehabilitate Santa Fe Canal.	3A. Extend Eagle Ditch into Refuge.	4A. Extend Eagle Ditch into Refuge.
			3B. Extend West Side Ditch to Eagle Ditch.	4B. Extend West Side Ditch to Eagle Ditch.
			3C. Convey Water from Garzas Creek to Los Banos Creek.	4C. Convey Water from Garzas Creek to Los Banos Creek.
			3D. Utilize Mud Slough.	4D. Utilize Mud Slough.
			3E. Extend Santa Fe Canal.	4E. Extend Santa Fe Canal.
			3F. Implement a Conjunctive Use Plan.	4F. Implement a Conjunctive Use Plan.
San Luis NWR[b]	None	2A. Enlarge and Line SLCC Facilities.	3A. Enlarge and Line SLCC Facilities.	4A. Enlarge and Line SLCC Facilities.
		2B. Construct Lift Pumps to Utilize San Joaquin River Water.	3B. Construct Lift Pumps to Utilize San Joaquin River Water.	4B. Construct Lift Pumps to Utilize San Joaquin River Water.
		2C. Implement a Conjunctive Use Plan.	3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
Merced NWR	None	2A. Utilize the East Side Bypass	3A. Extend Casebeer Lateral to Refuge Boundary.	4A. Extend Casebeer Lateral to Refuge Boundary.
		2B. Implement a Conjunctive Use Plan	3B. Extend Casebeer Lateral to Deadman Creek.	4B. Extend Casebeer Lateral to Deadman Creek.
			3C. Implement a Conjunctive Use Plan.	4C. Implement a Conjunctive Use Plan.
			3D. Utilize Treated Wastewater from the Merced Treatment Plant.	4D. Utilize Treated Wastewater from the Merced Treatment Plant.

CHAPTER IV B

SACRAMENTO NATIONAL WILDLIFE REFUGE

Sacramento National Wildlife Refuge (Refuge) was established in 1937 through the purchase of 10,776 acres. Funds were provided by the Emergency Conservation Fund Act of 1933 and Emergency Relief Appropriations for the purpose of providing a refuge and breeding grounds for migratory birds and resident wildlife, as prescribed under Executive Order 7562. The Refuge is located about five miles south of the City of Willows. The Refuge, managed by the Service, provides wintering and resting areas for ducks, geese, and swans; and reduces waterfowl damage to crops on neighboring farms.

The Refuge is part of a group of refuges located in the Colusa Basin. The Colusa Basin is a drainage area extending from Stony Creek in the north to Cache Creek in the south, and between the Sacramento River on the east and the Coast Range Mountains on the west. Historically, flood waters from the Sacramento River and the east side of the Coast Range Mountains flooded the marshes in the Colusa Basin during the winter and spring. Flood control projects have minimized the flooding; however, wetland habitat does occur within the "Colusa Trough" and within flooded rice fields. Only small marsh areas occur near agricultural sumps that collect agricultural run-off. The Colusa Basin also includes Delevan NWR, and Colusa NWR, as well as numerous private hunting clubs. The clubs flood the marshes primarily during the hunting season.

The Refuge consists of permanent ponds, seasonal marshes, rice fields, and millet fields. Rice and millet are grown and left in the fields to be used as waterfowl food. The marshes also support sources of waterfowl food such as swamp timothy and invertebrate populations. The upland areas of the Refuge provide habitat for geese, upland birds, and other wildlife species. The amount of land used for fields, ponds, and upland uses varies depending upon the amount of water available each year.

A. WATER RESOURCES

The Refuge holds four appropriative water licenses to divert up to 60 cfs from Logan Creek. However, the rights are subject to depletion by other rights with higher priorities.

The Refuge also receives surplus Central Valley Project (CVP) water on an as-available basis from the Sacramento River. The CVP water is delivered through facilities owned and operated by Glenn-Colusa Irrigation District (GCID).

1. Surface Waters

Surplus CVP water is transported from the Sacramento River at the Red Bluff Diversion Dam through the Tehama-Colusa Canal (TCC) to the western Sacramento Valley. Diversions from the TCC provide water to the Wasteway Cross Channel and the Williams Outlet. The GCID conveys surplus CVP water through exchange agreements with the CVP to the Colusa Basin refuges.

Natural flows and surplus CVP water from the TCC or Black Butte Reservoir are conveyed to the Refuge by GCID. Black Butte Reservoir, located on Stony Creek approximately nine miles upstream of Orland, was constructed by the Corps of Engineers for flood control purposes. Water from Black Butte Reservoir is conveyed by GCID through Stony Creek which has high conveyance losses.

Stony Creek is not recognized under Contract No. 14-06-200-8181A with Reclamation as a point of delivery from the TCC. Reclamation has the option of providing that water from Stony Creek or from the Sacramento River via the TCC.

Under Contract 14-06-200-8181A, GCID conveys a maximum of 50,000 acre-feet/year of surplus CVP water to the Refuge. The contract allows up to a 25 percent conveyance loss. A pumping station at Hamilton City pumps water from the Sacramento River into the GCID Main Canal. Due to the configuration of the GCID lateral system, a portion of the water supplied by GCID is from agricultural return flows.

Agricultural return flows are currently diverted from Logan Creek under appropriative water rights acquired by the Refuge. The Refuge has four licenses that permit the diversion of up to 60 cfs from Logan Creek to supply 4,575 acres of the Refuge. The rights are subject to depletion by other water rights with earlier priority dates, and therefore, are not considered to be a dependable water supply. In addition, water may not be available from Logan Creek during July and August. Water quality in Logan Creek may be poorer during the late agricultural season due to the presence of agricultural return flows.

Winter water supply problems at the Refuge are affected by operation of the Red Bluff Diversion Dam, the TCC, and the GCID canals. The TCC has been used to provide surplus CVP water to GCID Main Canal during the winter months. During the past two years, the gates at the Red Bluff Diversion Dam have been raised from December through March to improve fish passage at the Red Bluff Diversion Dam. The gates at the Red Bluff Diversion Dam were raised to allow unimpeded movement of winter-run chinook salmon adults and downstream migration of juveniles. The opening of the gates is presently a year-to-year experiment with no commitment to a long-term operation. A study has been conducted by the Service (funded by Reclamation) to identify methods to improve passage of salmon and steelhead trout at the Red Bluff Diversion Dam. The Service is scheduled to submit a final report on the study to Reclamation by September 30, 1988. Reclamation will evaluate this study and release a report in 1989 detailing the actions to be taken.

Without use of the TCC, surplus CVP water must be provided to the GCID Main Canal from other sources, such as Black Butte Reservoir. Under existing contracts, surplus water must be first used to meet agricultural contracts. During the past two years when the Red Bluff Diversion Dam gates have been opened, all surplus water has been allocated to agricultural users.

2. Water Conveyance Facilities

The GCID Main Canal supplies water to the Refuge through Lateral 26-2 and Lateral 35-1C. The GCID Lateral 26-2 provides water by gravity flow to the northwest corner of the Refuge where the Refuge's west canal distributes water to the western and northern portions of the Refuge. However, the GCID Main Canal is dewatered at the end of November for maintenance.

Water also can be provided to the Refuge from the GCID Main Canal via Lateral 35-1C, as shown in Figure IVB-1. Water in Lateral 35-1C can be pumped into the Refuge's west canal or diverted to the Refuge at Dam 3. During previous winter seasons when water was provided through the TCC, the GCID has created a 10-mile long backwater pool in the GCID Main Canal to gain sufficient elevation to allow diversions into the lateral.

Water also can be supplied from Logan Creek through diversions at Diversion Dam 1 to serve the eastern portion of the Refuge when the GCID canals are dewatered or when insufficient natural flows occur. The flows in Logan Creek depend upon precipitation and upstream agricultural return flows and may vary significantly throughout the year. Additional diversions could be made from Logan Creek during the winter if Diversion Dams 2 and 3 were modified. Currently, these diversion dams are removed during flood periods and cannot be replaced until after the wet weather season ends.

The Refuge reuses water to maximize its water use and maintain circulation in the ponds. However, re-circulation is difficult without construction of several lift stations, return canals, and underground power lines to serve the lift stations. The water flows through three to four ponds prior to discharge to Logan Creek or other drainage facilities. Water that returns to Logan Creek from the northern portion of the Refuge can be re-diverted at Diversion Dams 2 and 3 for reuse on the southern portion. The Refuge receives a seven percent return-flow and water right credit from GCID to compensate for re-diverted flows. This credit is generally between 2,800 and 3,300 acre-feet per year.

3. Groundwater

The Refuge is located in low-lying alluvial plains and fans of the Coast Range Mountains underlain by the Tehama Formation. The southeastern portion is located within flood plain deposits of the Sacramento River flood basin. The groundwater is located within 10 to 25 feet of the ground surface. Based upon existing data, the water quality appears to be suitable for irrigation and waterfowl needs. The safe yield of the aquifer under the Refuge has been estimated by Reclamation to be 12,900 acre-feet.

Because of high power costs, groundwater is not currently used for water supply. Two wells were drilled on the Refuge in 1978. One well was drilled to a depth of 260 feet and produced 1,200 gpm. The other well was drilled to a depth of 195 feet and produced less than 500 gpm.

B. FORMULATION & EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 50,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IVB-1. Each of the water supply levels provide a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water supply needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

Because the Refuge does not have a firm water supply, no facilities are required.

2. Delivery Alternatives for Level 2 (46,400 acre-feet)

Alternatives developed for Level 2 would provide more reliable water conveyance facilities throughout the year. Alternatives 2A, 2B, and 2C would provide water if the GCID Main Canal is dewatered. Alternative 2D provides facilities to improve the reliability of winter water deliveries from GCID. Alternative 2E would provide wells to be used in a conjunctive use program.

Alternative 2A - Construct Pipeline from Tehama-Colusa Canal. A five-mile, 100 cfs pipeline would be constructed from the TCC to the northwest corner of the Refuge. This canal would be used to convey both summer and winter water. If water was available from Black Butte Reservoir, water would be conveyed through the Orland Project's South Canal and Lateral 40 to the TCC.

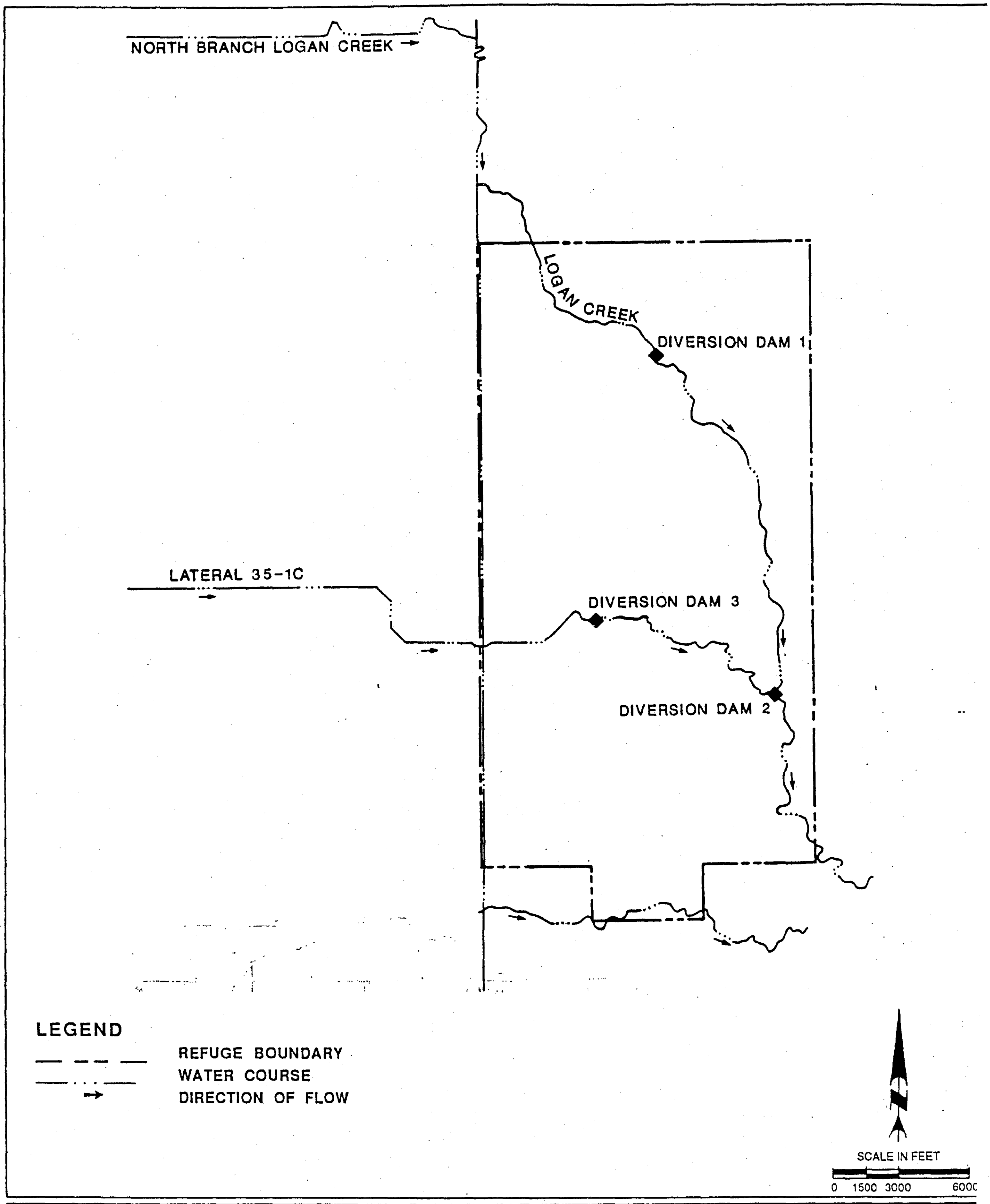


FIGURE IV B-1

SACRAMENTO NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

TABLE IV B-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE SACRAMENTO NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	1,200	1,250	1,250
February	0	1,200	1,250	1,250
March	0	300	1,250	1,250
April	0	300	300	300
May	0	2,100	2,250	2,250
June	0	2,600	2,750	2,750
July	0	4,000	4,200	4,200
August	0	6,300	6,700	6,700
September	0	7,500	7,900	7,900
October	0	9,300	9,850	9,850
November	0	8,300	8,800	8,800
December	0	3,300	3,500	3,500
Total	0	46,400	50,000	50,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d

Alternative 2B - Deliver CVP Water through Kanawha Water District. CVP water would be delivered from the TCC through the Kanawha Water District Laterals 5-5 and 6-5 to the north branch of Logan Creek which would convey the water under Interstate Highway 5, the frontage road, and the Southern Pacific Railroad tracks. A pipeline would be constructed from the terminus of the north branch of Logan Creek to the northwest corner of the Refuge, as shown in Figure IV B-2. Six turnouts would be enlarged on the Kanawha Water District laterals and a pump station would be constructed at the Refuge. This alternative would provide winter water to the Refuge when the GCID Main Canal is dewatered, and would require a conveyance agreement with Kanawha Water District for winter water deliveries. During the summer, the Refuge would receive water from GCID.

Alternative 2C - Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal. CVP water would be conveyed through the Kanawha Water District Lateral 6-5 which would discharge to a new pipeline and pump station which would convey water to the refuge. A pump station would be constructed to transport water onto the Refuge. This alternative would provide winter water to the Refuge when the GCID Main Canal is dewatered, and would require a conveyance agreement with Kanawha Water District for winter water deliveries. During the summer, the Refuge would receive water from GCID.

Alternative 2D - Deliver CVP Water from Tehama-Colusa Canal to Glenn-Colusa Irrigation District Lateral 35-1C. CVP water would be conveyed from TCC through the GCID Main Canal to the GCID Lateral 35-1C. The water requirements for this alternative would be higher than for the other alternative plans because the total volume of water must include a 10-mile long backwater pool in the GCID Main Canal that would allow gravity diversion of water into the GCID Lateral 35-1C.

Water would flow by gravity from the GCID Lateral 35-1C to serve the southeastern portions. Water would be pumped from the GCID Lateral 35-1C to the Refuge's west canal to serve the southwestern portions of the Refuge. The capacity of the GCID Lateral 35-1C would be increased from 25 cfs to 90 cfs. To increase the capacity of the GCID Lateral 35-1C, a 30-inch diameter reinforced concrete pipe (RCP) culvert and two 36-inch diameter RCP culverts at road crossings would be replaced with 42-inch diameter culverts to eliminate the hydraulic restrictions, as shown in Figure IV B-2. In addition, the lower portions of the GCID Lateral 35-1C would be cleaned.

This alternative would provide winter water to the Refuge when the GCID Main Canal is dewatered. During the summer, the Refuge would also would receive water from GCID.

Alternative 2E - Implement a Conjunctive Use Plan. Fifty-nine wells would be constructed on the Refuge to deliver the maximum

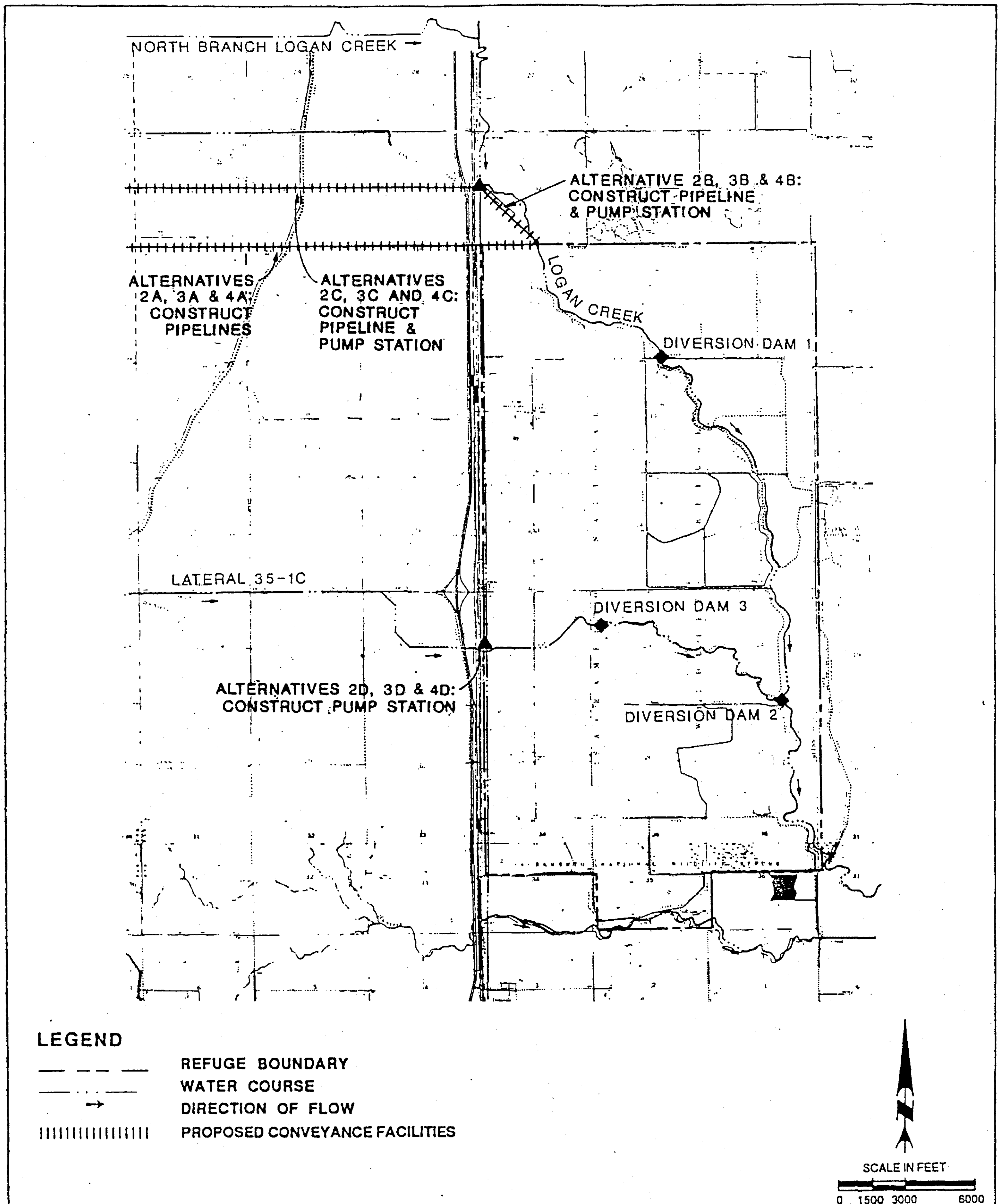


FIGURE IV B-2

SACRAMENTO NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

month water demand. The exact locations of the wells on the Refuge would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternatives 2A, 2B, 2C, or 2D.

3. Delivery Alternatives for Level 3 (50,000 acre-feet)

Water deliveries under Level 3 are similar to Level 2. Therefore, the same alternatives considered for Level 2 were evaluated for Level 3.

Alternative 3A - Construct Pipeline from Tehama-Colusa Canal. This alternative is identical to Alternative 2A.

Alternative 3B - Deliver CVP Water through Kanawha Water District. This alternative is identical to Alternative 2B.

Alternative 3C - Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal. This alternative is identical to Alternative 2C.

Alternative 3D - Deliver CVP Water from Tehama-Colusa Canal to Glenn-Colusa Irrigation District Lateral 35-1C. This alternative is identical to Alternative 2D.

Alternative 3E - Implement a Conjunctive Use Plan. Sixty-two wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative would be similar to Alternative 2E.

4. Delivery Alternatives for Level 4 (50,000 acre-feet)

Water Supply Level 4 is equal to Level 3. Therefore, the alternatives for Level 4 would be the same as discussed under Levels 3 and 4.

Alternative 4A - Construct Pipeline from Tehama-Colusa Canal. This alternative is identical to Alternative 2A.

Alternative 4B - Deliver CVP Water through Kanawha Water District. This alternative is identical to Alternative 2B.

Alternative 4C - Construct Pipeline to Transport CVP Water from Tehama-Colusa Canal. This alternative is identical to Alternative 2C.

Alternative 4D - Deliver CVP Water from Tehama-Colusa Canal to Glenn-Colusa Irrigation District Lateral 35-1C. This alternative is identical to Alternative 2D.

Alternative 4E - Implement a Conjunctive Use Plan. Sixty-two wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative would be similar to Alternative 2E.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1 because no firm water supply exists.

Alternatives 2A, 3A, and 4A would provide water throughout the year without pumping and through Refuge-owned facilities. Alternatives 2B and 2C, Alternatives 3B and 3C, and Alternatives 4B and 4C would convey water to the Refuge during the winter through Kanawha Water District facilities and during the summer through GCID facilities. These alternatives would require pumping of the water onto the Refuge. Alternatives 2D, 3D, and 4D would convey water to the Refuge through GCID facilities during both summer and winter. Alternatives 2A through 2D, Alternatives 3A through 3D, and Alternatives 4A through 4E would convey winter water from TCC. The winter water would be pumped from the Sacramento River at Red Bluff or possibly surplus water from Black Butte Reservoir.

Alternatives 2E, 3E, and 4E would provide wells to be used during during dry years when CVP water may not be available. This alternative would cause overdraft conditions because the water needs would exceed the safe yield under the Refuge. These alternatives also would require implementation of surface water alternatives (Alternatives 2A, 2B, 2C, and 2D; Alternatives 3A, 3B, 3C, and 3D; and Alternatives 4A, 4B, 4C, and 4D).

Alternatives 2B, 2C, and 2D; Alternatives 3B, 3C, and 3D; and Alternatives 4B, 4C, and 4D would require long-term conveyance agreements with irrigation districts to transport water to the Refuge. Alternatives 2B and 2C, Alternatives 3B and 3C, and Alternatives 4B and 4C would require winter operation of Kanawha Water District facilities. Alternatives 2D, 3D, and 4D would require winter operation of the GCID facilities.

C. COST & ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Levels 2, 3, and 4 are presented in Table IV B-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in the economy of Glenn and

TABLE IV B-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SACRAMENTO NWR

Items	Alternatives 2A	2B	2C	2D	2E
Additional Water (ac-ft)	46,400	46,400	46,400	46,400	46,400
Construction Cost					
Wells	$ --	$ --	$ --	$ --	$3,304,000 (i)
Diversion Structures	17,000 (a)	60,000 (c)	--	--	--
Pipelines/Canals	1,923,500 (b)	100,300 (d)	448,300 (f)	65,500 (g)	--
Pump Stations	--	161,000 (e)	161,000 (e)	105,000 (h)	--
Subtotal	$1,940,500	$321,300	$609,300	170,500	$3,304,000
Other Costs	--	--	--	--	1,940,500 (j)
Total	$1,940,500	$321,300	$609,300	$170,500	$5,244,500
Annualized Construction Cost (8.87%, 30 yrs)	$ 186,680	$ 30,900	$ 58,620	$ 16,400	$ 504,520
Additional Annual Costs					
Operation & Maintenance (k)	$ 10,000	$ 3,500	$ 3,600	$ 2,500	$ 112,000 (n)
Power	--	14,300 (l)	14,300 (l)	14,300 (l)	278,400 (m,n)
Local Conveyance Cost (o)	--	69,600	69,600	69,600	--
Subtotal	$ 10,000	$ 87,400	87,500	86,400	390,400
Other Costs	--	--	--	--	5,000 (j,m)
Total	$ 10,000	$ 87,400	87,500	86,400	$ 395,400
Total Annual Costs	$ 196,680	$118,300	$146,120	$102,800	$ 899,920
Cost/Additional Acre-Foot	$ 4.30	$ 2.60	$ 3.20	$ 2.20	$ 19.40

TABLE IV B-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SACRAMENTO NWR

(Continued)

Items	Alternatives				
	3A & 4B	3B & 4B	3C & 4C	3D & 4D	3E & 4E
Additional Water (ac-ft)	50,000	50,000	50,000	50,000	50,000
Construction Costs					
Wells	$ ---	$ ---	$ ---	$ ---	$3,472,000(p)
Diversion Structures	17,000(a)	60,000(c)	---	---	---
Pipelines/Canals	1,923,500(b)	100,300(d)	448,300(f)	655,500(g)	---
Pump Stations	---	161,000(e)	161,000(e)	105,000(h)	---
Subtotal	$1,940,500	$321,300	$609,300	$160,500	$3,472,000
Other Costs	---	---	---	---	1,940,500(j)
Total	$1,940,500	$321,300	$609,300	$160,500	$5,412,500
Annualized Construction Cost (8.87%, 30 yrs)	$ 186,680	$ 30,900	$ 58,620	$ 15,440	$ 520,680
Additional Annual Costs					
Operation & Maintenance(k)	$ 10,000	$ 3,500	$ 3,600	$ 2,500	$ 118,000(m)
Power	---	16,050(l)	16,050(l)	16,050(l)	300,000(m,n)
Local Conveyance Cost(o)	---	75,000	75,000	75,000	---
Subtotal	$ 10,000	$ 94,550	94,650	93,550	$ 418,000
Other Costs	---	---	---	---	5,000(j,m)
Total	$ 10,000	$ 94,550	$ 94,650	$ 93,550	$ 423,000
Total Annual Costs	$ 196,680	$125,450	$153,270	$108,990	$ 943,680
Cost/Additional Acre-Foot	$ 3.90	$ 2.50	$ 3.10	$ 2.20	$ 18.90

TABLE IV B-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SACRAMENTO NWR

(Continued)

Notes:

Alternatives 2A, 3A, 4A:	Construct Pipeline from Tehama - Colusa Canal
Alternatives 2B, 3B, 4B:	Deliver CVP Water through Kanawha Water District
Alternatives 2C, 3C, 4C:	Construct Pipelines to Transport CVP Water from Tehama - Colusa Canal
Alternatives 2D, 3D, 4D:	Deliver CVP Water from Tehama - Colusa Canal to GCID Lateral 35-1C
Alternatives 2E, 3E, 4E:	Implement a Conjunctive Use Plan

(a) 100 cfs turnout on TCC.

(b) 26,400-feet, 54-inch diameter pipeline.

(c) Six turnouts on Kanawha Water District laterals.

(d) 3,800 feet long, 18-inch diameter pressure pipeline.

(e) 60 cfs, 7-foot lift pump.

(f) 13,200 foot, 24-inch diameter pressure pipeline.

(g) Enlarge 6,600-feet of Lateral 35-1C to 60 cfs, including three 42-inch diameter siphons.

(h) 20 cfs, 10-foot lift pump to lift water into GCID Lateral 35-1C.

(i) 59 wells, 400-feet deep, 100-foot lift.

(j) Alternative 2E assumes implementation of Alternative 2A, Alternative 3E assumes implementation of Alternative 3A, and Alternative 4E assumes implementation of Alternative 4A.

(k) Basis for O&M costs are discussed in Appendix F.

(l) Unit Pumping Cost = $1.00/af; only for winter water.

(m) Values were multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(n) Unit Pumping Cost = 12.00/af.

(o) Unit Conveyance Cost = $1.50/af.

(p) 62 wells, 400-feet deep, 100-foot lift.

Colusa Counties during the construction period. The construction could be completed within one summer season by construction workers who reside within the area.

Because all of the Refuge is developed, the additional water would not increase public use levels significantly. Therefore, the economy of the surrounding communities would not be impacted by the alternatives. However, if no water is provided (Level 1) the existing vegetation will die and the waterfowl use will decrease, therefore public use will decrease significantly.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 56,024,000 use-days based upon census data from 1987. Approximately 77 and 18 percent of the bird use are by ducks and geese, respectively. Fish and wildlife resources associated with the Refuge are presented in Table IV B-3. The listed threatened and endangered species associated with the Refuge are the bald eagle, <u>Haliaeetus leucocephalus</u>; peregrine falcon, <u>Falco peregrines anatum</u>; Aleutian Canada goose, <u>Branta canadensis leucopareia</u>; and valley elderberry longhorn beetle, <u>Desmocerus californicus dimorphus</u>. Candidate species associated with the Refuge include the white-faced ibis, <u>Plegadis chichi</u>; tricolored blackbird, <u>Agelaius tricolor</u>; and California hibiscus, <u>Hibiscus californicus</u>, as listed in Table IV B-4.

The alternative plans would provide a dependable water supply throughout the Refuge which is nearly totally developed. Therefore, the water would be used to improve habitat and not to develop additional wetlands. The improved habitat would increase the number of bird use-days, as indicated in Table IV B-5.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species of birds and would improve habitat that could be used by the white-faced ibis and Aleutian Canada goose. No additional lands would be flooded; therefore, upland species would probably not be adversely affected. Detailed field investigations would be required during the advanced planning phase of the project. Implementation of a plan would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat and associated recreation and wildlife use. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to continued public use.

TABLE IV B-3

FISH AND WILDLIFE RESOURCES

SACRAMENTO NWR

Ducks

Hooded Merganser	Blue-Winged Teal[a]	Common Merganser[a]
Mallard[a]	Northern Shoveler[a]	Ring Necked Duck
Gadwall[a]	Pintail[a]	Common Goldeneye
European Wigeon	Wood Duck[a]	Greater Scaup
American Wigeon	Redhead[a]	Lesser Scaup
Green winged Teal[a]	Canvasback	Buffle Head
Cinnamon Teal[a]	Ruddy Duck[a]	

Geese and Swans

Snow Goose	White-fronted Goose	Cackling Canada Goose
Ross' Goose	Canada Goose	Lesser Canada Goose
Tundra Swan		

Coots

American Coot[a]

Shore and Wading Birds

Western Grebe[a]	Virginia Rail[a]	Common Snipe
Eared Grebe	Sora[a]	Long-billed Dowitcher
Pied-billed Grebe[a]	Common Gallinule[a]	Least Sandpiper
Double-crested Cormorant	Ring-billed Gull	Dunlin
White Pelican	Caspian Tern[a]	Western Sandpiper
American Bittern[a]	Forster's Tern	Greater Yellowlegs
Least Bittern[a]	Black Tern[a]	Long-billed Curlew
Great Blue Heron[a]	Wilson's Phalarope	Killdeer[a]
Great (common) Egret[a]	Green-backed Heron[a]	Greater Sandhill Crane
Snowy Egret[a]	American Avocet	Black-crowned Night Heron[a]
	Black-Necked Stilt	

TABLE IV B-3

FISH AND WILDLIFE RESOURCES

SACRAMENTO NWR
(Continued)

Upland Game

Ringed-necked Pheasant[a]	Rock Dove	Mourning Dove[a]
California Quail[a]		

Raptorial Birds

Turkey Vulture	Black-shouldered Kite[a]	Marsh Hawk
Sharp-shinned Hawk[a]	Cooper's Hawk[a]	Red-tailed Hawk[a]
Rough-legged Hawk	American Kestrel[a]	Barn Owl[a]
Great Horned Owl[a]	Red Shouldered Hawk[a]	Golden Eagle

Fish

Steelhead Trout	Salmon	Largemouth Bass
Catfish	Black Crappie	

Furbearers

Opossum	Gray Fox	Coyote
Raccoon	Beaver	Mink
Skunk	Muskrat	

Others

Black-tailed Deer		

Notes:

(a) Birds nesting on refuge

Source: USFWS computerized annual printout for NWR Birds, Department of Interior, USFWS (RF11650-2 9-79) (July 1973 to June 1974, NWRS Public Use Report (1)) and refuge records.

TABLE IV B-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

SACRAMENTO NWR

Listed Species

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (E)
Bald Eagle, *Haliaeetus leucocephalus* (E)
Peregrine Falcon, *Falco peregrines* (E)

Invertebrates

Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds

White-faced ibis, *Plegadis chihi* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Plants

California hibiscus, *Hibiscus californicus* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV B-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

SACRAMENTO NWR

	No Action Alternative	Alternatives				
		2A	2B	2C	2D	2E
Habitat Acres						
Permanent Pond	--	115	115	115	115	115
Seasonal Marsh	--	6,180	6,180	6,180	6,180	6,180
Watergrass	--	565	565	565	565	565
Rice	--	287	287	287	287	287
Bird Use Days						
Ducks	--	41,789,000	41,789,000	41,789,000	41,789,000	41,789,000
Geese	--	12,247,000	12,247,000	12,247,000	2,247,000	12,247,000
Waterbirds	--	1,988,000	1,988,000	1,988,000	1,988,000	1,988,000
Endangered Species	--	300	300	300	300	300
Total	--	56,024,300	56,024,300	56,024,300	56,024,300	56,024,300
Public Use Days						
Consumptive	--	6,300	6,300	6,300	6,300	6,300
Non-Consumptive	--	32,900	32,900	32,900	32,900	32,900
Total	--	39,200	39,200	39,200	39,200	39,200
Total Annual Cost	$--	$ 196,680	$ 118,300	$ 146,120	$ 102,800	$ 899,920
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 3.50	$ 2.10	$ 2.60	$ 1.80	$ 16.10
Incremental Cost/Additional Public Use Day	N/A	$ 5.00	$ 3.00	$ 3.70	$ 2.60	$ 23.00

TABLE IV B-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

SACRAMENTO NWR
(Continued)

	Alternatives				
	3A & 4A	3B & 4B	3C & 4C	3D & 4D	3E & 4E
Habitat Acres					
Permanent Pond	125	125	125	125	125
Seasonal Marsh	6,200	6,200	6,200	6,200	6,200
Watergrass	600	600	600	600	600
Rice	300	300	300	300	300
Bird Use Days					
Ducks	42,450,000	42,450,000	42,450,000	42,450,000	42,450,000
Geese	12,380,000	12,380,000	12,380,000	12,380,000	12,380,000
Waterbirds	2,020,000	2,020,000	2,020,000	2,020,000	2,020,000
Endangered Species	300	300	300	300	300
Total	56,850,300	56,850,300	56,850,300	56,850,300	56,850,300
Public Use Days					
Consumptive	6,500	6,500	6,500	6,500	6,500
Non-Consumptive	33,000	33,000	33,000	33,000	33,000
Total	39,500	39,500	39,500	39,500	39,500
Total Annual Cost	$ 196,680	$ 125,450	$ 153,270	$ 108,990	$ 943,680
Incremental Cost/Additional 1000 Bird Use Days	$ 3.50	$ 2.20	$ 2.70	$ 1.90	$ 16.60
Incremental Cost/Additional Public Use Day	$ 5.00	$ 3.20	$ 3.90	$ 2.80	$ 23.90

Notes:

Alternatives 2A, 3A, 4A:	Construct Pipeline from Tehama - Colusa Canal.
Alternatives 2B, 3B, 4B:	Deliver CVP water through Kanawha Water District.
Alternatives 2C, 3C, 4C:	Construct Pipeline to transport CVP water from Tehama - Colusa Canal.
Alternatives 2D, 3D, 4D:	Deliver CVP water from Tehama - Colusa Canal to GCID Lateral 35-C.
Alternatives 2E, 3E, 4E:	Implement a Conjunctive Use Plan.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver the CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Glenn and Colusa Counties would issue permits for construction of wells under Alternatives 2E, 3E, and 4E. The counties also would issue permits for construction along streams and roads to ensure that existing drainage facilities would not be adversely affected. If water is transferred through the north branch of Logan Creek under Alternatives 2B or 2C, Alternatives 3B or 3C, or Alternatives 4B or 4C, approvals would be required from the California Department of Water Resources, State Water Resources Control Board, and DFG. A Corps of Engineers permit would be required for construction in wetlands. Approvals from GCID would be required for construction under Alternatives 2D, Alternatives 3D, and Alternatives 4D.

CHAPTER IV C

DELEVAN NATIONAL WILDLIFE REFUGE

Delevan National Wildlife Refuge (Refuge) was authorized in 1962 under the Migratory Bird Conservation Commission. Initially, 5,583 acres were purchased with Migratory Bird Hunting Stamp Act funds. In 1963, an additional 80 acres were acquired with the same funds. The land was purchased as a refuge and breeding ground for migratory birds and wildlife. The Refuge is located about seven miles east of Maxwell in Colusa County, to the east of Interstate Highway 5 and to the west of the Sacramento River. The Refuge, which is managed by the Service, is part of a group of refuges located in the Colusa Basin, as discussed in Chapter IV B. The Refuge is located midway between the Sacramento and Colusa NWR's, and provides wintering and resting areas for ducks and geese and reduces waterfowl damage to crops on neighboring farms.

The Refuge consists of permanent ponds, rice, millet fields, seasonal marshes, and irrigated pasture. The irrigated pasture is a feeding area for geese. The wetlands also support sources of waterfowl food such as swamp timothy and invertebrate populations. The upland areas of the Refuge provide habitat for geese, upland birds, and other wildlife species. The amount of land used for fields, ponds, and upland uses varies each year depending upon water availability.

A. WATER RESOURCES

The Refuge has no firm water supply, and currently only receives surplus Central Valley Project (CVP) water.

1. Surface Waters

The Refuge receives surplus CVP water through Glenn-Colusa Irrigation District (GCID). The Refuge used to receive surplus water from Maxwell Irrigation District; however, this water supply has not been used since 1979 due to poor water quality.

The GCID conveys CVP water to the Colusa Basin refuges, as discussed in Chapter IVB. A portion of the water supplied by GCID is from agricultural return flows. Under Contract 14-06-200-8181A with Reclamation, GCID conveys a maximum of 30,000 acre-feet to the Refuge. The contracts provide for a 25 percent conveyance loss. Quality of the water delivered by GCID appears to be suitable for refuge irrigation under most conditions. Agricultural return flows are generally of poorer quality than fresh water especially when flows are reused several times before being delivered to the Refuge.

When GCID dewaters their system in the winter, CVP water is transported through the Tehama-Colusa Canal (TCC) to the Wasteway Cross Channel. The Wasteway Cross Channel is used to divert water to the GCID facilities that serve the Refuge.

Reclamation District 2047 was formed in 1919 to construct a master drain, known as the Colusa Basin Drainage Canal or the 2047 Drain. The 2047 Drain conveys agricultural return flows to an area south of Willows making refuge deliveries possible. In the winter, the 2047 Drain transports stormwater runoff from the Colusa Basin.

The Refuge could apply to the State Water Resources Control Board for a permit to divert water from the 2047 Drain from September through June; however, the appropriation would be subject to prior appropriations. Therefore, only surplus water would be available. Quality of water in the 2047 Drain in the summer is influenced by the quality of agricultural return flows. Previous water quality analyses have detected DDT and toxaphene at concentrations above National Academy of Science action levels (SWRCB, 1984). During the winter, the quality of the 2047 Drain water appears to be adequate for the Refuge.

Water supply problems also occur due to the shutdown of the TCC and the GCID Main Canal during the winter, as discussed in Chapter IV B. Without the water from the TCC, water must be provided to the GCID Main Canal from other sources, such as Black Butte Reservoir. Winter water could be provided to the Refuge from the 2047 Drain if unappropriated water could be obtained and a pump was constructed.

2. Water Conveyance Facilities

During most of the year, GCID conveys water from the GCID Hamilton City Pumps through the GCID Main Canal to the Refuge. The water is tranferred from the GCID Main Canal to Hunters Creek and diverted into the Refuge near the northwest corner through Hunters Creek No. 2 Weir, as shown in Figure IV C-1. This weir is used to back-up water in Hunters Creek for diversion to the Refuge. During irrigation season, Hunters Creek also conveys agricultural return flows.

In the winter when the GCID Main Canal is dewatered, water from the TCC has been conveyed through the Wasteway Cross Channel to the GCID Main Canal. The water is transferred to Hunters Creek and diverted to the Refuge through the No. 2 Weir. During floods, GCID may remove the weir structure to allow passage of the floodwaters. The weir is generally not replaced until the spring when the water levels have receded.

Approximately 385 acres of land along the southeastern boundaries (Tracts 25, 31, 35, and 41) are hydraulically separated

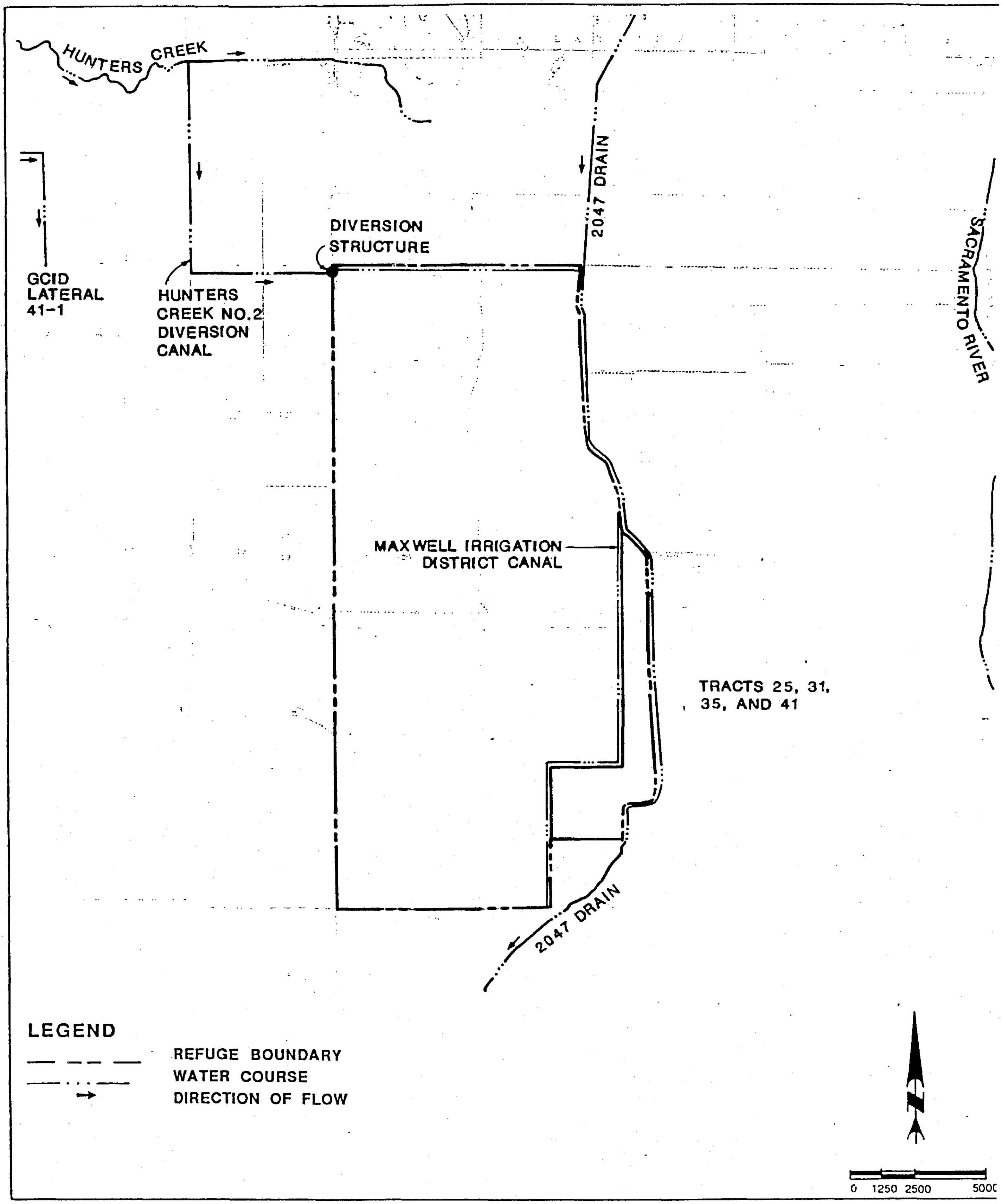


FIGURE IV C-1

DELEVAN NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

from the rest of the Refuge water delivery system by the Maxwell Irrigation District Canal. This area is currently undeveloped due to lack of a water supply and distribution facilities.

The Refuge conveyance system is in relatively good condition, but allows for little reuse of water. The main delivery ditches on the northern and eastern boundaries need to be improved to increase conveyance capacity. Additional maintenance work is needed to repair levees and ditches which are damaged during periodic flooding.

3. Groundwater

The Refuge is located on flood plain deposits of the Sacramento River flood basin which is underlain by the Tehama Formation. No wells currently exist on the Refuge. However, shallow wells in the vicinity of the Refuge have produced less than 400 gpm and have experienced significant drawdowns. Wells drilled to depths of more than 400 feet may enter the Tehama Formation aquifer and could produce up to 1,000 gpm. Based upon existing data, the water quality appears to be suitable for irrigation and waterfowl needs. The safe yield of the aquifer under the Refuge has been estimated by Reclamation to be 6,800 acre-feet.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 30,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified by the Service, as presented in Table IV C-1. Each of the water supply levels provide a different rate and volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

Because the Refuge does not have a firm water supply, no facilities are required.

2. Delivery Alternatives for Level 2 (20,950 acre-feet)

Alternatives 2A, 2B, and 2C have been developed to increase the dependability of the GCID water deliveries, especially during

TABLE IV C-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE DELEVAN NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	1,650	1,200	2,375
February	0	1,300	600	1,875
March	0	450	600	625
April	0	100	800	125
May	0	450	1,000	625
June	0	900	2,400	1,250
July	0	1,550	3,200	2,250
August	0	2,200	3,200	3,125
September	0	3,050	4,000	4,325
October	0	4,350	2,000	4,375
November	0	3,050	2,000	4,375
December	0	2,900	4,000	4,675
Total	0	20,950	25,000	30,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d and 1986e

the winter months. Alternatives 2B and 2C were developed assuming that winter water would be provided to the GCID Main Canal.

Alternative 2A - Convey Water from Sacramento NWR. A pump station and 13,200-foot long pipeline would be constructed from the Sacramento NWR to the Refuge. Water would be conveyed to the Sacramento NWR as discussed in Chapter IV B. The pipeline would be constructed across agricultural fields. Rights-of-ways would be required for the pipeline alignment.

Alternative 2B - Construct Cross-over on Glenn-Colusa Irrigation District Lateral 41-1. A cross-over, or crosstie, ditch would be constructed to allow delivery of water to the northwestern corner of the Refuge from the GCID Main Canal when the flashboards in the Hunters Creek No. 2 Weir are removed. Water would be diverted from the TCC through the Wasteway Cross Channel to the GCID Main Canal and into GCID Lateral 41-1. A 5,250-foot long ditch and two siphons would be constructed from the GCID Lateral 41-1 to the existing ditch that conveys water from Hunters Creek No. 2 Diversion Canal to the Refuge, as shown in Figure IV C-2. The new ditch would bypass the Hunters Creek No. 2 Diversion Canal. This alternative also would reduce the need for use of waters in Hunters Creek during the late summer and fall months.

Alternative 2C - Improve Hunters Creek No. 2 Diversion Weir. Water would be delivered to the GCID Main Canal and diverted to Hunters Creek. A radial gate would be installed at Hunters Creek No. 2 Weir to allow continued operation of the weir during the winter. The radial gate could be easily opened to allow passage of flood flows and then closed even if water is present in the canal. This alternative also may be implemented if GCID dewaters the Main Canal because water can be diverted directly from the TCC to Hunters Creek if a turnout is constructed.

Alternative 2D - Implement a Conjunctive Use Plan. Twenty-eight wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells on the Refuge would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternatives 2A, 2B, or 2C.

Delivery Alternatives for Level 3 (25,000 acre-feet)

Water deliveries under Level 3 are similar to the Level 2 deliveries. The same alternatives considered for Level 2 were evaluated for Level 3.

Alternative 3A - Convey Water from the Sacramento NWR. This alternative is identical to Alternative 2A.

Alternative 3B - Construct Cross-over on Glenn-Colusa Irrigation District Lateral 41-1 This alternative is identical to Alternative 2B.

Alternative 3C - Improve Hunters Creek No. 2 Diversion Weir. This alternative is identical to Alternative 2C.

Alternative 3D - Implement a Conjunctive Use Plan. Twenty-eight wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative is similar to Alternative 2D, and would require implementation of Alternatives 3A, 3B, or 3C.

4. Delivery Alternatives for Level 4 (30,000 acre-feet)

Surface drainage from the main portion of the Refuge to Tracts 25, 31, 35, and 41 is blocked by the Maxwell Irrigation District Canal. Due to a lack of water, this southeastern portion of the Refuge is currently not developed. The alternatives for Level 4 provide for conveyance of water to this undeveloped area.

Alternative 4A - Construct Pump Station on the 2047 Drain. A 25 cfs pump station would be constructed on the Reclamation District 2047 Drain. The pump station would transfer water from the 2047 Drain directly to the southeastern portion of the Refuge. A weir also would be required to ensure pump operation during low flow periods. The water delivered under this alternative would consist of CVP water co-mingled with agricultural return flows. Therefore, the water would be of lesser quality than 100-percent CVP water, but adequate for the refuge uses.

Alternative 4B - Construct Siphons Under the Maxwell Irrigation District Canal. To allow water to flow to the southeastern portion of the Refuge, three siphons would be constructed under the Maxwell Irrigation District Canal at the natural drainage courses. This alternative would maximize reuse of flows from the northern portions of the Refuge. Under this alternative, CVP water would be provided to the Refuge in the winter through facilities described in Alternatives A or B.

Alternative 4C - Implement a Conjunctive Use Plan. Thirty wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative is similar to Alternative 2D, and would require implementation of Alternatives 3A, 3B, or 3C and Alternatives 4A, 4B, or 4C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1 because the Refuge does not have a firm water supply.

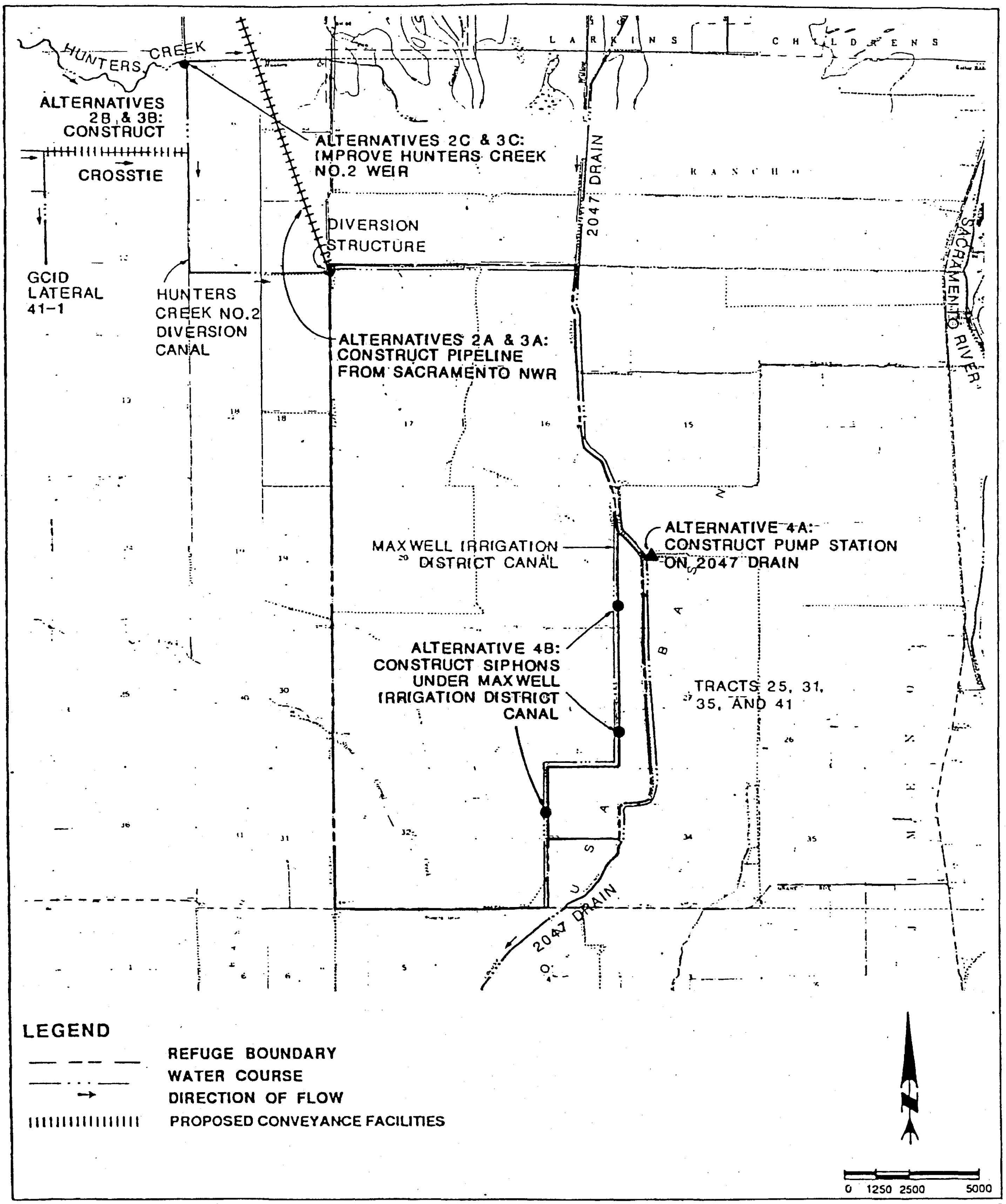


FIGURE IV C-2

DELEVAN NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

Alternatives 2A and 3A would maximize the use of water allocated to Sacramento NWR and minimize the need to use GCID facilities during the winter. Alternatives 2B and 2C and Alternatives 3B and 3C would provide winter water when the Hunters Creek No. 2 Weir is opened. All of these alternatives assume that winter water will be provided to the TCC from the Red Bluff Diversion Dam or surplus water from Black Butte Reservoir. Alternatives 2B and 2C and Alternatives 3B and 3C would require long-term contracts with GCID.

Alternatives 4A and 4B would provide water to the undeveloped southeastern portion of the Refuge. Alternative 4B would have lower operating costs than Alternative 4A because Alternative 4B would not require construction and operation of additional lift stations. Alternative 4B also would allow water from the main part of the Refuge to be reused in the southeastern portion. The quality of water from the main part of the Refuge (Alternative 4B) may be of a better quality than water from the 2047 Drain (Alternative 4A) which contains agricultural return flows during portions of the year. Alternatives 4A and 4B would require implementation of Alternatives 3A, 3B, or 3C.

Alternatives 2D, 3D, and 4C would provide wells to be used during during dry years when CVP water may not be available. This alternative would cause overdraft conditions because the water needs would exceed the safe yield under the Refuge. Alternative 2D would require implementation of Alternatives 2A, 2B, or 2C. Alternative 3C would require implementation of Alternatives 3A, 3B, or 3C. Alternative 4C would require implementation of Alternatives 3A, 3B, or 3C as well as Alternatives 4A or 4B.

C. COSTS AND ECONOMICS ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Levels 2, 3, and 4 are presented in Table IV C-2. The construction costs include factors to cover engineering, contingencies, and overhead costs. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in the economy of Colusa County during the construction period. The construction could be completed within one summer season by construction workers who reside within the area.

Currently, the annual public use (Level 2) at the Refuge is about 7,800 visits per year. If additional water is provided the public use levels are not anticipated to increase.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately

TABLE IV C-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

DELEVAN NWR

Items	Alternatives										
	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C
Additional Water (ac-ft)	20,950	20,950	20,950	20,950	25,000	25,000	25,000	25,000	30,000	30,000	30,000
Construction Costs											
Wells	$ ---	$ ---	$ ---	$1,439,200(d)	$ ---	$ ---	$ ---	$1,439,200(d)	$ ---	$ ---	$1,545,000(i)
Diversion Structures	---	---	225,000(c)	---	---	---	225,000(c)	---	---	---	---
Pipelines/Canals	567,200(a)	153,400(b)	---	---	567,200(a)	$153,400(b)	---	---	---	21,000(h)	---
Pump Stations	---	---	---	---	---	---	---	---	120,000(f)	---	---
Subtotal	$567,200	$153,400	$225,000	$1,439,200	$567,200	$153,400	$225,000	$1,439,200	$120,000	$21,000	1,545,000
Other Costs	---	---	---	567,200(e)	---	---	---	567,200(e)	567,200(g)	567,200(g)	588,200(j)
Total(l)	$567,200	$153,400	$225,000	$2,006,400	$567,200	$153,400	$225,000	$2,006,400	687,200	588,200	2,133,200
Annualized Construction Cost (3.87%, 30 yrs)	$54,570	$ 14,760	$ 21,650	$ 193,020	$ 54,570	$ 14,760	$ 21,650	$ 193,020	$ 66,110	$56,590	$ 205,220
Operation & Maint.(k)	$ 2,850	$ 3,070	$ 1,100	$ 48,900	$ 2,850	$ 3,070	$ 1,100	$ 48,900	$ 1,100	$ 2,110	$ 52,500
Power	---	---	500(m)	125,700(n,o)	---	---	500(m)	$ 150,000(n,o)	5,000(p)	---	180,000(n,o)
Local Conveyance Cost(q)	---	31,430	31,420	---	---	37,500	37,500	---	7,500	7,500	---
Subtotal	$ 2,850	$ 34,500	$ 33,020	$ 174,600	$ 2,850	$ 40,570	$ 39,100	$ 198,900	$ 13,600	$ 9,610	$ 232,500
Other Costs	---	---	---	1,430(e,o)	---	---	---	$ 1,430(j,o)	2,850(g)	2,850(h)	6,230(e,o)
Total(l)	$ 2,850	$ 34,500	$ 33,020	$ 176,030	$ 2,850	$ 40,560	$ 39,100	$ 200,330	$ 16,450	$12,460	$ 238,730
Total Annual Costs	$57,420	$ 49,260	$ 54,670	$ 369,050	$ 57,420	$ 55,330	$ 60,750	$ 393,350	$ 82,560	$69,050	$ 443,950
Cost/Additional Acre/Foot	$ 2.80	$ 2.40	$ 2.60	$ 17.70	$ 2.30	$ 2.20	$ 2.40	$ 15.80	$ 2.80	$ 2.30	$ 14.80

Notes: Alternatives 2A and 3A - Convey Water from Sacramento NWR.
Alternatives 2B and 3B - Construct Cross-over on Glenn-Colusa Irrigation District Lateral 41-1.
Alternatives 2C and 3C 2D, 3D, 4C - Implement a Conjunctive Use Plan.
Alternative 4A - Construct Pump Station on 2047 Drain.
Alternative 4B - Construct Siphons under the Maxwell Irrigation District Canal.

TABLE IV C-2
SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES
DELEVAN NWR
(Continued)

(a) 13,200-foot long, 30-inch diameter pressure pipeline; 3 siphons
(b) 5,250-foot canal, 120 cfs; including eight 48-inch diameter, 80-foot long siphons.
(c) Radial gate.
(d) 28 wells, 500-feet deep, 100-foot lift.
(e) Alternative 2C assumes implementation of Alternative 2A, and Alternative 3C assumes implementation of Alternative 3A.
(f) 25 cfs, 10-foot lift pump.
(g) Alternatives 4A and 4B would require implementation of Alternative 3A.
(h) Three 36-inch, 80-foot long siphons.
(i) 30 wells, 500-feet deep, 100-foot lift.
(j) Alternative 4C assumes implementation of Alternative 4B.
(k) Basis for O&M costs are discussed in Appendix F.
(l) Costs have not been included in this analysis to fund facilities described in Chapter IV-B to provide winter water supplies.
(m) Power Cost for moving radial gate is $500/year.
(n) Unit Pumping Cost = $12.00/af.
(o) Values were multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.
(p) Unit Pumping Cost = $1.00/af.
(q) Unit Conveyance Cost = $1.50/af.

35,478,000 use-days based upon census data from 1987. Approximately 71 and 26 percent of the waterfowl use are by ducks and geese, respectively, including many species which nest on the Refuge. Wildlife and fishery resources associated with the Refuge are presented in Table IV C-3. The listed threatened and endangered species associated with the Refuge are: bald eagle, Haliaeetus leucocephalus; peregrine falcon, Falco peregrines anatum; Aleutian Canada Goose, Branta Canadensis Leucopareia; and the valley elderberry longhorn beetle, Desmocerus Californicus Dimorphus. Candidate species associated with the Refuge include the white-faced ibis, Plegadis chichi; tricolored blackbird, Agelaius tricolor; and California hibiscus, Hibiscus californicus, as listed in Table IV C-4.

Facilities discussed under any of the alternatives would provide a more reliable water supply and additional water to improve habitat and develop additional ponds, seasonal marsh, and watergrass areas. The improved habitat would increase the number of bird-use days, as indicated in Table IV C-5.

Implementation of the plans probably would not adversely affect the listed candidate, threatened and endangered species of birds, and would improve habitat that could be used by the white-faced ibis and Aleutian Canada goose. Detailed field investigations will be completed during the advanced planning phase of the project. Implementation of any of the alternatives would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat and associated recreation and wildlife use. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the ditches and siphons, or new wells would be positive due to the potential public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company (PG&E) serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A detailed discussion of project-use power and wheeling agreements is provided in Chapter II.

G. PERMITS

Construction of the ditches, siphons, or wells would require several permits. Colusa County would require approvals for construction along stream banks and within natural drainage courses to ensure that existing drainage facilities would not

TABLE IV C-3

FISH AND WILDLIFE RESOURCES

DELEVAN NWR

Ducks

Hooded Merganser	Blue Winged Teal[a]	Ring Necked Duck
Mallard[a]	Northern Shoveler[a]	Common Goldeneye
Gadwall[a]	Pintail[a]	Greater Scaup
European Wigeon	Wood Duck[a]	Lesser Scaup
American Wigeon	Redhead[a]	Buffle Head
Green winged Teal[a]	Canvasback	Common Merganser[a]
Cinnamon Teal[a]	Ruddy Duck[a]	

Geese and Swans

Snow Goose	White-fronted Goose	Cackling Canada Goose
Ross' Goose	Canada Goose	Lesser Canada Goose
		Tundra Swan

Coots

American Coot[a]

Shore and Wading Birds

Western Grebe[a]	Virginia Rail[a]	Common Snipe
Eared Grebe	Sora[a]	Long-billed Dowitcher
Pied-billed Grebe[a]	Common Gallinule[a]	Least Sandpiper
Double-crested Cormorant	Ring-billed Gull	Dunlin
White Pelican	Caspian Tern[a]	Western Sandpiper
American Bittern[a]	Forster's Tern	Greater Yellowlegs
Least Bittern[a]	Black Tern[a]	Long-billed Curlew
Great Blue Heron[a]	Wilson's Phalarope	Killdeer[a]
Great (common) Egret[a]	American Avocet	Black- crowned Night Heron[a]
Snowy Egret[a]	Black-Necked Stilt	Greater Sandhill Crane
Green-backed Heron[a]		

TABLE IV C-3

FISH AND WILDLIFE RESOURCES

DELEVAN NWR
(Continued)

Upland Game		
Ringed-necked Pheasant[a]	Rock Dove	Mourning Dove[a]
California Quail (a)		
Raptorial Birds		
Turkey Vulture	Black-Shouldered Kite[a]	Northern Harrier
Sharp-shinned Hawk[a]	Cooper's Hawk[a]	Red-tailed Hawk[a]
Rough-legged Hawk	American Kestrel[a]	Barn Owl[a]
Great Horned Owl[a]	Red Shouldered Hawk[a]	Golden Eagle
Bald Eagle		Peregrine Falcon
Fish		
Steelhead Trout	Salmon	Largemouth Bass
Catfish	Black Crappie	
Furbearers		
Opossum	Gray Fox	Coyote
Raccoon	Beaver	Mink
Skunk	Muskrat	
Others		
Black-tailed Deer		

Notes:

(a) Birds nesting on refuge

Source: USFWS computerized annual printout for NWR Birds, Department of Interior, USFWS (RF11650-2 9-79) (July 1973 to June 1974, NWRS Public Use Report (1)) and refuge records.

TABLE IV C-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

DELEVAN NWR

Listed Species

Birds

Aleutian Canada goose, Branta canadensis leucopareia (E)
Bald Eagle, Haliaeetus leucocephalus (E)
Peregrine Falcon, Falco peregrines anatum (E)

Invertebrates

Valley elderberry longhorn beetle, Desmocerus californicus dimorphus (T)

Proposed Species

None

Candidate Species

Birds

White-faced ibis, Plegadis chihi (2)
Tricolored blackbird, Agelaius tricolor (2)

Plants

California hibiscus, Hibiscus californicus (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV C-5

WILDLIFE RECREATIONAL BENEFITS AND RSOURCE IMPACTS
DELEVAN NWR

	No Action Alternative	Alternatives										
		2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C
Habitat Acres												
Permanent Pond	—	53	53	53	53	70	70	70	70	86	86	86
Seasonal Marsh	—	3,407	3,407	3,4067	3,407	3,750	3,750	3,750	3,750	4,000	4,000	4,000
Watergrass	—	316	316	316	316	316	316	316	316	450	450	450
Rice	—	204	204	204	204	204	204	204	204	204	204	204
Bird Use Days												
Ducks	—	25,165,000	25,165,000	25,165,000	25,165,000	27,440,000	27,440,000	27,440,000	27,440,000	29,970,000	29,970,000	29,970,000
Geese	—	9,172,000	9,172,000	9,172,000	9,172,000	10,000,000	10,000,000	10,000,000	10,000,000	10,920,000	10,920,000	10,920,000
Waterbirds	—	1,141,000	1,141,000	1,141,000	1,141,000	1,240,000	1,240,000	1,240,000	1,240,000	1,355,000	1,355,000	1,355,000
Endangered Species	—	100	100	100	100	100	100	100	100	100	100	100
Total	—	35,478,100	35,478,100	35,478,100	35,478,100	38,680,100	38,680,100	38,680,100	38,680,100	42,245,100	42,245,100	42,245,100
Public Use Days												
Consumptive	—	5,600	5,600	5,600	5,600	5,900	5,900	5,900	5,900	6,200	6,200	6,200
Non-Consumptive	—	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
Total	—	7,800	7,800	7,800	7,800	8,100	8,100	8,100	8,100	8,400	8,400	8,400
Total Annual Cost	—	$ 57,420	$ 49,260	$ 54,670	$ 369,050	$ 57,420	$ 55,330	$ 60,750	$ 393,350	$ 82,560	$ 69,050	$ 443,950
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 1.60	$ 1.40	$ 1.50	$ 10.40	$ 1.50	$ 1.40	$ 1.60	$ 10.20	$ 2.00	$ 1.60	$ 10.50
Incremental Cost/Additional Public Use Day	N/A	$ 7.40	$ 6.30	$ 7.00	$ 47.30	$ 7.10	$ 6.80	$ 7.50	$ 48.60	$ 9.80	$ 8.20	$ 52.90

Notes: Alternatives 2A and 3A - Convey water from Sacramento NWR
Alternatives 2B and 3B - Construct cross-over on Glen-Colusa Irrigation District Lateral 41-1
Alternatives 2C and 3C - Improve Hunter's Creek No. 2 Diversion Weir
Alternatives 2D, 3D, and 4C - Implement a Conjunctive Use Plan
Alternative 4A - Construct Pump Station on 2047 Drain
Alternative 4B - Construct Siphons under the Maxwell Irrigation District Canal

be adversely affected by the new ditches and siphons. Colusa County also would issue permits for well construction under Alternatives 2D, 3D, or 4C. Construction of Alternative 4B facilities under the Maxwell Irrigation District Canal would require approvals from Maxwell Irrigation District. Construction within streams would require Stream Alteration Permits from DFG and possibly Corps of Engineers permits for construction in wetlands or riparian corridors.

CHAPTER IV D

COLUSA NATIONAL WILDLIFE REFUGE

Colusa National Wildlife Refuge (Refuge) was established in 1944 under the Lea Act, which authorized and appropriated funds for the purchase of land for migratory waterfowl refuges in the Sacramento Valley. Additional land was acquired in 1949 and 1952 with Migratory Bird Hunting Stamp Act funds. The Refuge covers 4042 acres and is located about one-half mile southwest of Colusa in Colusa County. The Refuge is bordered on the north by State Highway 20 and on the south by Ware Road. The Refuge provides wintering and resting areas for ducks and geese, and reduces waterfowl damage to crops on neighboring farms. The Refuge is part of a group of refuges located in the Colusa Basin, as discussed in Chapter IV B.

The Refuge consists of permanent ponds, seasonal marshes, millet and moist soil fields, and upland areas. A portion of the crops remain in the field to serve as food for waterfowl. The wetlands support sources of waterfowl food such as swamp timothy and invertebrate populations. The upland areas of the Refuge provide habitat for geese, upland birds, and other wildlife species. The amount of land used for fields, ponds, and upland uses varies each year depending upon the amount of water available.

A. WATER RESOURCES

The Refuge has no firm water supply and receives surplus runoff flows from the Reclamation District 2047 Drain, and surplus Central Valley Project (CVP) water through Glenn-Colusa Irrigation District (GCID) facilities.

1. Surface Waters

The Refuge obtains most of its water from the Reclamation District 2047 Drain. As discussed in Chapter IV C, most of the water in the 2047 Drain during the irrigation season is from agricultural return flows which are of poorer quality than CVP water, but acceptable for refuge use. The 2047 Drain also transports storm water runoff. The Refuge has one appropriative right for diversion from the 2047 Drain under License 4197. However, due to prior appropriations, water is generally not available for the Refuge during July and August from the 2047 Drain. The Refuge also receives agricultural return flows from fields outside of the Refuge through the "J" Drain.

The Refuge receives surplus CVP water from the Sacramento River via the Tehama-Colusa Canal (TCC). Water from the TCC flows into the Williams Outlet which conveys water to the GCID Main Canal. Water flows from the GCID Main Canal through Fresh Water Creek to the Refuge (USBR, 1986a).

As discussed in Chapter IV B, GCID conveys CVP water or provides GCID water through exchange agreements with the CVP to the Colusa Basin refuges. A portion of the water supplied by GCID is from agricultural return flows. Under Contract 14-06-200-8181A and Contract 14-06-0001-78021 with Reclamation, GCID conveys a maximum of 25,000 acre-feet to the Refuge. The quality of the water delivered by GCID appears to be suitable for refuge irrigation under most conditions.

Additional water may be obtained from GCID Powell Slough or the 2047 Drain. Use of wastewater effluent from the Colusa wastewater treatment plant has been suggested for use as a supplemental water supply. However, the total amount of available water is less than 1,000 acre-feet per year and may not be available during the irrigation season due to previous contracts.

For the purpose of this analysis, it was assumed that winter water would be provided to the TCC from the Sacramento River through the Red Bluff Diversion Dam or surplus water would be available in the winter from Black Butte Reservoir, as discussed in Chapter IV B. Winter water also could be provided from the 2047 Drain.

2. Water Conveyance Facilities

Approximately 60 percent of the Refuge is located north of Abel Road and receives water from the 2047 Drain. Three pumps provide water for a portion of this area, which is known as the O'Hair Tract. Another pump provides water to a portion of the Refuge known as the Lynn Tract. The Davis Weir is located on the 2047 Drain downstream of the Refuge, as shown in Figure IV D-1. The Davis Weir is operated by GCID and creates a backwater pool in the 2047 Drain that allows operation of the refuge pumps. Low water levels in the 2047 Drain frequently prevent the pumps from providing adequate flows to the Refuge. The weir structure is removed from the Davis Weir in October as the rice fields are drained. Removal of the weir makes the operation of the Refuge pumps difficult even with normal winter flows.

The GCID H-1 Canal conveys water to a pump on the central-west side of the Refuge. The pumps lift water from the H-1 Canal to the Refuge's main canal. Water for portions of the Refuge located to the south of Abel Road is provided by the Reclamation District 2047 "J" Drain and GCID Laterals 64-1, 64-C, and 64-2A.

Tracts 7, 8, and 11 in the northeastern portion of the Refuge could receive water from the 2047 Drain if a lift station were constructed.

The existing conveyance system on the developed portions of the Refuge is adequate. Periodically, the Refuge is subjected to flooding. Following flood events, additional maintenance work is needed to repair levees and ditches. Tracts 9 and 4 require an internal conveyance system.

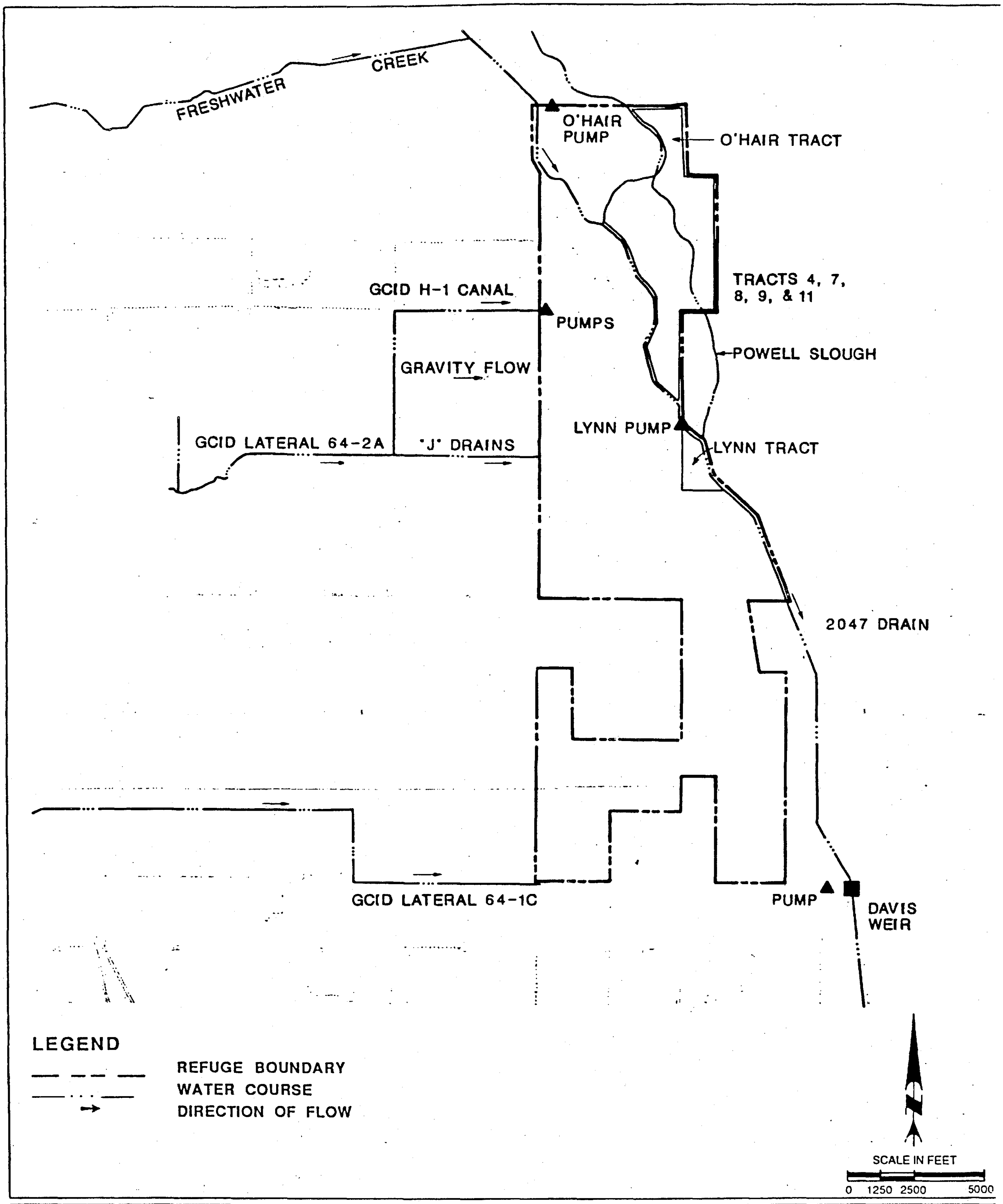


FIGURE IV D-1

COLUSA NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

TABLE IV D-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE COLUSA NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	1,200	1,200	1,200
February	0	800	800	800
March	0	350	350	350
April	0	770	770	770
May	0	1,440	1,440	1,440
June	0	2,500	2,500	2,500
July	0	2,880	2,880	2,880
August	0	2,880	2,880	2,880
September	0	3,840	3,840	3,840
October	0	3,840	3,840	3,840
November	0	2,400	2,400	2,400
December	0	2,100	2,100	2,100
Total	0	25,000	25,000	25,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986c, 1986d, and 1986e

3. Groundwater

The Refuge is located in flood plain deposits of the Sacramento River flood basin which is underlain by the Tehama Formation. Wells drilled to depths of more than 400 feet may enter the Tehama Formation aquifer and could produce 1,000 to 4,000 gpm. The quality appears to be suitable for irrigation and waterfowl needs. The safe yield of the aquifer under the Refuge has been estimated by Reclamation to be 4,850 acre-feet. The Refuge has one existing well, with a production capacity of 3,300 gpm.

B. FORMULATION & EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 25,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified by the Service, as presented in Table IV D-1. Each of the water supply levels provide a different volume of water, and are summarized as follows:

- Level 1 - Existing firm water supply
- Level 2 - Current average annual water deliveries
- Level 3 - Water supply needed for full use of existing development
- Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

Because the Refuge does not have a firm water supply, no facilities are required.

2. Delivery Alternatives for Level 2 (25,000 acre-feet)

The alternatives developed for Level 2 were developed to improve water deliveries, especially during the winter. Alternatives 2A and 2B were developed based on the assumption that winter water would be provided to GCID facilities or 2047 Drain. Alternative 2C was developed to provide for a conjunctive use program.

Alternative 2A - Construct New Weir on the 2047 Drain and Replace Davis Weir. This alternative would include two separate facilities to provide water to both the northern and southern portions of the Refuge. A low weir would be constructed on the 2047 Drain to provide adequate water levels for pumping into the northern portion of the Refuge, as shown in Figure IV D-2. The weir would be constructed immediately downstream of an existing southern

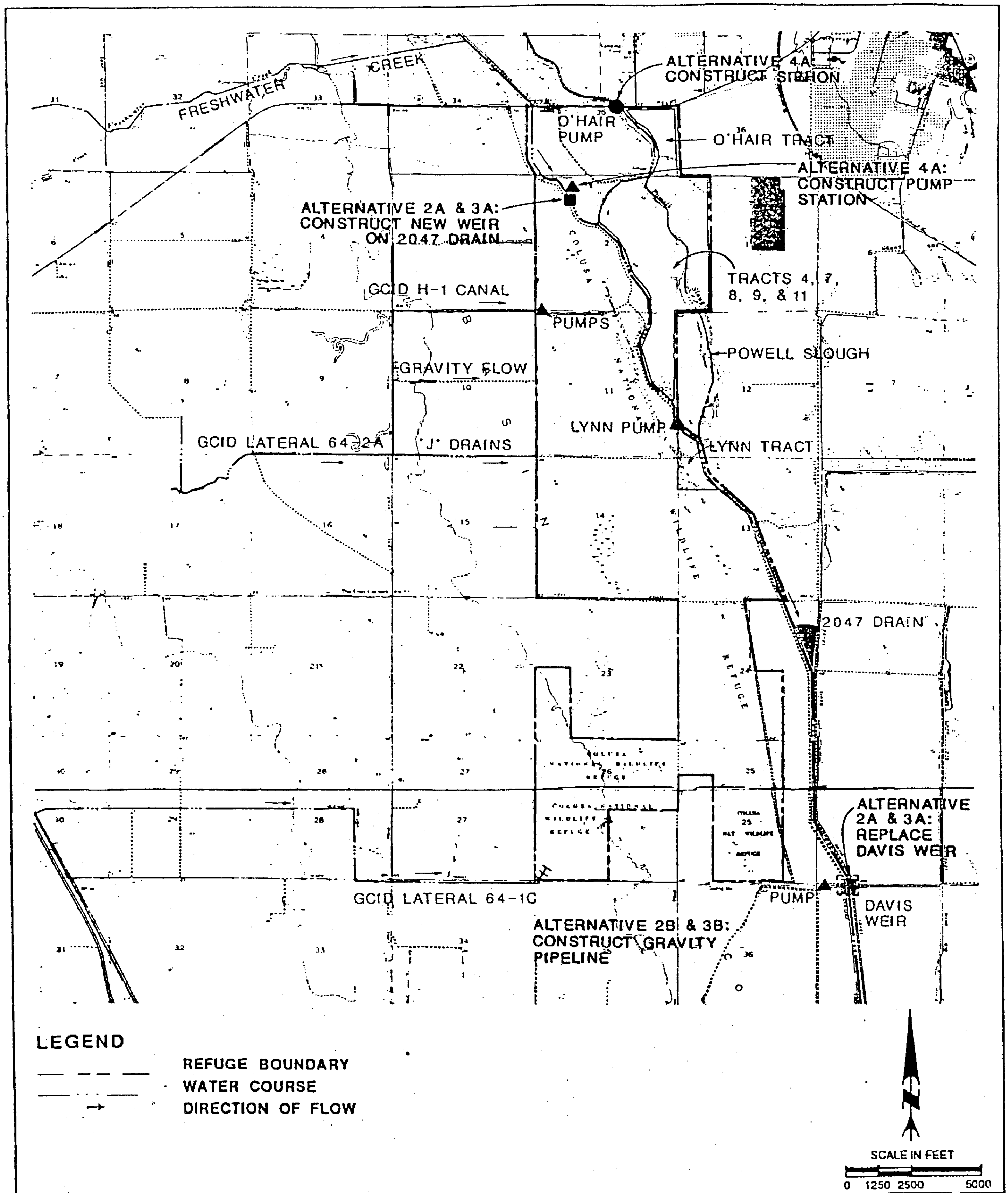


FIGURE IV D-2

COLUSA NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

pumphouse. The 3-foot high, 60-foot long weir structure would create a 4-foot deep pool in the 2047 Drain to improve pumping capabilities following removal of the weir boards at Davis Weir.

This alternative also would include replacement of the Davis Weir to provide adequate water for the southern portions of the Refuge. The new radial weir structure would be 8 feet high and 60 feet long and would create a pool in the 2047 Drain.

Alternative 2B - Convey CVP Water Through Zumwalt Farms and Glenn-Colusa Irrigation District Canals. CVP water would be transported from the TCC to the GCID Main Canal through existing canals operated by GCID and Zumwalt Water District. A 300-foot, 30-inch diameter pipeline, control gate, road crossing, connecting ditch, and siphon would be constructed to transport water by gravity from GCID 64-1C Lateral to the Refuge.

Alternative 2C - Implement a Conjunctive Use Plan. Twelve wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells on the Refuge would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. This alternative also would require implementation of Alternative 2A or 2B.

3. Delivery Alternatives for Level 3 (25,000 acre-feet)

Water Supply Level 3 is equal to Level 2. Therefore, the facilities alternatives discussed under Level 2 also would be considered for Level 3.

Alternative 3A - Construct New Weir on the 2047 Drain and Replace Davis Weir. This alternative is identical to Alternative 2A.

Alternative 3B - Convey CVP Water Through Zumwalt Farms and Glenn-Colusa Irrigation District Canals. This alternative is identical to Alternative 2B.

Alternative 3C - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 2C. This alternative also would require implementation of Alternative 3A or 3B.

4. Delivery Alternatives for Level 4 (25,000 acre-feet)

Water Supply Level 4 is equal to Level 2. However, the water would be distributed differently throughout the Refuge in order to develop Tracts 4, 7, 8, 9, and 11. Alternative 4A would provide the facilities to serve these tracts. Alternative 4B would provide wells for a conjunctive use program.

Alternative 4A - Construct Facilities to Serve Tracts 4, 7, 8, 9, and 11. This alternative would require two separate facilities to be constructed. A new 25 cfs pump station would be constructed on the 2047 Drain at the Refuge bridge to serve Tracts 7, 8, and 11. A 15 cfs siphon would be constructed under Powell Slough to allow water to flow from the western portions of the Refuge into Tracts 4 and 9. This alternative would require implementation of Alternatives 3A or 3B.

Alternative 4B - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 3C. Implementation of this alternative also would require implementation of Alternative 3A or 3B, as well as Alternative 4A.

5. Summary of Alternatives.

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter II.

There are no alternatives for Level 1 because the Refuge has no firm water supplies at this time.

Alternatives 2A and 2B and Alternatives 3A and 3B would provide winter water when the Davis Weir is opened. These alternatives would require a dependable supply of surface water during the summer and long-term conveyance agreements with GCID and Reclamation District 2047. Alternatives 2B and 3B also would require long-term conveyance agreements with Zumwalt Water District.

Alternatives 2C and 3C and Alternative 4B would provide wells to be used during dry years when CVP water may not be available. These alternatives would cause overdraft conditions because the water needs would exceed the safe yield under the Refuge. Alternative 2C would require implementation of surface water alternatives, Alternatives 2A or 2B. Alternative 3C would require implementation of Alternatives 3A or 3B.

Alternative 4A would require implementation of Alternatives 3A or 3B. Alternative 4B would require implementation of Alternatives 3A or 3B, as well as 4A.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans for Levels 2, 3, and 4 are presented in Table IV D-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of facilities under all of the alternatives would result in additional money being spent in the economy of Colusa

TABLE IV D-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

COLUSA NWR

Items	Alternatives				
	2A & 3A	2B & 3B	2C & 3C	4A	4B
Additional Water (ac-ft)	25,000	25,000	25,000	25,000	25,000
Construction Costs					
Wells	$ --	$ --	$ 897,000[c]	$ --	$ 897,000[c]
Diversion Structures	260,000[a]	10,350	--	--	--
Pipelines/Canals	--	9,650[b]	--	3,600[e]	--
Pump Stations	--	--	--	84,000[f]	--
Subtotal	$260,000	$ 20,000	$ 897,000	$ 87,600	$ 897,000
Other Costs	--	--	260,000[d]	260,000[d]	347,600[g]
Total (h)	$260,000	$ 20,000	$1,157,000	$347,600	$1,244,600
Annualized Construction Costs (8.87%, 30 yrs)	$ 25,000	$ 1,920	$ 111,300	33,440	119,730
Additional Annual Costs					
Operation & Maintenance[i]	$ 1,500	$ 50	$ 30,500	$ 1,250	$ 30,500
Power	500[j]	--	166,250[k,l]	2,100[m]	166,250[k,l]
Local Conveyance Cost [n]	37,500	37,500	--	--	--
Subtotal	$ 39,500	$ 37,550	$ 196,750	$ 3,350	$ 196,750
Other Costs	--	--	19,750[d,l]	39,500[d]	21,425[g,l]
Total (h)	$ 39,500	$ 37,550	$ 216,500	$ 42,850	$ 218,175
Total Annual Cost	$ 64,500	$ 39,470	$ 327,800	$ 76,290	$ 337,905
Cost/Additional Acre-Foot	$ 2.60	$ 1.60	$ 13.10	$ 3.10	$ 13.50

TABLE IV D-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

COLUSA NWR

(Continued)

Notes: Alternatives 2A and 3A - Construct New Weir on the 2047 Drain and Replace Davis Weir.
Alternatives 2B and 3B - Convey CVP Water through Zumwalt Farms and Glenn-Colusa Irrigation District Canals.
Alternatives 2C and 3C - Implement a Conjunctive Use Plan.
Alternative 4A - Construct Facilities to Serve Tracts 4, 7, 8, 9 and 11.
Alternative 4B - Implement a Conjunctive Use Plan.

(a) New 3-foot high, 60-foot wide weir; and a new 8-foot high, 60-foot wide radial weir.

(b) 300-feet, 30-inch diameter pipeline; one siphon, and one turnout.

(c) 12 wells, 750 feet deep, 110-foot lift.

(d) Alternative 2C assumes implementation of Alternative 2A, Alternative 3C assumes implementation of Alternative 3A, and Alternative 4A assumes implementation of Alternative 3A.

(e) 80-feet, 24-inch diameter siphon.

(f) 15 cfs, 8-foot lift pump station.

(g) Alternative 4B assumes implementation of Alternative 3A and 4A.

(h) Costs have not been included in this analysis for funding facilities described in Chapter IVB to provide winter water supply.

(i) Basis for O&M costs are discussed in Appendix F.

(j) Power cost for moving radial gate is $500/year.

(k) Unit Pumping Cost = $13.30/af.

(l) Values were multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(m) Unit Pumping Cost = $1.00/af.

(n) Unit Conveyance Cost = $1.50/af.

County during construction. The construction could be completed within one summer season by construction workers who reside within the area.

Currently, the annual public use (Level 2) at the Refuge is about 7,200 visits per year. If additional water is provided the public use days are not anticipated to increase.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 28,106,000 use-days based upon census data from 1987. Approximately 90 and 5 percent of the bird use are by ducks and geese, respectively. Wildlife and fishery resources associated with the Refuge are presented in Table IV D-3. The listed threatened and endangered species associated with the Refuge are the Aleutian Canada goose, <u>Branta canadensis leucopareia</u>; bald eagle, <u>Haliaeetus leucocephalus</u>; peregrine falcon, <u>Falco peregrines anatum;</u>, and the Valley elderberry longhorn beetle, <u>Desmocerus californicus dimorphus</u>. Candidate threatened and endangered species associated with the Refuge include the white-faced ibis, <u>Plegadis chichi</u>; tricolored blackbird, <u>Agelaius tricolor</u>; and California hibiscus, <u>Hibiscus californicus</u>, as listed in Table IV D-4.

The alternative plans would provide a more reliable water supply to maintain habitat in the Refuge and develop additional ponds, seasonal marsh, and watergrass areas. The number of bird-use days and recreational-use days would increase if a more reliable water supply is provided, as indicated in Table IV D-5.

Implementation of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species. Detailed field investigations will be completed during the advanced planning phase of the project. Implementation of the plan would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under all of the alternatives would be positive due to the continued public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is

TABLE IV D-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

COLUSA NWR

Listed Species

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (E)
Bald Eagle, *Haliaeetus leucocephalus* (E)
Peregrine Falcon, *Falco peregrines anatum* (E)

Invertebrates

Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds
White-faced ibis, *Plegadis chihi* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Plants
California hibiscus, *Hibiscus californicus* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat
(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV D-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

COLUSA NWR

	No Action Alternative	Alternatives				
		2A & 3A	2B & 3B	2C & 3C	4A	4B
Habitat Acres						
Permanent Pond	--	455	455	455	495	495
Seasonal Marsh	--	2,280	2,280	2,280	2,280	2,280
Watergrass	--	535	535	535	535	535
Rice	--	86	86	86	86	86
Bird Use Days						
Ducks	--	23,316,000	23,316,000	23,316,000	26,300,000	26,300,000
Geese	--	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000
Waterbirds	--	1,790,000	1,790,000	1,790,000	1,790,000	1,790,000
Endangered Species	--	100	100	100	100	100
Total	--	28,106,100	28,106,100	28,106,100	31,090,100	31,090,100
Public Use Days						
Consumptive	--	4,100	4,100	4,100	4,100	4,100
Non-Consumptive	--	3,100	3,100	3,100	3,100	3,100
Total	--	7,200	7,200	7,200	7,200	7,200
Total Annual Cost	--	$ 64,500	$ 39,470	$ 327,800	$ 76,290	$ 337,905
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 2.30	$ 1.40	$ 11.70	$ 2.50	$ 12.00
Incremental Cost/Additional Public Use Day	N/A	$ 9.00	$ 5.50	$ 45.50	$ 10.60	$ 46.90

Notes: Alternatives 2A and 3A: Construct New Weir on the 2047 Drain and Replace Davis Weir
Alternatives 2B and 3B: Convey Water through Zumwalt Farms and Glenn-Colusa Irrigation District Canals
Alternatives 2C and 3C: Implement a Conjunctive Use Plan
Alternative 4A: Construct Facilities to Serve Tracts 4, 7, 8, 9, and 11
Alternative 4B: Implement a Conjunctive Use Plan

currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in Chapter II.

G. PERMITS

Construction of the weirs, siphons, pump stations, and wells would require several permits. Colusa County would issue permits for facilities along stream banks and in natural drainage courses to ensure that the existing drainage would not be adversely affected. The County also would issue permits for construction of the wells. Construction of the facilities under Alternatives 2A, 3A, and Alternative 4A would require approvals and permits or easements from the Reclamation District 2047 and GCID. Construction of siphons under Powell Slough and construction of weirs and pump stations in 2047 Drain would require a Stream Alteration Permit from DFG and may require a Corps of Engineers permit for construction in wetlands.

CHAPTER IV E

SUTTER NATIONAL WILDLIFE REFUGE

Sutter National Wildlife Refuge (Refuge) was established in 1944 under the Lea Act which authorized and appropriated funds for the purchase of land for migratory waterfowl in the Sacramento Valley. The Refuge was originally established to reduce crop losses due to waterfowl. Additional lands were acquired in 1953 and 1956 with funds provided by the Duck Stamp Act. The Refuge is managed by the Service and is located in Sutter County eight miles southwest of Yuba City. Most of the Refuge is within the Sutter Bypass, north of the confluence with the Tisdale Bypass, as shown in Figure IV E-1. The Refuge is the only publicly-owned wildlife management area in the Sutter Basin.

Sutter Basin extends from the Sutter Buttes on the north to the confluence of the Feather and Sacramento Rivers. The basin drains north to south. Historically, flood flows from the Sacramento River, Butte Sink, and Feather River have inundated large portions of the 57,000-acre Sutter Basin year-round. However, most of the land has since been developed for agricultural uses. Most of the rice fields are also used as private hunting clubs.

The Refuge consists of ponds, moist soil plant and millet fields, and uplands. The natural ponds support sources of waterfowl food such as swamp timothy and invertebrate populations. Moist soil plants and millet are raised for waterfowl food. The upland areas of the Refuge provide habitat for geese, upland birds, and other wildlife species.

A. WATER RESOURCES

The Refuge receives water from the East and West Borrow Ditches in the Sutter Bypass and the Sutter Extension Water District.

1. Surface Waters

Surface water supplies for the Refuge are provided through the Sutter Bypass or from Thermalito Afterbay via the Sutter-Butte Canal or Butte Creek. Over 85 percent of the water supply for the Refuge is obtained from the East and West Borrow Ditches of the Sutter Bypass. During the irrigation season, most of the water in the Bypass is agricultural return flows. Flood flows are conveyed in the Bypass during the winter.

The Refuge holds three water rights in the Bypass. License 4590, obtained in 1946 with Priority No. 24, allocates 25 cfs from June 1 to October 30 to be diverted from the East Borrow Pit for irrigation of 1000 acres inside of the Bypass. License 3149, obtained in 1946 with Priority No. 25, appropriates 5 cfs from April 15 to October 1 to be diverted from the East Borrow Pit for irrigation of 270 acres inside of the Bypass. License 6996, obtained in 1957, appropriates 10 cfs of water from the main drainage canal on the east side of the East Sutter Bypass levee between October 1 and January 1 for irrigation of 450 acres. These water rights do not have a high priority number. Therefore, only surplus water is available to the Refuge. Due to the lack of available water during most of the the year, these sources cannot be considered to be dependable water sources. The water right under License 6996 is not used due to poor water quality and limited availability.

Water has been purchased by the Refuge and cooperative farmers from Sutter Extension Water District for portions of the Refuge located outside of the Sutter Bypass (Tracts 18, 19, and 20). The Sutter Extension Water District is a member of the Sutter-Butte Joint Water District which owns and operates the Sutter-Butte Canal that conveys water from the Thermalito Afterbay.

The Western Canal Water Users Association (WCWUA) was formed in 1985 when the PG&E canal facilities were purchased. The WCWVA canal facilities divert water from Thermalito Afterbay and are operated year-round to deliver water to duck clubs in the Butte Sink. The WCWUA could convey water to Butte Creek for conveyance to the Sutter Bypass. However, the additional water in Butte Creek could be illegally diverted upstream of the Refuge.

Another potential source of water is the Oroville-Wyandotte Irrigation District which obtains water from the Thermalito Afterbay. The water could be conveyed through the Sutter-Butte Joint Water District facilities.

2. Water Conveyance Facilities

The east channel of the Sutter Bypass, or the East Borrow Pit, provides most of the water to the Refuge. Water flows by gravity through the DWR Weir Number 2 which allows gravity flooding via the Refuge's main canal to most of the southern portion of the Refuge. Water for the northern portion of the Refuge is pumped from the Refuge's main canal at the north end of the Refuge. A replacement weir structure has been proposed by the DWR which would be one-foot lower than the existing weir. Therefore, the Refuge pumping costs would be increased. Water also is diverted from the West Borrow Pit at a dam near the southwest corner of the Refuge.

Water is pumped from the Sutter Extension Water District Lateral F2 to serve portions of the Refuge outside of the Sutter Bypass.

3. Groundwater

The Refuge is located along the margin of the Sacramento River flood basin deposits and the low alluvial plain deposits of streams that drain the Sierra Nevada Mountains. Two aquifers of different quality occur under the Refuge. High quality water is located at

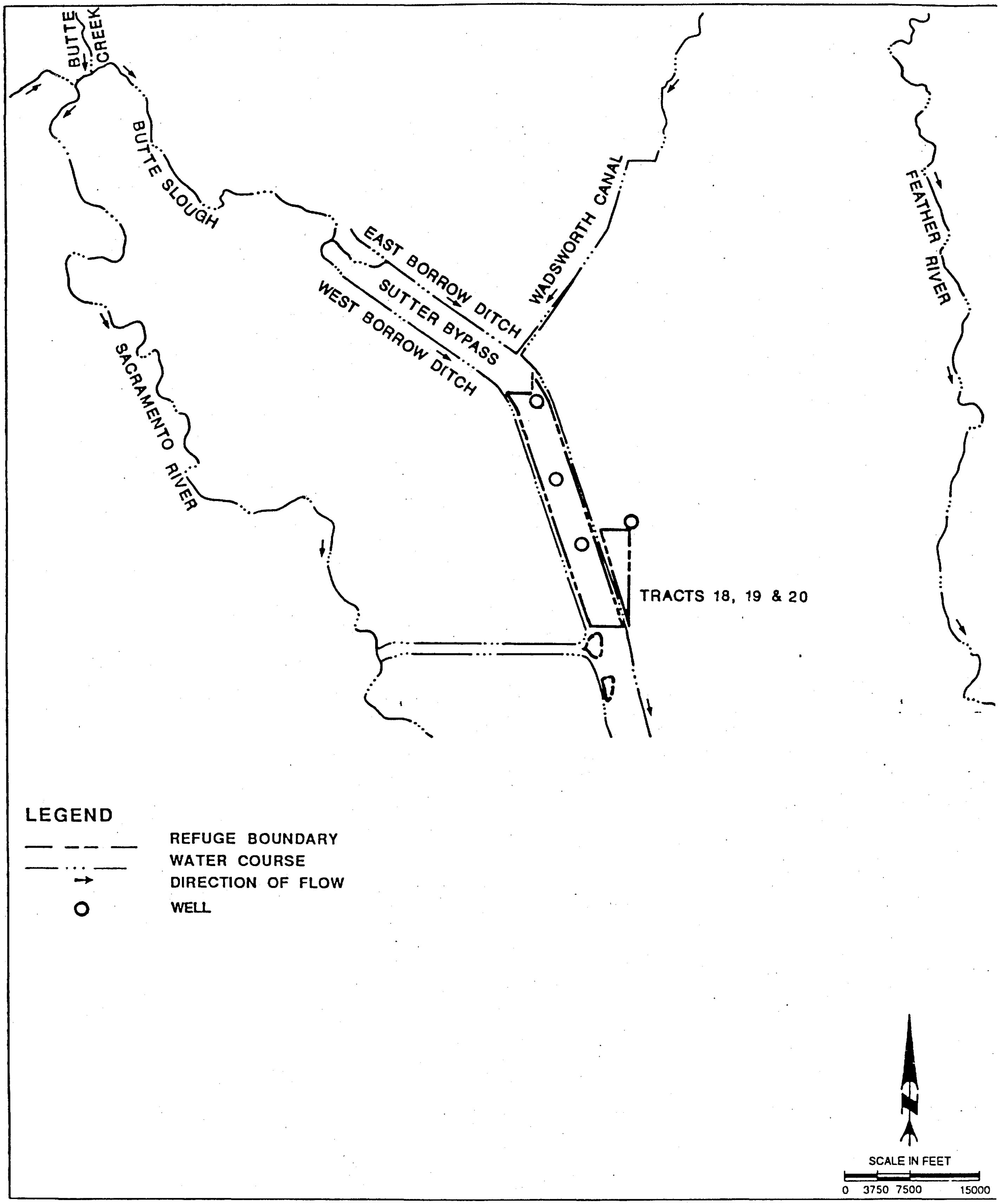


FIGURE IV E-1

SUTTER NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

depths of 100 to 350 feet. Water with high specific conductivities is located at depths of 350 to 750 feet. If the better quality water is pumped at high rates, the water with the high specific conductivities may rise and contaminate the good quality water.

The best well production is anticipated to occur in the southwestern corner of the Refuge which is underlain by deep lenses of sand and gravel. In this area, high quality groundwater is located within 200 feet of the ground surface. The average discharge rate for pumps in the southwestern portion of the Refuge is estimated to be 2,500 gpm.

The Refuge has four wells which could be used to supplement water flows in a conjunctive use program. The pumping capacity of the wells range from 1,800 to 3,000 gpm. The groundwater quality is good for irrigation and wildlife uses. A deep well is used by the areas outside of the Sutter Bypass (Tracts 18, 19, and 20) when water is not available from Sutter Extension Water District. The safe yield of the aquifer under the Refuge has been estimated by Reclamation to be 3,110 acre-feet.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 30,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV E-1. Each of the water supply levels provide a different volume of water and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

The Refuge does not have a firm water supply; therefore, no facilities were considered.

2. Delivery Alternatives for Level 2 (23,500 acre-feet)

This level of water delivery represents the current average water delivery. Although existing facilities are capable of transporting flows from the East and West Borrow Ditches and through the Sutter Extension Water District, these current water supplies are not considered to be dependable water supplies. The following alternatives have been developed to improve the

TABLE IV E-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE SUTTER NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	950	1,200	1,200
February	0	1,000	1,300	1,300
March	0	1,000	1,300	1,300
April	0	950	1,200	1,200
May	0	1,100	1,440	1,440
June	0	1,300	1,680	1,680
July	0	1,300	1,680	1,680
August	0	3,800	4,800	4,800
September	0	4,500	5,800	5,800
October	0	3,800	4,800	4,800
November	0	1,900	2,400	2,400
December	0	1,900	2,400	2,400
Total	0	23,500	30,000	30,000

Notes:

Supply Level 1 Existing firm water supply
Supply Level 2 Current average annual water deliveries
Supply Level 3 Full use of existing development
Supply Level 4 Optimum management

Source: USBR, 1986a; USFWS, 1986d

reliability and quality of water provided to the Refuge. These alternatives assume that a long-term agreement will be negotiated between DWR and Reclamation to exchange CVP water for water from Thermalito Afterbay.

Alternative 2A - Deliver Water from Thermalito Afterbay through Butte Creek. Water from Thermalito Afterbay or Oroville-Wyandotte Irrigation District would be delivered by the WCWUA to Butte Creek. The water would flow down Butte Creek and Butte Slough, as shown in Figure IV E-2, to the Sutter Bypass and would be diverted from the East and West Borrow Ditches. Both of these systems would have adequate capacity to convey water to the Refuge. During this study, the WCWUA indicated that the maintenance shutdown period could be reduced to allow water delivery to the Refuge. This conveyance plan was used during the 1977 drought period to convey water to the Refuge. Illegal upstream diversions may occur under this alternative.

Alternative 2B - Deliver Water from Thermalito Afterbay through Wadsworth Canal. Water would be conveyed directly from the Thermalito Afterbay to the Wadsworth Canal, or from Thermalito Afterbay through the Sutter-Butte Canal to the Wadsworth Canal. Water would flow from the Wadsworth Canal into the Sutter Bypass and would be diverted from the East Borrow Ditch. Adequate capacity is available for conveyance of water to the main portion Refuge which is located within the Sutter Bypass. Sutter-Butte Canal and Wadsworth Canal are operated by Sutter Extension Water District, a member of Sutter-Butte Joint Water District. Illegal upstream diversions may occur under this alternative.

Alternative 2C - Obtain Water from Sutter Extension Water District. A long-term agreement with Sutter Extension Water District would be developed to provide a dependable water supply for areas of the Refuge located outside of the Sutter Bypass (Tracts 18, 19, and 20). The water supply for these tracts is currently being provided by Sutter Extension Water District on an as-available basis. Water would be supplied to the remaining portions of the Refuge as described under Alternative 2B.

Alternative 2D - Implement a Conjunctive Use Plan. The existing four wells and nine new wells would be used to deliver the maximum month water demand. The exact locations of the new wells on the refuge would be determined in a future study. The wells would be used as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. This alternative would require implementation of Alternative 2A, 2B, or 2C.

3. Delivery Alternatives for Level 3 (30,000 acre-feet)

Water deliveries under Level 3 are similar to the Level 2 deliveries. The same alternatives considered for Level 2 were evaluated for Level 3.

Alternative 3A - Deliver Water from Thermalito Afterbay through Butte Creek. This alternative is identical to Alternative 2A.

Alternative 3B - Deliver Water from Thermalito Afterbay through Wadsworth Canal. This alternative is identical to Alternative 2B.

Alternative 3C - Obtain Water from Sutter Extension Water District. This alternative is identical to Alternative 2C.

Alternative 3D - Implement a Conjunctive Use Plan. The existing 4 wells and 15 new wells would be used to deliver the maximum month water demand. This alternative is similar to Alternative 2D and would require implementation of Alternative 3A, 3B, or 3C.

4. Delivery Alternatives for Level 4 (30,000 acre-feet)

The water deliveries under Level 4 would be equal to the deliveries under Level 3. Therefore, the alternatives for Level 4 would be the same as discussed under Levels 2 and 3.

Alternative 4A - Deliver Water from Thermalito Afterbay through Butte Creek. This alternative is identical to Alternative 3A.

Alternative 4B - Deliver Water from Thermalito Afterbay through Wadsworth Canal. This alternative is identical to Alternative 3B.

Alternative 4C - Obtain Water from Sutter Extension Water District. This alternative is identical to Alternative 3C.

Alternative 4D - Implement a Conjunctive Use Plan. The existing wells and 15 new wells would be used to deliver the maximum month water demand. This alternative is identical to Alternative 3D and would require implementation of Alternative 4A, 4B, or 4C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1 because the Refuge does not have a firr water supply.

The alternatives were developed to provide a dependable summer and winter supply of good quality water to the Refuge. All of the alternatives were developed assuming that a long-term agreement would be negotiated between DWR and Reclamation to allow an exchange

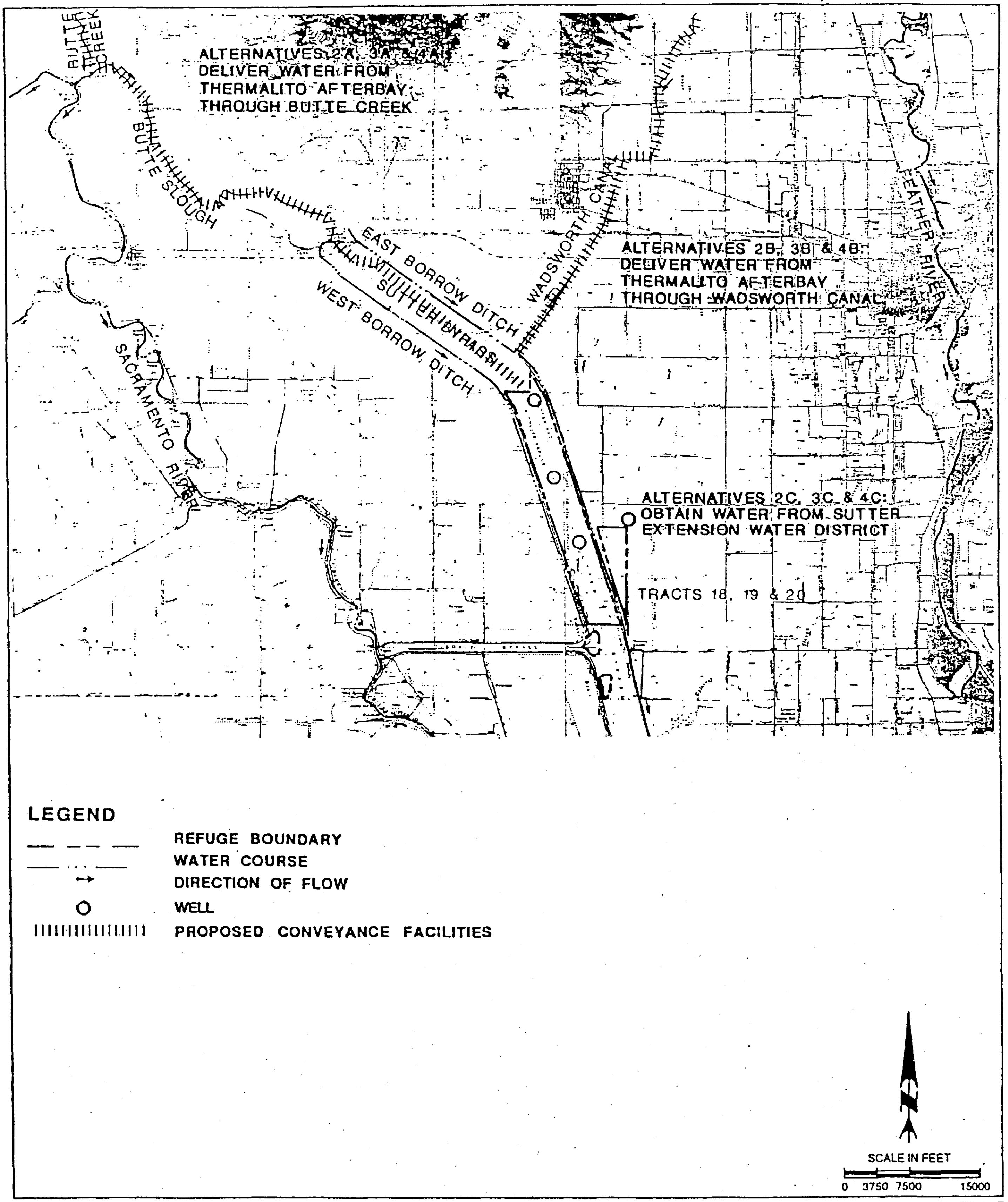


FIGURE IV E-2

SUTTER NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

JMM

of CVP water for SWP water from the Thermalito Afterbay. Alternatives 2A, 3A, and 4A would require long-term conveyance agreements with WCWUA. Alternatives 2B, 3B, and 4B would require long-term agreements with the Sutter-Butte Joint Water District and Sutter Extension Water District. Alternatives 2C, 3C, and 4C would require long-term agreements with Sutter Extension Water District. None of the alternatives would require construction of additional facilities.

Alternatives 2C, 3C, and 4C would need to be implemented in conjunction with Alternatives 2A or 2B, 3A or 3B, or 4A or 4B, respectively.

Alternatives 2D, 3D, and 4D would provide wells to be used during dry years when CVP water may not be available. This alternative may cause overdraft conditions because the water needs would exceed the safe yield under the Refuge. These alternatives would require implementation of the surface water alternatives (Alternatives 2A, 2B, or 2C; Alternatives 3A, 3B, or 3C; or Alternatives 4A, 4B, or 4C).

C. COSTS & ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Levels 2, 3, and 4 are presented in Table IV E-2. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP water. The construction costs include factors to cover engineering, contingencies, and overhead. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under Alternatives 2D, 3D, and 4D would result in additional money being spent in the economy of Sutter County. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use (Level 2) at the Refuge is about 3,100 visits per year. If additional water is provided, the public use levels are not anticipated to increase significantly.

D. WILDLIFE RESOURCES

The average annual bird use on the Refuge is over 15,817,000. Wildlife and fishery resources associated with the Refuge are presented in Table IV E-3. The only listed threatened and endangered species associated with the Refuge are the bald eagle, <u>Haliaeetus lecicocephalus</u>; peregrine falcon, <u>Falco peregrines anatum</u>; Aleutian Canada goose, <u>Branta canadensis Leucopareia</u>; and the Valley elderberry longhorn beetle, <u>Desmocerus californicus dimorphus</u>. Candidate threatened and endangered species associated with the Refuge include the white-

TABLE IV E-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SUTTER NWR

Items	2A	2B	2C	2D	3A & 4A	3B & 4B	3C & 4C	3D & 4D
	Alternatives							
Additional Water (ac-ft)	23,500	23,500	23,500	23,500	30,000	30,000	30,000	30,000
Construction Costs								
Wells	$ --	$ --	$ --	$672,750[a]	$ --	$ --	$ --	$1,121,250[b]
Diversion	--	--	--	--	--	--	--	--
Pipelines/Canals	--	--	--	--	--	--	--	--
Pump Station	--	--	--	--	--	--	--	--
Subtotal	--	--	--	$672,750	--	--	--	$1,121,250
Other Costs	--	--	--	--	--	--	--	--
Total	--	--	--	$672,750	--	--	--	$1,121,250
Annualized Construction Costs (8.87%, 30 yrs)	--	--	--	$ 64,720	--	--	--	$ 107,870
Additional Annual Costs								
Operation & Maintenance[c]	$ --	$ --	$ --	$ 22,900	$ --	$ --	$ --	$ 38,100
Power	--	--	--	293,750[d,e]	--	--	--	375,000[d,e]
Local Conveyance Cost[f]	105,750	105,750	105,750	--	135,000	135,000	135,000	--
Subtotal	$105,750	$105,750	$105,750	$316,650	$135,000	$135,000	$135,000	$ 413,100
Other Costs	--	--	--	52,875[e,g]	--	--	--	67,500[e,g]
Total	$105,750	$105,750	$105,750	$369,525	$135,000	$135,000	$135,000	$ 480,600
Total Annual Costs	$105,750	$105,750	$105,750	$434,245	$135,000	$135,500	$135,000	$ 588,470
Cost/Additional Acre-Foot	$ 4.50	$ 4.50	$ 4.50	$ 18.50	$ 4.50	$ 4.50	$ 4.50	$ 19.60

TABLE IV E-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SUTTER NWR
(Continued)

Notes: Alternatives 2A, 3A, and 4A - Deliver water from Thermalito Afterbay through Butte Creek.
Alternatives 2B, 3B, and 4B - Delivery water from Thermalito Afterbay through Wadsworth Canal.
Alternatives 2C, 3C, and 4C - Obtain Water from Sutter Extension Water District.
Alternatives 2D, 3D, and 4D - Implement a Conjuctive Use Plan.

(a) 9 wells, 750-feet deep, 150-foot lift.

(b) 15 wells, 750-feet deep, 150-foot lift.

(c) Basis for O&M costs are discussed in Appendix F.

(d) Unit Pumping Cost = $25/af.

(e) Values were multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(f) Unit Conveyance Cost = $4.50/af.

(g) Alternative 2D assumes implementation of Alternative 2A, 2B, or 2C; Alternative 3D assumes implementation of Alternative 3A, 3B, or 3C; and Alternative 4D assumes implementation of 4A, 4B, or 4C.

TABLE IV E-3

FISH AND WILDLIFE RESOURCES

SUTTER NWR

Ducks

Hooded Merganser	Blue Winged Teal[a]	
Mallard[a]	Northern Shoveler[a]	Ring Necked Duck
Gadwall[a]	Pintail[a]	Common Goldeneye
European Wigeon	Wood Duck[a]	Greater Scaup
American Wigeon	Redhead[a]	Lesser Scaup
Green winged Teal[a]	Canvasback	Buffle Head
Cinnamon Teal[a]	Ruddy Duck[a]	Common Merganser[a]

Geese and Swans

Snow Goose	White-fronted Goose	Cackling Goose
Ross' Goose	Canada Goose	Lesser Canada Goose
		Tundra Swan

Coots

American Coot[a]

Shore and Wading Birds

Western Grebe[a]	Virginia Rail[a]	Common Snipe
Eared Grebe	Sora[a]	Long-billed Dowitcher
Pied-billed Grebe[a]	Common Gallinule[a]	Least Sandpiper
Double-crested Cormorant	Ring-billed Gull	Dunlin
White Pelican	Caspian Tern[a]	Western Sandpiper
American Bittern[a]	Forester's Tern	Greater Yellowlegs
Least Bittern[a]	Black Tern[a]	Long-billed Curlew
Great Blue Heron[a]	Wilson's Phalarope	Killdeer[a]
Great (common) Egret[a]	American Avocet	Black- crowned Night Heron[a]
Snowy Egret[a]	Black-Necked Stilt	Greater Sandhill Crane
Green-backed Heron[a]		

TABLE IV E-3

FISH AND RESOURCES

SUTTER NWR
(Continued)

Upland Game		
Ringed-necked Pheasant[a]	Rock Dove	Mourning Dove[a]
California Quail[a]		
Raptorial Birds		
Turkey Vulture	Black-shouldered Kite[a]	Northern Harrier
Sharp-shinned Hawk[a]	Cooper's Hawk[a]	Red-tailed Hawk[a]
Rough-legged Hawk	American Kestrel[a]	Barn Owl[a]
Great Horned Owl[a]	Red Shouldered Hawk[a]	Golden Eagle
Bald Eagle		Peregrine Falcon
Fish		
Steelhead Trout	Salmon	Largemouth Bass
Catfish	Black Crappie	
Furbearers		
Opossum	Gray Fox	Coyote
Raccoon	Beaver	Mink
Skunk	Muskrat	
Others		
Black-tailed Deer		

Notes:

(a) Birds nesting on refuge

Source: USFWS computerized annual printout for NWR Birds, Department of Interior, USFWS (RF11650-2 9-79) (July 1973 to June 1974, NWRS Public Use Report (1)) and refuge records.

faced ibis, Plegadis chichi; tricolored blackbird, Agelaius tricolor; and California hibiscus, Hibiscus californicus, as listed in Table IV E-4.

The alternative plans would provide a dependable water supply. As all portions of the Refuge have developed water transportation systems, additional water would be used to improve habitat rather than to develop additional wetlands. The improved habitat would increase the number of bird-use days, as indicated in Table IV E-5.

Implementation of alternative plans probably probably would not adversely affect the listed and candidate threatened and endangered species of wildlife. Detailed field investigations will be completed during the advanced planning phase of the project. Implementation of the plan would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of operating the facilities of the selected plans would be positive due to the continued public use.

F. POWER ANALYSIS

The Refuge is served by PG&E under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver the CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in Chapter II.

G. PERMITS

To obtain State Water Project water, approvals from DWR would be required. Sutter County would issue permits for construction of the wells under Alternatives 2D, 3D, and 4D.

TABLE IV E-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

SUTTER NWR

Listed Species

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (E)
Bald Eagle, *Haliaeetus leucocephalus* (E)
Peregrine Falcon, *Falco peregrines anatum* (E)

Invertebrates

Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds

White-faced ibis, *Plegadis chihi* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Plants

California hibiscus, *Hibiscus californicus* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV E-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

SUTTER NWR

	No Action Alternative	Alternatives							
		2A	2B	2C	2D	3A & 4A	3B & 4B	3C & 4C	3D & 4D
Habitat Acres									
Permanent Pond	--	73	73	73	73	85	85	85	85
Seasonal Marsh	--	1,047	1,047	1,047	1,047	1,250	1,250	1,250	1,250
Watergrass	--	865	865	865	865	1,100	1,100	1,100	1,100
Bird Use Days									
Ducks	--	13,203,000	13,203,000	13,203,000	13,203,000	16,200,000	16,200,000	16,200,000	16,200,000
Geese	--	1,432,000	1,432,000	1,432,000	1,432,000	1,760,000	1,760,000	1,760,000	1,760,000
Waterbirds	--	1,182,000	1,182,000	1,182,000	1,182,000	1,450,000	1,450,000	1,450,000	1,450,000
Endangered Species	--	100	100	100	100	100	100	100	100
Total	--	15,817,100	15,817,100	15,817,100	15,817,100	19,410,100	19,410,100	19,410,100	19,410,100
Public Use Days									
Consumptive	--	3,100	3,100	3,100	3,100	3,600	3,600	3,600	3,600
Non-Consumptive	--	--	--	--	--	--	--	--	--
Total	--	3,100	3,100	3,100	3,100	3,600	3,600	3,600	3,600
Total Annual Cost	--	$ 105,750	$ 105,750	$ 105,750	$ 434,245	$ 135,000	$ 135,000	$ 135,000	$ 588,470
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 6.70	$ 6.70	$ 6.70	$ 27.50	$ 7.00	$ 7.00	$ 7.00	$ 30.30
Incremental Cost/Additional Public Use Day	N/A	$ 34.10	$ 34.10	$ 34.10	$ 140.10	$ 37.50	$ 37.50	$ 37.50	$ 163.50

Notes:
Alternatives 2A, 3A and 4A: Deliver Water from Thermalito Afterbay through Butte Creek
Alternatives 2B, 3B, and 4B: Deliver Water from Thermalito Afterbay through Wadsworth Canal
Alternatives 2C, 3C, and 4C: Obtain Water from Sutter Extension Water District
Alternatives 2D, 3D, and 4D: Implement a Conjuntive Use Plan

CHAPTER IV F

GRAY LODGE WILDLIFE MANAGEMENT AREA PLAN

In 1931 the State Division of Fish and Game purchased the 2,540-acre Gray Lodge Gun Club to establish the first Sacramento Valley wildlife refuge. The club was purchased with Governor's Conservation Fund monies. In 1971, the refuge area was increased to 8,400 acres under the authority of the cooperative State and Federal Pittman-Robertson Federal Aid to Wildlife Restoration Act which provides funds to acquire and develop wetlands. The Gray Lodge Wildlife Management Area (Refuge) is located within an intensively developed agricultural farming area in Sutter and Butte Counties about 10 miles southwest of Gridley. The Refuge is located adjacent to the Butte Sink which is an overflow area of Butte Creek and the Sacramento River.

Butte Basin extends from the City of Red Bluff in the north to Butte and Morrison Sloughs and Sutter Buttes in the south. The Butte Basin is bounded by the Sacramento River on the west and the Feather River on the east. Part of the Butte Sink still remains comparatively unchanged from its original condition, although water developments have reduced flooding. Water for wetlands in the Butte Sink is derived from flood waters, Butte Creek, Sacramento River, and agricultural return flows from rice fields. During wet winters, Butte Basin flood waters flow into the Sutter Bypass flood control area and then into the Sacramento River, or directly into the Sacramento River. Within the Butte Basin, 67 organized hunting clubs maintain over 52,000 acres of habitat including over 22,000 acres of flooded lands. The Butte Sink frequently contains more than one million ducks and thousands of geese, although normal waterfowl populations are about 550,000.

The Refuge consists of marshlands, ponds, wheat fields, and uplands. The wetlands support sources of waterfowl food such as swamp timothy and invertebrate populations. The upland areas of the Refuge provide habitat for geese, upland birds, and other wildlife species. The Refuge is managed by the DFG.

A. WATER RESOURCES

The Refuge receives 8,000 acre-feet of dependable water from the Biggs-West Gridley Irrigation District (BWGID) and Reclamation Districts 833 and 2054. Over 40 percent of water supply is from wells.

1. Surface Waters

Approximately 2,600 acres of the Refuge is located within the BWGID. The BWGID is a member of the Sutter-Butte Joint Water District which owns and operates the Sutter-Butte Canal that conveys water from

Thermalito Afterbay. During some years, the BWGID does not receive adequate water supplies and must purchase water from other districts. The BWGID has allocated 12,000 acre-feet of water per year to the Refuge. However, only 8,000 acre-feet is available during the irrigation season from April to November. The Refuge turnouts are located at the end of the BWGID system and therefore, cannot receive water following dewatering of the BWGID canals in November. Improvements of the BWGID canals, Sutter-Butte Canal, and the Reclamation District drainage system would be needed to maintain year-round water supplies.

The Refuge also diverts water from the Reclamation District 833 Drain and Reclamation District 2054 Drain. These canals convey agricultural return flows. The return flows are only available during the summer and early fall when the rice fields are drained. The Reclamation Districts do not use or claim the agricultural return flows which are diverted by the Refuge under appropriative rights. Based upon existing data, water quality appears to be adequate for refuge management.

Additional water potentially may be obtained from Thermalito Afterbay and conveyed through BWGID facilities, the Cherokee Canal, or Western Canal Water Users Association (WCWUA) facilities. The Cherokee Canal, an old mining drainage channel, is operated by Richvale Irrigation District, a member of the Sutter-Butte Joint Water District. Water from the Cherokee Canal could be diverted to BWGID for delivery to the Refuge. The WCWUA facilities divert water from Thermalito Afterbay and are operated year-round to deliver water to hunting clubs in the Butte Sink.

2. Water Conveyance Facilities

The BWGID delivers water to the Refuge through four supply ditches: Rising River Ditch, Cassidy Ditch, Justeson Ditch, and Lateral C, as shown in Figure IV F-1. Water flows by gravity onto the Refuge from the Rising River, Cassidy, and Justeson Ditches and is available from April to November. Water from Lateral C is diverted into a ditch on the western portion of the Refuge and is pumped onto the Refuge. Lateral C is operated year-round.

Water can be diverted year-round from the Reclamation District 833 Drain through the Refuge. However, water may not be available in the 833 Drain after rice fields are drained in the fall. Water is available by gravity flow from the 2054 Drain from April to November.

The Refuge internal conveyance system is in good condition and only requires minor improvements. The improvements would reduce energy costs by diverting water onto the Refuge at the highest elevations and allowing distribution by gravity flow or low-lift pumps.

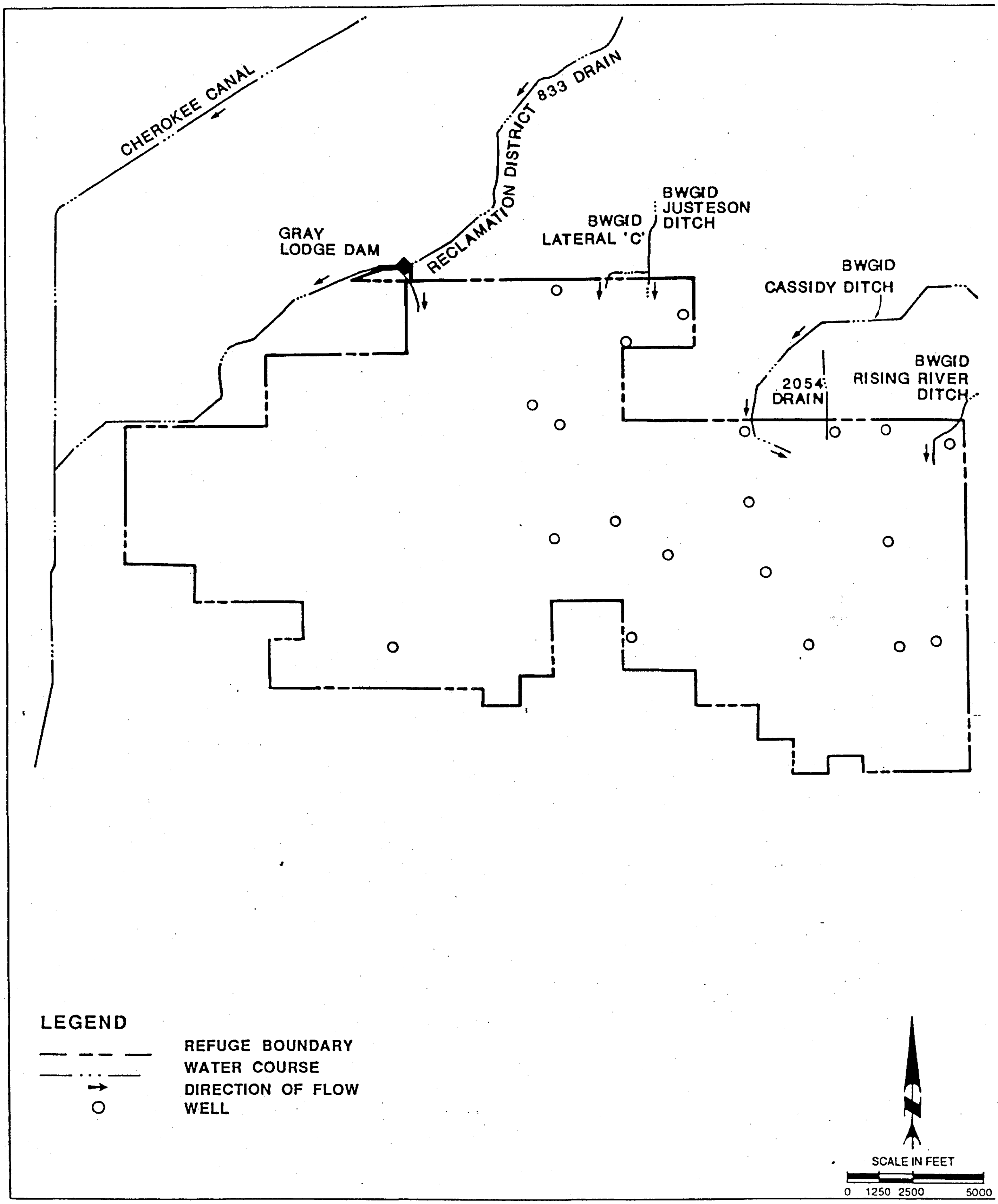


FIGURE IV F-1

GRAY LODGE WILDLIFE MANAGEMENT AREA

EXISTING WATER SUPPLY FACILITIES

3. Groundwater

The Refuge is located on the Butte Creek floodplain and uplands. The area is underlain by fine grained materials with sand lenses which may be part of or derived from the Tuscan Formation. The groundwater is located within 100 feet of the ground surface. Based upon existing data, the quality appears to be suitable for irrigation and waterfowl needs. The safe yield of the aquifer under the Refuge based upon operational records has been estimated to be 12,000 acre-feet.

B. FORMULATION & EVALUATION OF ALTERNATIVE PLANS

The DFG estimates that 44,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water supply alternatives, four levels of water supply have been identified, as presented in Table IV F-1. Each of the water supply levels provide a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (8,000 acre-feet)

The existing facilities are adequate to deliver 8,000 acre-feet of water from BWGID. This 8,000 acre-feet of water is the maximum amount available to the Refuge on a dependable basis. If the agricultural return flows are reduced in the future, this amount could be reduced.

2. Delivery Alternatives for Level 2 (35,400 acre-feet)

The following alternatives would improve water conveyance facilities, reduce the reliance on groundwater, improve the quality of circulated water, and increase the reliability of winter water supplies. All of the alternatives were developed to provide both winter and summer water. Alternatives 2A, 2B, and 2C assume that water can be obtained from Thermalito Afterbay. This would require a long-term agreement between Reclamation and DWR to exchange CVP water for water from Thermalito Afterbay. Because the Refuge has existing wells, additional wells would not need to be constructed to implement a conjunctive use program.

TABLE IV F-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE GRAY LODGE WMA

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	240	1,050	1,230	1,320
February	240	1,050	1,230	1,320
March	240	1,050	1,230	1,320
April	240	1,050	1,230	1,320
May	560	2,500	2,870	3,080
June	800	3,500	4,100	4,400
July	560	2,500	2,870	3,080
August	640	2,850	3,280	3,520
September	1,600	7,100	8,200	8,800
October	1,520	6,750	7,790	8,360
November	1,040	4,600	5,330	5,720
December	320	1,400	1,640	1,760
Total	8,000	35,400	41,000	44,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Source: USBR, 1986a

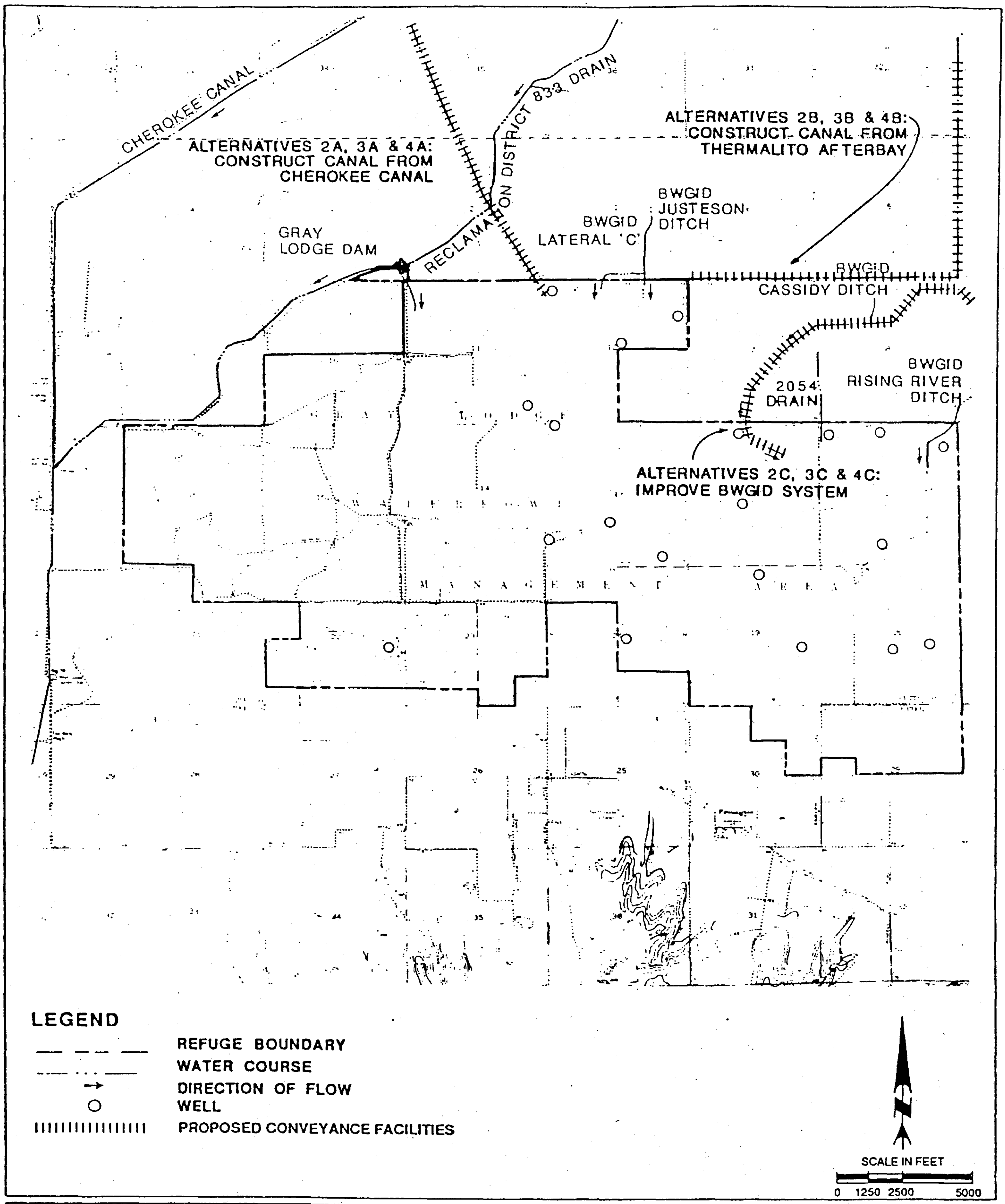


FIGURE IV F-2

GRAY LODGE WILDLIFE MANAGEMENT AREA

ALTERNATIVE WATER SUPPLY FACILITIES

Alternative 2A - Construct Ditch from Cherokee Canal. To deliver water from Cherokee Canal to the Refuge, an 11,000-foot ditch would be constructed from the Cherokee Canal to the Refuge, as shown in Figure IV F-2. Water would be delivered from the Thermolito Afterbay by Richvale Irrigation District to the Cherokee Canal. Due to the location of the Cherokee Canal, the water would be delivered to the lowest elevation on the Refuge and would require pumping to distribute water on the Refuge.

Alternative 2B - Construct Canal from Thermolito Afterbay. A canal would be constructed from Thermalito Afterbay to the Refuge. The 63,360-foot canal would include siphons under State Highway 99, Southern Pacific Railroad tracks, and at four local roads.

Alternative 2C - Improve Biggs-West Gridley Irrigation District System. BWGID cannot deliver water to the Refuge in the winter due to maintenance on the canals. This plan was developed so that improvements would be completed on portions of the BWGID conveyance system which would reduce the need to dewater the canals. The improvements would include construction of a larger culvert at Evans Reimer Road to increase the capacity of the Cassidy Ditch from 25 cfs to over 60 cfs, as well as other improvements to 4,750 feet of the Cassidy Ditch. This alternative would require implementation of Alternative 2A or 2B.

Alternative 2D - Implement a Conjunctive Use Plan. Existing wells would be used to deliver the maximum month water demand. The wells would be operated as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP exchange water is provided. Implementation of this alternative also would require implementation of Alternative 2A, 2B, or 2C.

3. Delivery Alternatives for Level 3 (41,000 acre-feet)

Water deliveries under Level 3 are similar to the Level 2 deliveries. The same alternatives considered for Level 2 were evaluated for Level 3.

Alternative 3A - Construct Ditch from Cherokee Canal. This alternative is identical to Alternative 2A.

Alternative 3B - Construct Canal from Thermolito Afterbay. This alternative is identical to Alternative 2B.

Alternative 3C - Improve Biggs-West Gridley Irrigation District System. This alternative is identical to Alternative 2C. This alternative would require implementation of Alternative 3A or 3B.

Alternative 3D - Implement a Conjunctive Use Plan. Existing wells would be used to deliver the maximum month water demand. This alternative is identical to Alternative 2D. Implementation of this alternative also would require implementation of Alternative 3A, 3B, or 3C.

4. Delivery Alternatives for Level 4 (44,000 acre-feet)

Under Level 4, a portion of the uplands would be flooded to improve refuge management. However, the water supply alternatives proposed under Levels 2 and 3 would be adequate to provide water supplies under Level 4. Therefore, the alternatives for Level 4 would be the same as for Levels 2 or 3.

Alternative 4A - Construct Ditch from Cherokee Canal. This alternative is identical to Alternative 2A.

Alternative 4B - Construct Canal from Thermolito Afterbay. This alternative is identical to Alternative 2B.

Alternative 4C - Improve Biggs-West Gridley Irrigation District System. This alternative is identical to Alternative 2C. This alternative would require implementation of Alternative 4A or 4B.

Alternative 4D - Implement a Conjunctive Use Plan. Existing wells would be used to deliver the maximum month water demand. This alternative is identical to Alternative 2D. Implementation of this alternative also would require implementation of Alternative 4A, 4B, or 4C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1.

Alternatives 2A, 3A, and 4A would require long-term agreements with Richvale Irrigation District. Alternatives 2C, 3C, and 4C would require long-term conveyance agreements with BWGID to transport additional water to the Refuge. Alternatives 2B, 3B, and 4B may be difficult to implement due to the need to aquire easements along the 12-mile alignment.

Alternatives 2C, 3C, and 4C would require implementation of Alternatives 2A or 2B, 3A or 3B, and 4A or 4B, respectively, to provide summer water supplies.

Alternatives 2D, 3D, and 4D may result in overdraft conditions because the amount of water needed would exceed the safe yield of the Refuge. These alternatives would require implementation of surface water alternatives (Alternatives 2A, 2B, or 2C; Alternatives 3A, 3B, or 3C; and Alternatives 4A, 4B, or 4C) to provide water during wet years.

C. COSTS & ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Levels 2, 3, and 4 are presented in Table IV F-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP exchange water. During the advanced planning phase, these costs will be refined further. The costs do not include the costs to provide water under Level 1.

Construction of the facilities under the alternative plans would result in additional money being spent in the economy of Sutter and Butte Counties during construction. The construction could be completed within one summer season by construction workers who reside within the area.

Currently, the annual public use (Level 2) at the Refuge is about 165,200 visits per year. If additional water is provided, the public use levels are anticipated to increase.

D. WILDLIFE RESOURCES

The average annual bird use on the Refuge is over 58,300,000. Butte Basin is one of the most important wintering areas for the endangered Aleutian Canada goose. Wildlife and fishery resources associated with the Refuge are presented in Table IV F-3. The only federally listed threatened and endangered species associated with the Refuge are the Aleutian Canada goose, Branta canadensis Leucopareia and the Valley elderberry longhorn beetle, Desmocerus californicus dimorphus. Candidate threatened and endangered species associated with the Refuge include the white-faced ibis, Plegadis chichi; tricolored blackbird, Agelaius tricolor; Sacramento anthicid beetle, Anthicus Sacramento; and California hibiscus, Hibiscus californicus, as listed in Table IV F-4.

Implementation of alternative plans probably would not adversely affect the listed and candidate threatened and endangered species of wildlife. The improved habitat would increase the number of public-use days, as indicated in Table IV F-5. Detailed field investigations will be completed during the advanced planning phase of the project. Implementation of the plan would result in overall beneficial environmental effects. The No Action Alternative could result in the loss of habitat and associated recreational benefits. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

TABLE IV F-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

GRAY LODGE WMA

	Alternatives 2A	2B	2C	2D	3A	3B
Additional Water (ac-ft)	27,400	27,400	27,400	27,400	33,000	33,000
Construction Costs						
Wells	$ --	$ --	$ --	$ --	$ --	$ --
Pipelines/Canals	59,500 (a)	948,300 (c)	34,000 (d)	--	59,500 (a)	948,300 (c)
Pump Station	216,000 (b)	--	--	--	216,000 (b)	--
Subtotal	$275,500	$948,300	$ 34,000	$ --	$275,500	$948,300
Other Costs	--	--	275,500 (e)	275,500 (f)	--	--
Total (g)	$275,500	$948,300	$309,500	$275,500	$275,500	$948,300
Annualized Construction Costs (8.87%, 30 yrs)	$ 26,500	$ 91,230	$ 29,780	$ 26,500	$ 26,500	$ 91,230
Additional Annual Costs						
Operation & Maintenance (h)	$ 4,200	$ 18,500	$ 1,100	$ 37,000	$ 4,200	$ 18,500
Power	41,100 (i)	--	--	130,150 (j,k)	49,500 (i)	--
Local Conveyance Cost (l)	49,320	--	-- (m)	--	59,400	--
Subtotal	$ 94,620	$ 18,500	$ 1,100	$167,150	$113,100	$ 18,500
Other Costs	--	--	94,620 (e)	47,310 (f,k)	--	--
Total (g)	$ 94,620	$ 18,500	$ 95,720	$214,460	$113,100	$ 18,500
Total Annual Cost	$121,120	$109,730	$125,500	$240,960	$139,600	$109,730
Cost/Additional Acre-Foot	$ 4.40	$ 4.00	4.60	$ 8.80	$ 4.20	$ 3.30

TABLE IV F-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

GRAY LODGE WMA

(Continued)

	Alternatives					
	3C	3D	4A	4B	4C	4D
Additional Water (ac-ft)	33,000	33,000	36,000	36,000	36,000	36,000
Construction Costs						
Wells	$ --	$ --	$ --	$ --	$ --	$ --
Pipelines/Canals	34,000(d)	--	59,500(a)	948,300(c)	34,000(d)	--
Pump Station	--	--	216,000(b)	--	--	--
Subtotal	$ 34,000	$ --	$275,500	$948,300	$ 34,000	$ --
Other Costs	275,000(e)	275,500(f)	--	--	275,000(e)	275,500(f)
Total (g)	$309,000	$275,500	$275,500	$948,300	$309,000	$275,500
Annualized Construction Costs (8.87%, 30 yrs)	$ 29,750	$ 26,500	$ 26,500	$ 91,230	$ 29,730	$ 26,500
Additional Annual Costs						
Operation & Maintenance	$ 1,100	$ 37,000	$ 4,200	$ 18,500	$ 1,100	$ 37,000
Power	--	156,750(i,j)	54,000(h)	--	--	171,000(i,j)
Local Conveyance Cost(k)	--(l)	--	64,800	--	--(l)	--
Subtotal	$ 1,100	$193,750	$123,000	$ 18,500	$ 1,100	$208,000
Other Costs	113,100(e)	56,550(f,j)	--	--	123,000(e)	61,500(f,j)
Total (g)	$114,200	$250,300	$123,000	$ 18,500	$124,100	$269,500
Total Annual Cost	$143,950	$276,800	$149,500	$109,730	$153,830	$296,000
Cost/Additional Acre-Foot	$ 4.40	$ 8.40	$ 4.20	$ 3.10	$ 4.30	$ 8.20

TABLE IV F-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

GRAY LODGE WMA

(Continued)

Notes: Alternatives 2A, 3A, and 4A: Construct Ditch from Cherokee Canal.
Alternatives 2B, 3B, and 4B: Construct Canal from Thermalito Afterbay.
Alternatives 2C, 3C, and 4C: Improve Biggs-West Gridley Irrigation District System.
Alternatives 2D, 3D, and 4D: Implement a Conjunctive Use Plan.

(a) 11,000-foot, 36 cfs unlined canal; three 80-ft siphons.

(b) 36 cfs, 20-foot lift pump station.

(c) 63,360-foot, 140 cfs unlined canal; seven 80-ft siphons.

(d) 4,750-foot, 60 cfs unlined canal; 66-inch diameter crossing.

(e) Alternative 2C assumes implementation of 2A, Alternative 3C assumes implementation of 3A, Alternative 4C assumes implementation of 4A.

(f) Alternative 2D assumes implementation of 2A, Alternative 3D assumes implementation of 3A, Alternative 4D assumes implementation of 4A.

(g) The cost for Water Supply Level 1 is not included.

(h) Basis for O&M cost are discussed in Appendix F.

(i) Unit Pumping Cost = $1.50/af.

(j) Unit Pumping Cost = $9.50/af.

(k) Values multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(l) Unit Conveyance Cost = $1.80/af.

(m) Cost included with conveyance costs for Alternatives 2A, 3A, or 4A, respectively.

TABLE IV F-3

FISH AND WILDLIFE RESOURCES

GRAY LODGE WMA

Ducks		
Hooded Merganser	Cinnamon Teal[a]	Scaup
Mallard[a]	Blue-winged Teal	Ring-necked Duck
Canvasback	Northern Shoveler	Common Goldeneye
European Wigeon	Wood Duck[a]	Bufflhead
American Wigeon	Gadwall[a]	Ruddy Duck[a]
Common Merganser	Pintail[a]	Red-breasted Merganser
Green-winged Teal	Redhead[a]	
Geese and Swans		
Ross' Goose	Snow Goose	White-fronted Goose
Cackling Canada Goose	Canada Goose	Lesser Canada Goose
Tundra Swan		
Coots		
	American Coot[a]	
Shore and Wading Birds		
Common Gallinule[a]	American Avocet[a]	Black-necked Stilt[a]
Great Blue Heron[a]	Green-backed Heron[a]	Snowy Egret[a]
Great (Common) Egret[a]	Common Snipe	
Upland Game		
Ring-necked Pheasant	Dove	
Jackrabbit	Cottontail	

TABLE IV F-3

FISH AND WILDLIFE RESOURCES

GRAY LODGE WMA
(Continued)

Raptorial Birds		
American Kestrel[a]	Northern Harrier[a]	Screech Owl[a]
Great Horned Owl[a]	Burrowing Owl[a]	Black-shouldered Kite[a]
Red-tailed Hawk[a]	Turkey Vulture	Golden Eagle
Fish		
Largemouth Bass	Catfish	
Carp	Pan Fish	
Furbearers		
Opossum	Raccoon	Coyote
Mink	Beaver	Skunk
Muskrat		
Others		
Mule Deer		

Notes:

(a) Birds nesting on refuge

Source: Environmental Assessment Reports, Gray Lodge Wildlife Area, and Refuge records

TABLE IV F-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

GRAY LODGE WMA

Listed Species

Invertebrates

Valley elderberry longhorn beetle, Desmocerus californicus dimorphus (T)

Proposed Species

None

Candidate Species

Birds

White-faced ibis, Plegadis chihi (2)
Tricolored blackbird, Agelaius tricolor (2)

Invertebrates

Sacramento anthicid beetle, Anthicus sacramento (2)

Plants

California hibiscus, Hibiscus californicus (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV F-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

GRAY LODGE WMA

	No Action Alternative	Alternatives											
		2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D
Habitat Acres													
Permanent Pond	0	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,700	2,700	2,700	2,700
Native Marsh	2,600	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800
Cereal Grains	300	300	300	300	300	300	300	300	300	300	300	300	300
Upland	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,200	1,200	1,200	1,200
Administration	400	400	400	400	400	400	400	400	400	400	400	400	400
Bird Use Days													
Ducks and Geese	13,100,000	57,100,000	57,100,000	57,100,000	57,100,000	66,200,000	66,200,000	66,200,000	66,200,000	70,800,000	70,800,000	70,800,000	70,800,000
Other Waterbirds	300,000	1,200,000	1,200,000	1,200,000	1,200,000	1,400,000	1,400,000	1,400,000	1,400,000	1,500,000	1,500,000	1,500,000	1,500,000
Total	13,400,000	58,300,000	58,300,000	58,300,000	58,300,000	67,600,000	67,600,000	67,600,000	67,600,000	72,300,000	72,300,000	72,300,000	72,300,000
Public Use Days													
Consumptive	20,800	29,800	29,800	29,800	29,800	31,100	31,100	31,100	31,100	32,500	32,500	32,500	32,500
Non-Consumptive	83,300	135,400	135,400	135,400	135,400	157,000	157,000	157,000	157,000	168,000	168,000	168,000	168,000
Total	104,100	165,200	165,200	165,200	165,200	188,100	188,100	188,100	188,100	200,500	200,500	200,500	200,500
Total Annual Cost	-	$ 121,120	$ 109,730	$ 125,500	$ 240,960	$ 139,600	$ 109,730	$ 143,950	$ 276,800	$ 149,500	$ 109,730	$ 153,830	$ 296,000
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 2.70	$ 2.50	$ 2.80	$ 5.40	$ 2.60	$ 2.00	$ 2.70	$ 5.10	$ 2.50	$ 1.90	$ 2.60	$ 5.00
Incremental Cost/Additional Public Use Day	N/A	$ 2.00	$ 1.80	$ 2.10	$ 4.00	$ 1.70	1.30	1.70	$ 3.30	$ 1.60	$ 1.20	$ 1.60	$ 3.10

Notes: Alternatives 2A, 3A, and 4A: Construct Ditch from Cherokee Canal.
Alternatives 2B, 3B, and 4B: Construct Canal from Thermalito Afterbay.
Alternatives 2C, 3C, and 4C: Improve Biggs-West Gridley Irrigation District System.
Alternatives 2D, 3D, and 4D: Implement a Conjunctive Use Plan.

E. SOCIAL ANALYSIS

The social consequences of operating the facilities of the selected plans would be positive due to the potential increase in public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. The power is used for the wells and on-refuge conveyance system pumps. Timers have been installed on many pumps to increase the use of off-peak pump operations.

A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver the CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in Chapter II.

G. PERMITS

Construction of the facilities would require several permits. Butte County would issue approvals for construction of the new canals to ensure that existing drainage facilities would not be adversely affected. Construction under Alternatives 2B, 3B, 4B, 2C, 3C, and 4C may require a Stream Alteration Permit from DFG and a Corps of Engineers permit for construction in wetlands or riparian corridors. Alternatives 2B, 3B, and 4B also would require permits from CalTrans to cross State Highway 99, from Butte County to cross local roads, and from Southern Pacific Railroad to cross the railroad property.

CHAPTER IV G

GRASSLAND RESOURCE CONSERVATION DISTRICT

The Grassland Resource Conservation District (GRCD) is comprised of 75,000 acres of land which contains the Grassland Water District (GWD), including 165 hunting clubs; Kesterson National Wildlife Refuge (NWR); Volta Wildlife Management Area (WMA); Los Banos WMA; and privately owned wetlands, as shown in Figure IV G-1. The GRCD includes 60,000 acres of privately-owned hunting clubs, 12,000 acres of land owned by the Federal and state governments, and 3,000 acres of cropland. The GRCD is presided over by the Grassland Resource Conservation Board whose members are elected by the people who reside within the boundaries of GRCD.

This area, commonly referred to as the West Grasslands, represents the largest contiguous block of wetlands remaining in the Central Valley and is a major wintering ground for the migratory waterfowl of the Pacific Flyway. Up to 30 percent of the Pacific Flyway wintering population of duck species use this area.

These wetlands are the remnants of a much larger seasonal wetlands complex that historically extended throughout the Central Valley. The wetlands are characterized as shallow wetlands that maintain standing waters during the rainy season but are depleted of soil moisture during the summer. The Service ranked the habitat provided by the GRCD as the most important wetlands in the San Joaquin Valley.

Management of portions of the GRCD wetland habitat has been assisted since 1972 through the Water Bank Program which provides financial incentive to participating landowners to maintain their land as wetland habitat, as well as providing technical assistance from various State and Federal agencies. Recently, the program has been broadened to encourage increased production of food plants for waterfowl (ESA, 1987). Because of limited funding, an average of 15,000 acres have historically been allowed to participate in the program each year. In addition, severely restricted supplies of uncontaminated water have further reduced the landowner's ability to take advantage of the program since 1985.

Although an overall management plan does not exist, the GRCD management objectives encourage food plant and habitat production, primarily swamp timothy and wild millet. Land uses within GRCD included seasonally flooded inland marshes, permanent pasture, seasonally flooded native pasture, and agricultural crops.

To preserve waterfowl habitat, perpetual easements on about 26,000 acres within the GRCD have been purchased by the Service. These easements authorize the Service to restrict land uses that would diminish waterfowl habitat. The purpose of the easement acquisition is to assure that wintering habitat will continue to be preserved and managed for migratory waterfowl (GWD, 1987). Participation in the easement program does not guarantee or provide the landowner with a water supply to manage the property for waterfowl habitat.

A. WATER RESOURCES

Within the non-refuge portions of GRCD, 70 to 80 percent of the acreage is managed to provide habitat for wintering waterfowl. The agricultural lands only receive drain water and are managed for permanent pasture and other agricultural crops such as sugar beets, alfalfa, and cotton. Any wetland areas within GWD which are converted to agriculture uses are not eligible to use CVP water available from GWD.

Approximately 70 to 80 percent of the lands in GWD and other non-refuge areas are flooded from mid-September to January 15 to an average depth of 18 inches. Some owners drain their land shortly after the hunting season ends in mid-January. However, recognizing the need to provide later winter habitat, GWD has encouraged the landowners to retain the water beyond the end of the hunting season. As a result, there are an increasing number of owners who do not release the water until mid-March or the first of April. Around May 15 of each year, a few areas with uncontaminated water supplies are flood irrigated with about six to eight inches of water for five to ten days to stimulate the growth of waterfowl food plants. If water is available, some owners also irrigate in June or July.

1. Surface Waters

In 1953, as settlement of a water rights claim by Grasslands area interests, 50,000 acre-feet per year of CVP water was made available for use in GWD. The GWD was formed under the California Water Code in 1953 to provide a legal entity to contract for the 50,000 acre-feet per year and to assume responsibility for the distribution of water and maintenance of facilities within the district. The contract limits delivery of this water to the period between September 15 and November 30.

In 1963, GWD initiated a successful protest of the Reclamation's water right for the Los Banos Creek project and received an additional 3,500 acre-feet of CVP water annually. By subsequent agreements, GWD's water was made available from Reclamation at no cost with the following conditions: 1) that GWD maintain at least 80 percent of the district land in wildlife habitat (GWD, 1987), and 2) that GWD supply to the Service not less than 3500 acre-feet of water during the period from October 1 through November 30 of each year. Consequently, the total amount of firm water available to the private wetlands was again reduced to 50,000 acre-feet annually.

To supplement this supply and to provide water for the balance of the year, the GRCD has used agricultural return flows, operational

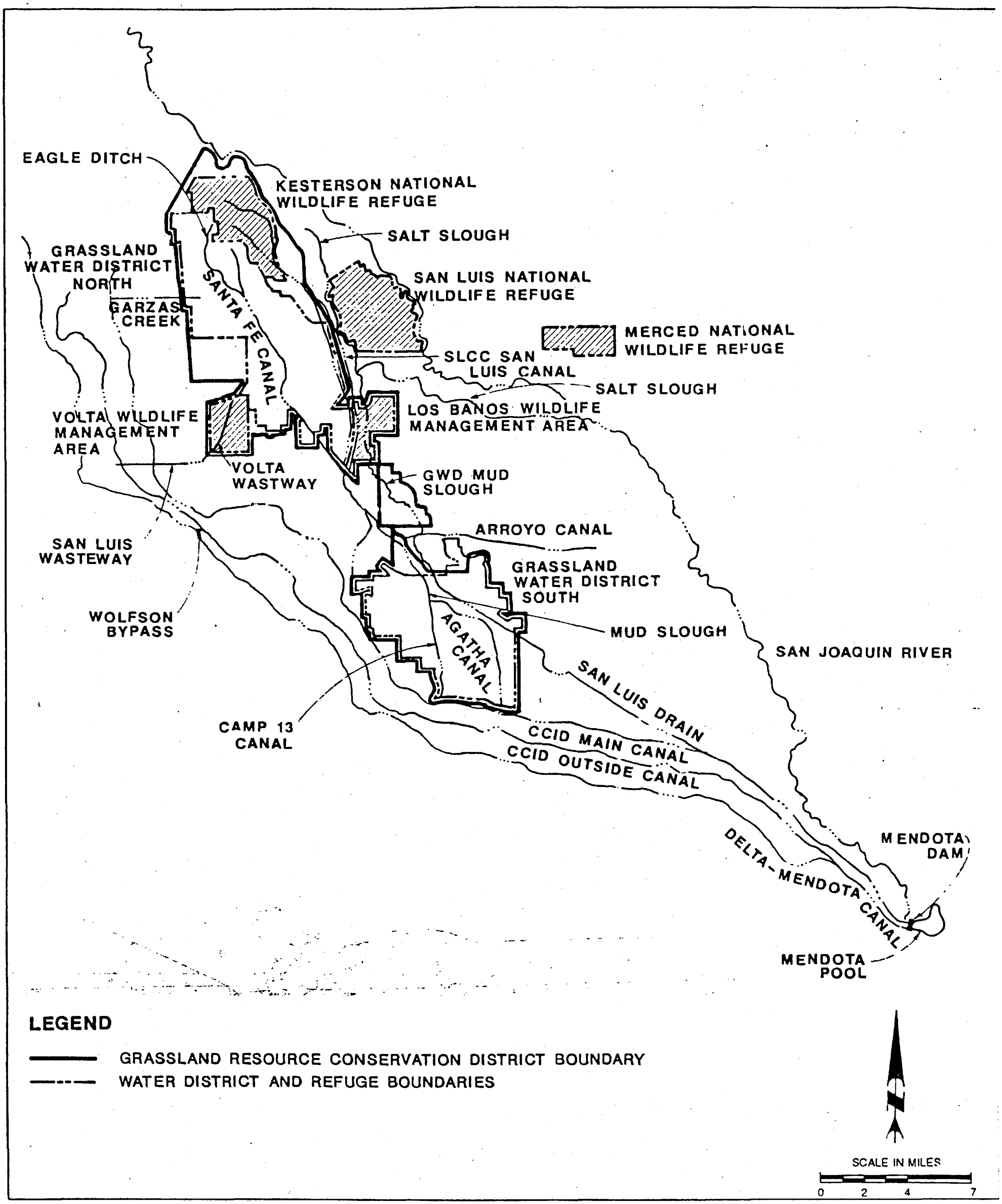
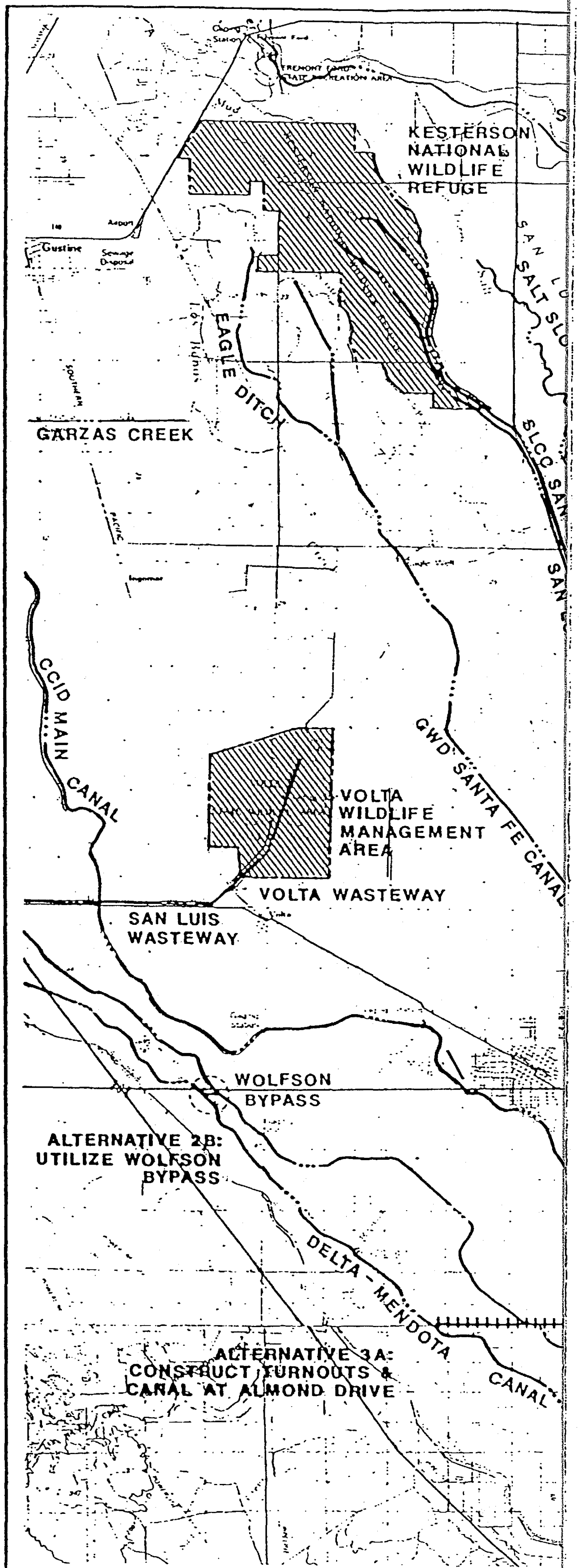


FIGURE IV G-1

GRASSLAND RESOURCE CONSERVATION DISTRICT

EXISTING WATER SUPPLY FACILITIES

After Figure IV G



LEGEND

- - - - REFUGE BOUNDARY

—··— WATER COURSE

SCALE IN FEET

0 3000 6000 12000

FIGURE IV G-2

GRASSLAND RESOURCE CONSERVATION DISTRICT

ALTERNATIVE WATER SUPPLY FACILITIES

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spill flows from upslope irrigation and water districts, and wells to a very limited extent. Private wetlands within GRCD but outside of boundaries of GWD, are totally dependent upon the receipt of agricultural return flows from neighboring farm lands, water from deep wells, or where feasible, have contracted for the delivery of water from other local water agencies.

The Kesterson Problem. During the spring and summer of 1983, serious waterfowl reproductive problems were observed involving the twelve 100-acre ponds on the Kesterson NWR, which is within the GRCD boundary. Studies revealed that selenium toxicity was a suspected cause of these problems.

The Kesterson ponds served as the terminus for Reclamation's San Luis Drain. The San Luis Drain was designed to remove subsurface irrigation drainage waters from portions of San Joaquin Valley farmlands. An undetermined acreage of these irrigated lands is thought to be the source of the selenium contamination that is causing the toxicity at the Kesterson ponds.

In 1984, shortly after reproductive problems were identified at the refuge, a hazing operation was initiated to discourage waterfowl from using the area. In 1985, the State Water Resources Control Board issued a cleanup and abatement order, which was followed by a cleanup and closure order from the Secretary of the Interior. Although complete implementation of these orders may take up to several years, the value of the Kesterson pond habitat to waterfowl has been lost.

The Kesterson problem has created an uncertain future for other projects in the Valley that involve using subsurface irrigation drainage waters to create waterfowl habitat. In the Grassland area, 148,000 acre-feet of drainage water had been used annually for maintaining waterfowl habitat (USBR, 1986d). However, upon the discovery that much of the subsurface drain waters entering the area contain harmful amounts of selenium and other contaminants, the use of this water has been discontinued. This has caused perhaps as much as two-thirds of the former water supply to no longer be useable for waterfowl habitat.

Beginning in 1986, a series of one year temporary contracts was implemented with Reclamation to provide a supplemental water supply of up to 100,000 acre-feet annually to lands within GWD. However, the cost ($12/acre-foot) precluded use of the water on a widespread basis. More significantly the unavailability of capacity in the DMC has hampered efforts to deliver this water on a continuing basis.

2. Water Conveyance Facilities

The GRCD is divided into the northern and southern areas, as shown in Figure IV G-1. Water supplies to the northern area are delivered by Garzas Creek on the northwest, Volta Wasteway and San Luis Wasteway on the southwest side, the GWD Santa Fe Canal and Eagle

Ditch in the central portion, and the San Luis Canal on the east side. CVP water can be delivered from the DMC through the Mendota Pool or Wolfsen Bypass to the CCID Main Canal which flows into Garzas Creek. Water also can be diverted from the DMC to the Volta Wasteway.

Water supplies for the southern GRCD area are routed through the CCID Main Canal and CCID Helm Canal. The primary conveyance facilities in the southern division of the GWD are the Camp 13 and Agatha/Geis systems. As noted above, CVP water from the DMC can be diverted into the CCID Main Canal and then to the Agatha Canal and Camp 13 Ditch.

Water supply problems have occurred when the CCID facilities are used to transport agricultural return flows which may not be suitable for refuge management. However, with the aid of funding from the State Resources Agency and the Wildlife Conservation Board, facilities to allow for the separation of flows have been and are being constructed. Additional flow separation projects would further improve management, as discussed below.

The Porter-Blake Bypass has been constructed to divert unusable agricultural drain flows which pass through the Camp 13 and Agatha Canals into Mud Slough. The flows are conveyed in Mud Slough to Salt Slough for continued conveyance to the San Joaquin River. This bypass currently allows freshwater deliveries to be made via the San Luis Canal into northern GRCD area. However, use of the bypass was and is intended to be only a temporary means of dealing with the contamination problem. By agreement with the San Luis Canal Company (SLCC), the operation of this system is scheduled to be discontinued by 1990. At that time, unless an alternate means of separating drainage flows from fresh water supplies is implemented, such as the alternatives discussed in this chapter, portions of the northern GRCD service area may become contaminated.

The GWD also has completed the first two phases of a three-phase project to separate fresh water supplies from drain water for the southern GRCD area. This separation project when completed will allow GWD to alternate the conveyance of fresh water between the Agatha and Camp 13 Canal Systems. When fresh water is flowing in one system, adjacent marshlands can be flooded and irrigated, while agricultural drainage water is bypassed to Mud Slough through the other system. By alternating the type of water carried by each system, all of the southern portion of the GRCD wetlands can receive water of suitable quality. However, drain water would be present in one or the other of the systems at all times, therefore the wetlands cannot be assured of receiving fresh water at the precise time of need.

Another conveyance problem is related to the dewatering of the CCID Main Canal and Reclamation's Mendota Pool for maintenance between mid-November and February. The loss of water delivery capabilities in November constrains management of waterfowl habitat and the availability of the area for public use. The Mendota Pool is not completely dewatered every year, however, CCID does lower the water level in the CCID canals every winter. Refuge management would be improved if the lowering of the water level was delayed until early December. Negotiations have been completed between GWD and CCID to convey water which may be available at other times during the year when and if CCID has excess capacity in its canal system.

The lands within the GRCD are subject to flooding from several of the natural streams which traverse the area. However, operational modifications on the Los Banos Creek Detention Dam have reduced the frequency and extent of flooding in that watershed. The northernmost portions of the GRCD continue to be impacted by uncontrolled run-off in Garzas Creek (GWD, 1985, 1987).

3. Groundwater

Most of the GRCD is located on land deposits created from overflow of the San Joaquin River. Portions of the GRCD on the eastern side lie within the San Joaquin River floodplain and in channel deposits.

Two water bearing zones are present under the surface and are separated by the Corcoran Clay, an approximately 100-foot thick layer of clay at about a 200-foot depth. Records from wells in the general area of the GRCD show that pump yields range from 675 to 2,100 gallons per minute. Existing well data indicates that dissolved solids concentrations in the groundwater are generally high above the Corcoran Clay. Water below the Corcoran Clay is generally of better quality with total dissolved solids below 2,000 ppm (USFWS, 1978).

Groundwater pumping facilities are present on approximately 15 of the 165 hunting clubs within GWD. Excessive pumping costs and generally poor quality groundwater preclude the use of these wells for anything other than a supplemental supply (GWD, 1987). Some of these wells have not been kept fully operational because of poor yield. Reclamation estimates that the safe yield for the GRCD areas not within the NWRs and WMAs is 71,500 acre-feet. This safe yield assumes that the water would be pumped from below the Corcoran Clay.

4. Offstream Storage

There is a need for additional CVP yield within the San Joaquin Valley to relieve the groundwater overdraft and to provide additional water needed for agricultural, municipal, and fish and wildlife purposes. Surplus water could be pumped from the Sacramento River or the Delta during times when the system is operating at less than maximum capacity, stored at an offstream site until needed, and then delivered during times when canal capacity is available.

Reclamation began investigating various potential offstream storage sites within the San Joaquin Valley in October 1985. In 1987, the California Waterfowl Association requested that the GRCD be included as a potential offstream storage site, whereby wetlands could be enhanced for the benefit of waterfowl and at the same time increase project yield.

An evaluation of GRCD lands for offstream storage on wetland habitat was conducted by Reclamation. The results of this evaluation (USBR, 1987k) indicated that an opportunity for offstream storage within the GRCD does exist. However, the exact amount of return flow varied according to water operations. The report pointed out that more information is needed relative to seepage, evaporation, water quality and impacts on wildlife to determine the viability of an offstream storage program within the GRCD.

In October, 1987, Reclamation entered into a cooperative agreement with the GWD to perform, on a cost-sharing basis, a pilot study to assess the potential for the use of wetlands within the GRCD as an offstream storage site. The primary purpose of this one year study was to obtain additional data on seepage, evaporation, and water quality. Reclamation provided 20,680 acre-feet and local water districts provided 3570 acre-feet of water to GWD during the fall for distribution on approximately 17,000 acres in the northern portion of GWD. The ponded water was released during the spring of 1988 and monitored for quality and quantity. Although weather conditions were extremely dry during the study period and abnormal evaporation rates were experienced, return flow from the ponded area was calculated to be 24 percent of the total applied water. The quality values were determined to be acceptable when blended with other water in the San Joaquin River. Based on the favorable results, a second year of the program was initiated in the fall of 1988.

As information relative to the 1988-89 off-stream storage program in GRCD becomes available, it will be appropriately incorporated into the Refuge Water Supply Planning Report. If the data from the study continues to be favorable, off-stream storage may become a component of a plan to provide the GRCD with dependable water supplies.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service, GRCD, and GWD estimate that 180,000 acre-feet of water would be required for full development and optimum management of the GRCD, not including the NWRs and WMAs. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV G-1.

TABLE IV G-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE GRASSLAND RCD

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac—ft	Supply Level 4 ac-ft
January	0	3,000	5,200	5,200
February	0	0	6,000	6,000
March	0	0	5,800	5,800
April	0	5,000	9,100	9,100
May	0	12,000	25,700	25,700
June	0	12,000	20,800	20,800
July	0	0	5,800	5,800
August	0	4,000	8,200	8,200
September	10,000	25,000	25,800	25,800
October	30,000	36,000	38,600	38,600
November	10,000	19,000	19,300	19,300
December	0	9,000	9,700	9,700
Total	50,000	125,000	180,000	180,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum mangement

Source: USFWS, 1986g

Each of the water supply levels provide a different rate and volume of water, summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 -Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (50,000 acre-feet)

Adequate facilities exist to deliver the current firm water supply to the GRCD. Therefore, no facilities were developed for Level 1.

2. Delivery Alternatives for Level 2 (125,000 acre-feet)

Water from the CVP would be conveyed to the GRCD through existing canals following modifications to separate the fresh water from the agricultural return flows. The Level 2 alternatives would modify existing canals to provide a reliable and good quality water supply. The improved water quality would allow GRCD to increase wildlife habitat such as brood ponds and nesting cover, and increase areas with smartweed and watergrass.

Alternative 2A - Convey Water Under the Zahm-Sansoni-Nelson Plan. The Zahm-Sansoni-Nelson Plan has been revised several times. Under the most recent revision, the San Luis Drain would convey water to the Mendota Pool from CVP facilities, surplus water from the San Joaquin River, and/or surplus water from the Kings River through an intertie in Fresno County (near Bass Avenue). This would allow the GRCD to use flood flows during wet years and reduce capacity problems which occur when CCID cannot use the Wolfson Bypass during flood periods. Water would be diverted from the San Luis Drain near Mallard Road to serve a large portion of the southern GRCD.

The water would flow in the San Luis Drain to the junction of the GWD Santa Fe Canal and the GWD Camp 13 - Mud Slough Bypass. Several new valves and a siphon would be constructed to divert CVP water into the GWD Santa Fe Canal. The CVP water would be mixed with usable agricultural return flows from the SLCC Arroyo Canal which also contains flows from the Agatha Canal Extension. The water would flow through the GWD Santa Fe Canal and be diverted to the SLCC San Luis Canal and Eagle Ditch for delivery to the GRCD and other refuges.

Currently, the GWD Santa Fe Canal conveys a mixture of useable agricultural return water from the SLCC Arroyo Canal and poorer quality return water from Mud Slough. The water quality of the combined flows is too poor to be used for refuge management. Under this plan, flows from the Camp 13 Canal would be prevented from entering the GWD Santa Fe Canal by a new valve. Instead, the poorer quality water would enter the San Luis Drain, as shown in Figure IV G-2.

This plan would allow GRCD to make use 40 to 120 cfs of useable agricultural return flows available from April to September without using the Porter-Blake Bypass. However, use of the San Luis Drain to convey fresh water would require prior cleaning of toxic sediments, such as selenium.

Alternative 2B - Utilize the Wolfson Bypass. The CCID Wolfson Bypass provides CVP water from the DMC to the CCID Outside Canal, as shown in Figure IV G-2. Water in the CCID Outside Canal can flow to the north or the south. When water is conveyed through the Wolfson Bypass, water in the CCID Outside Canal flows south.

The Wolfson Bypass would be used to transfer CVP water to the CCID Outside Canal. Water would be diverted from the CCID Outside Canal to the CCID Main Canal through an existing cross-tie. From this point, CVP water would be conveyed through the CCID Main Canal to the SLCC San Luis Canal for delivery to the refuges. A lift pump would be constructed on the CCID Main Canal to transfer water through the Helm Extension to the Agatha Canal.

Use of this alternative is limited to times when CCID allows water to flow to the south in the Outside Canal. This plan also may be useful when the Mendota Pool is dewatered.

Alternative 2C - Implement a Conjunctive Use Plan. Ninety-five wells would be constructed within the non-refuge portion of GRCD to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternative 2A or 2B.

3. Delivery Alternatives for Level 3 (180,000 acre-feet)

The following alternatives would provide facilities to deliver the increased water supply level from the DMC to the southern portion of the GRCD. Alternative 3A would require implementation of Alternative 2A or 2B. Alternative 3B would require implementation of Alternative 3A or 3B.

Alternative 3A - Construct Turnouts on the Delta-Mendota Canal at Almond Drive and Russell Avenue. Water would be diverted from the DMC at two new turnouts under this plan. The first turnout would be located near Almond Drive. A new 12,600-foot unlined canal would be constructed parallel to Almond Drive from the turnout to the existing Almond Drive Ditch. Approximately 10,400 feet of the Almond Drive Ditch would be rehabilitated to convey the increased flows. Water would flow through the Almond Drive Ditch to Flyway Ditch and Gadwall Canal which would serve about 2,000 acres of GRCD and eight private hunting clubs.

The new canal along Almond Drive would include siphons under the Outside Canal and the Main Canal. During construction these two canals would probably be dewatered. Another siphon would be constructed under Mercey Spring Road. During construction a detour would be required.

An over-the-lining turnout and pump station would be constructed on the DMC near Russell Avenue. Water would flow directly into an existing ditch that parallels Russell Avenue. The existing ditch would convey water to a point near the CCID Outside Canal. Water would be conveyed in a new 150-foot siphon under the CCID Outside Canal. A new 6000-foot canal would be constructed to convey water to the Main Canal upstream of an existing dam for diversion to the Helm Canal. Portions of the existing ditch along Russell Avenue would be rehabilitated. During construction of the siphon, the CCID Outside Canal would need to be dewatered.

Alternative 3B - Implement a Conjunctive Use Plan. On the non-refuge portion of the GRCD, 126 wells would be constructed to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternative 3A.

4. Delivery Alternatives for Level 4 (180,000 acre-feet)

Water Supply Level 4 is equal to Level 3. Therefore, the alternatives for Level 4 would be the same as discussed for Level 3. Alternative 4A would require implementation of Alternative 2A or 2B. Alternative 4B would require implementation of Alternative 4A.

Alternative 4A - Construct Turnout on the Delta-Mendota Canal at Almond Drive and Russell Avenue. This alternative is identical to Alternative 3A.

Alternative 4B - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 3B.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative to provide additional water were compared with respect to criteria listed in Chapter III.

There were no alternatives for Level 1 because the existing 50,000 acre-feet of water can be delivered in existing facilities.

Alternative 2A would require reconfiguration of the existing canal system. Alternative 2B would use existing facilities. However, Alternative 2A would provide more operational flexibility than Alternative 2B which can only be effective when the CCID Outside Canal is flowing to the south. Whenever CCID operates the Outside Canal in a northerly flow pattern, GRCD would not receive water under Alternative 2B. Both Alternatives 2A and 2B would provide better quality water than water that is delivered through the Mendota Pool. In addition, conveyance losses would be decreased by at least 10 percent if CVP water is not delivered through the Mendota Pool.

Alternatives 3A and 4A would require long-term conveyance agreements as well as extensive improvements to existing canal structures. Alternatives 3A and 4A also would require implementation of Alternative 2A or 2B.

Alternatives 2C, 3B, and 4B would cause an overdraft situation during dry years because the wells would withdraw more water than the safe yield of the GRCD. These alternative also would require implementation of Alternatives 2A or 2B, Alternative 3A, or Alternative 4A to deliver surface water during wet years.

C. COSTS AND ECONOMIC ANALYSIS

Costs of the alternative plans for providing adequate water supplies under the Water Delivery Levels 2, 3, and 4 are presented in Table IV G-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs only include the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in the economy of Merced County during the construction period. The construction could be completed within one summer season by construction workers who reside in the area.

If the total amount of water supplied is equal to Level 1, public use will decline from current average annual values of 109,000 visits per year (Level 2). Therefore, the local economy that relies upon the public use also would decline. If the total amount of water supplied is equal to Levels 3 or 4, the public use and the associated economy would increase.

TABLE IV G-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

GRASSLAND RESOURCE CONSERVATION DISTRICT

Items	Alternatives				
	2A	2B	2C	3A & 4A	3B & 4B
Additional Water (ac-ft)	75,000	75,000	75,000	130,000	130,000
Construction Costs					
Wells	$ --	$ --	$5,842,500 (c)	$ --	$ 7,749,000 (h)
Diversion Structures	--	--	--	540,000 (e)	--
Pipelines/Canals	675,000 (a)	--	--	2,020,000 (f)	--
Pump Stations	--	175,000 (b)	--	2,300,000 (g)	--
Subtotal	$ 675,000	$ 175,000	$5,842,500	$4,860,000	$ 7,749,000
Other Costs	--	--	675,000 (d)	675,000 (n)	5,535,000 (d)
Total (j)	$ 675,000	$ 175,000	$6,517,000	$5,535,000	$13,284,000
Annualized Construction Cost (8.87%, 30 yrs)	$ 64,940	$ 16,840	$ 626,990	$ 532,470	$ 1,277,920
Additional Annual Cost					
Operation & Maintenance (i)	$ --	$ --	$ 198,700	$ --	$ 263,500
Power	--	75,000 (j)	300,000 (m,n)	40,000 (j)	520,000 (m,n)
Local Conveyance Cost	825,000 (k)	56,300 (l)	--	--	--
Subtotal	$ 825,000	$ 131,300	$ 498,700	$ 40,000	$ 783,500
Other Costs	--	--	412,500 (d,n)	825,000 (o)	432,500 (d,n)
Total (j)	$ 825,000	$ 131,300	$ 911,200	$ 865,000	$ 1,216,000
Total Annual Costs	$ 889,940	$ 148,140	$1,538,190	$1,397,470	$ 2,493,920
Cost/Additional Acre-Foot	$ 11.90	$ 2.00	$ 20.50	$ 10.80	$ 19.20

TABLE IV G-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

GRASSLAND RESOURCE CONSERVATION DISTRICT

Notes: Alternatives 2A - Convey water under the Zahm-Sansoni-Nelson Plan.
Alternatives 2B - Utilize the Wolfson Bypass.
Alternatives 2C, 3B and 4B - Implement a Conjuctive Use Plan.
Alternatives 3A and 4A - Construct Turnouts on the Delta-Mendota Canal at Almond Drive and Russell Avenue.

(a) 1 siphon, 4 valves, and connecting canal/pipeline, and enlarge existing canals. Cost estimate provided by Reclamation. Does not include cost to remove contaminated deposits from San Luis Drain.

(b) 100 cfs, 5-foot lift pump.

(c) 95 wells, 600 feet deep, 70-foot lift.

(d) Alternative 2C assumes implementation of Alternative 2A, and Alternatives 3B and 4B assume implementation of Alternatives 3A and 4A.

(e) Two 200 cfs turnout.

(f) 18,600 feet of unlined canal, 16,400 feet of rehabilitated canal, 5 siphons, relocated bridge, and 2 crossings.

(g) 1,000 cfs, 15-foot lift pump.

(h) 126 wells, 600 feet deep, 70-foot lift.

(i) Basis for O&M costs are discussed in Appendix F.

(j) Unit Pumping Cost = $1/af.

(k) Unit Conveyance Cost = $11/af ($10/af by SLC and $1/af by GWD)

(l) Unit Conveyance Cost = $0.75/af.

(m) Unit Pumping Cost = $8/af.

(n) Values are multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(o) Alternatives 3A and 4A assumes implementation of Alternative 2A.

D. WILDLIFE RESOURCES

The annual bird use in the GRCD is approximately 127,210,000 use-days. Approximately 63 and 5 percent of the bird use are by ducks and geese, respectively. Wildlife and fishery resources associated with the GRCD are listed in Table IV G-3. The federally listed, proposed, and candidate threatened and endangered species are the San Joaquin kit fox, Vulpes macrotis mutica; the Valley elderberry longhorn beetle, Desmocerus californicus dimorphus; bald eagle, Haliaeetus leucocephalus; peregrine falcon, Falco peregrines anatum; and Aleutian Canada goose, Branta canadensis leucopareia, as listed in Table IV G-4. The improved habitat would increase the number of wildlife-use days and recreational benefits, as presented in Table IV G-5.

Implementation of the alternative plans may not adversely affect the listed and candidate threatened and endangered species of birds. Detailed field investigations would be completed during the advanced planning phase of the project. Implementation of the plans may result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat and associated recreation and wildlife use if supplemental water is not available. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to the potential increase in public use.

F. POWER ANALYSIS

The Pacific Gas and Electric serves the GRCD under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the GRCD is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Merced County would issue permits for construction along drainage courses and under roads to ensure that the existing drainage facilities would not be adversely affected. CCID would issue permits and approvals for all alternatives. Stream Alteration

Permits would be required from the DFG for Alternatives 2A, 2B, 3A, and 4A. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors under all alternatives. Approvals would be needed from the Regional Water Quality Control Board and other state agencies before the San Luis Drain could be used to convey CVP water under Alternative 2A.

TABLE IV G-3

FISH AND WILDLIFE RESOURCES

GRASSLAND RESOURCE CONSERVATION DISTRICT

Ducks

Pintail[a]	Mallard[a]	Green-winged Teal
Gadwall[a]	Shoveler[a]	Cinnamon Teal[a]
Ring-necked Duck	Canvasback	Ruddy Duck[a]
		Widgeon

Geese and Swans

Ross' Goose	Cackling Goose	White-fronted Goose
Snow Goose	Tundra Swan	

Coots

American Coot[a]		

Shore and Wading Birds

Pied-billed Grebe	Snowy Egret	Great Yellowlegs
White-faced Ibis	American Bittern	Sandpiper
Lesser Sandhill Crane	Black-crowned Night Herons	Killdeer[a]
Common Snipe	American Avocet	Rail[a]
Long-billed Curlews	Black-necked Stilt[a]	Sora[a]
Great Blue Heron	Dowitchers	Gallinule[a]
Common Egret		

Upland Game

Ring-necked Pheasant[a]	Black-tailed Jackrabbits	
Cottontail Rabbits	Dove	

TABLE IV G-3

FISH AND WILDLIFE RESOURCES

GRASSLAND RESOURCE CONSERVATION DISTRICT
(Continued)

Raptorial Birds		
Northern Harrier[a]	Red-tailed Hawk[a]	American Kestrel
Black-shouldered Kite[a]	Cooper's Hawk	Turkey Vulture
Sparrow Hawk[a]	Golden Eagle	

Fish		
Brown Bullhead	Channel Catfish	Striped Bass
Carp	Largemouth Bass	

Furbearers		
Coyotes	Muskrats	Raccoon
Opossum	Striped Skunk	Grey Fox
Beaver	Mink	Badger
Spotted Skunk		

Notes:

(a) Birds nesting on refuge

Source: Environmental Assessment Reports, Los Banos Wildlife Area, and Refuge records

TABLE IV G-4

FEDERAL LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

GRASSLAND RESOURCE CONSERVATION DISTRICT

Listed Species

Mammals
San Joaquin kit fox, Vulpes macrotis mutica (E)

Birds
Aleutian Canada goose, Branta canadensis leucopareia (E)
Bald Eagle, Haliaeetus leucocephalus (E)
Peregrine Falcon, Falco peregrines anatum (E)

Invertebrates
Valley elderberry longhorn beetle, Desmocerus californicus dimorphus (T)

Proposed Species

None

Candidate Species

Birds
Swainson's hawk, Buteo swainsoni(2)
Tricolored blackbird, Agelaius tricolor (2)
White-faced ibis, Plegadis chihi (2)
Western Snowy Plover, Charadrus alaxandrinus

Reptiles
Giant garter snake, Thamnophis couchi gigas (2)
California tiger salamander, Ambystoma tigrinium californiense (2)

Invertebrates
Molestan blister beetle, Lytta molesta (2)

Plants
Hispid bird's-beak, Cordylanthus mollis subsp. hispidus (2)
Delta coyote-thistle, Eryngium racemosum (1)
Bearded allocarya, Plagiobothrys hystriculus (2)
Valley spearscale, Atriplex patula subsp. spicata (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat
(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV G-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

GRASSLAND RCD

	No Action Alternative	Alternatives 2A	2B	2C	3A & 4A	3B & 4B
Habitat Acres						
Permanent Water	200	2,000	2,000	2,000	4,000	4,000
Seasonal Marsh	54,800	51,000	51,000	51,000	46,000	46,000
Smartweed & Watergrass	1,000	3,000	3,000	3,000	6,000	6,000
Bird Use Days						
Ducks	60,000,000	80,000,000	80,000,000	80,000,000	100,000,000	100,000,000
Geese	5,000,000	7,000,000	7,000,000	7,000,000	9,000,000	9,000,000
Waterbirds	30,000,000	40,000,000	40,000,000	40,000,000	50,000,000	50,000,000
Endangered Species	180,000	210,000	210,000	210,000	250,000	250,000
Total	95,180,000	127,210,000	127,210,000	127,210,000	159,250,000	159,250,000
Public Use Days						
Consumptive	60,000	70,000	70,000	70,000	80,000	80,000
Non-consumptive	31,000	39,000	39,000	39,000	56,000	56,000
Total	91,000	109,000	109,000	109,000	136,000	136,000
Total Annual Cost	$ --	$ 889,940	$ 148,140	$ 1,538,190	$ 1,397,470	$ 2,493,920
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 27.80	$ 4.60	$ 48.00	$ 21.80	$ 38.90
Incremental Cost/Additional Public Use Day	N/A	$ 49.50	$ 8.20	$ 85.50	$ 31.10	$ 55.40

Notes: Alternatives 2A - Convey water under the Zahm-Sansoni-Nelson Plan.
Alternatives 2B - Utilize the Wolfson Bypass.
Alternatives 2C, 3B and 4B - Implement a Conjuctive Use Plan.
Alternatives 3A and 4A - Construct Turnouts on the Delta-Mendota Canal at Almond Drive and Russell Avenue.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to the potential increase in public use.

F. POWER ANALYSIS

The Pacific Gas and Electric serves the GRCD under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the GRCD is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Merced County would issue permits for construction along drainage courses and under roads to ensure that the existing drainage facilities would not be adversely affected. CCID would issue permits and approvals for all alternatives. Stream Alteration Permits would be required from the DFG for Alternatives 2A, 2B, 3A, and 4A. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors under all alternatives. Approvals would be needed from the Regional Water Quality and other state agencies before the San Luis Drain could be used to convey CVP water under Alternative 2A.

CHAPTER IV H

VOLTA WILDLIFE MANAGEMENT AREA

Volta Wildlife Management Area (Refuge) is owned by Reclamation and has been operated by DFG since 1952 under a lease agreement. The Refuge consists of approximately 3,000 acres of primarily large alkali ponds with waterfowl areas containing aquatic communities, predominantly swamp timothy, bulrush, sprangletop, watergrass, and smartweed. The Refuge is located approximately six miles northwest of the City of Los Banos and within the Grassland Resource Conservation District (GRCD), described in Chapter IV G. The Refuge serves as a control area for ongoing selenium studies.

A. WATER RESOURCES

The Refuge has a firm contract with Reclamation for 10,000 acre-feet of Central Valley Project (CVP) water. The water management plan for the Refuge requires flooding to begin on July 15. This early flooding provides feeding and resting areas for early arriving waterfowl. The Refuge is the first and usually the only area in GRCD to be flooded early in the year (CDFG, 1986b). The Refuge needs additional dependable water supplies to provide optimum management levels.

1. Surface Waters

The CVP water is delivered from the San Luis Reservoir and O'Neill Forebay via the Delta-Mendota Canal (DMC) or Reclamation's Volta Wasteway, as shown in Figure IV H-1. The Refuge also receives water from Volta Lake when the lake water levels are high. Volta Lake is supplied by artesian wells.

2. Water Conveyance Facilities

The Volta Wasteway enters the Refuge at the southwest corner and passes through the center. The water is lifted into two ditches by low lift pumps near Ingomar Grade Road. The ditches convey water to the eastern and western sections of the Refuge. Water flows from the boundary ditches to internal ditches by gravity. The ditch along the southern boundary contains runoff from an adjacent dairy.

Water also is diverted from the Volta Wasteway via outtake pipes located near a check dam in the center of the Refuge. These 18-inch diameter pipes frequently cause hydraulic constrictions.

Grassland Water District (GWD) routes water through the Refuge in the GWD San Luis Wasteway/Mosquito Ditch, which sometimes causes management problems for the Refuge due to fluctuating water levels.

3. Groundwater

Groundwater levels are usually within 25 feet of the land surface. The groundwater has relatively high boron concentrations and would require surface water for dilution. Although groundwater has not been used as a water supply at the Refuge, the safe yield of the Refuge has been estimated by Reclamation to be 4,200 acre-feet.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The DFG estimates that 16,000 acre-feet of water would be required for full development and optimum management of the entire refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified and are presented in Table IV H-1. Each of the water supply levels provides a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (10,000 acre-feet)

No additional facilities would be required to provide the existing firm water supply.

2. Delivery Alternative for Level 2 (10,000 acre-feet)

Water Supply Level 2 is equal to Level 1. As discussed above, no facilities would be required to provide the existing firm water supply.

3. Delivery Alternatives for Level 3 (13,000 acre-feet)

Alternative 3A would increase the capacity of the Volta Wasteway. Alternative 3B involves establishment of a conjunctive use program. Alternative 3B also would require implementation of 3A to deliver surface waters during the wet years.

Alternative 3A - Construct Turnout at Main Canal and Upgrade Outtakes. A turnout on the Central California Water District (CCID) Main Canal and a canal to convey water to the Volta Wasteway would be constructed. Water would be supplied to the CCID Main Canal through the Wolfson Bypass which was described in Chapter IV G.

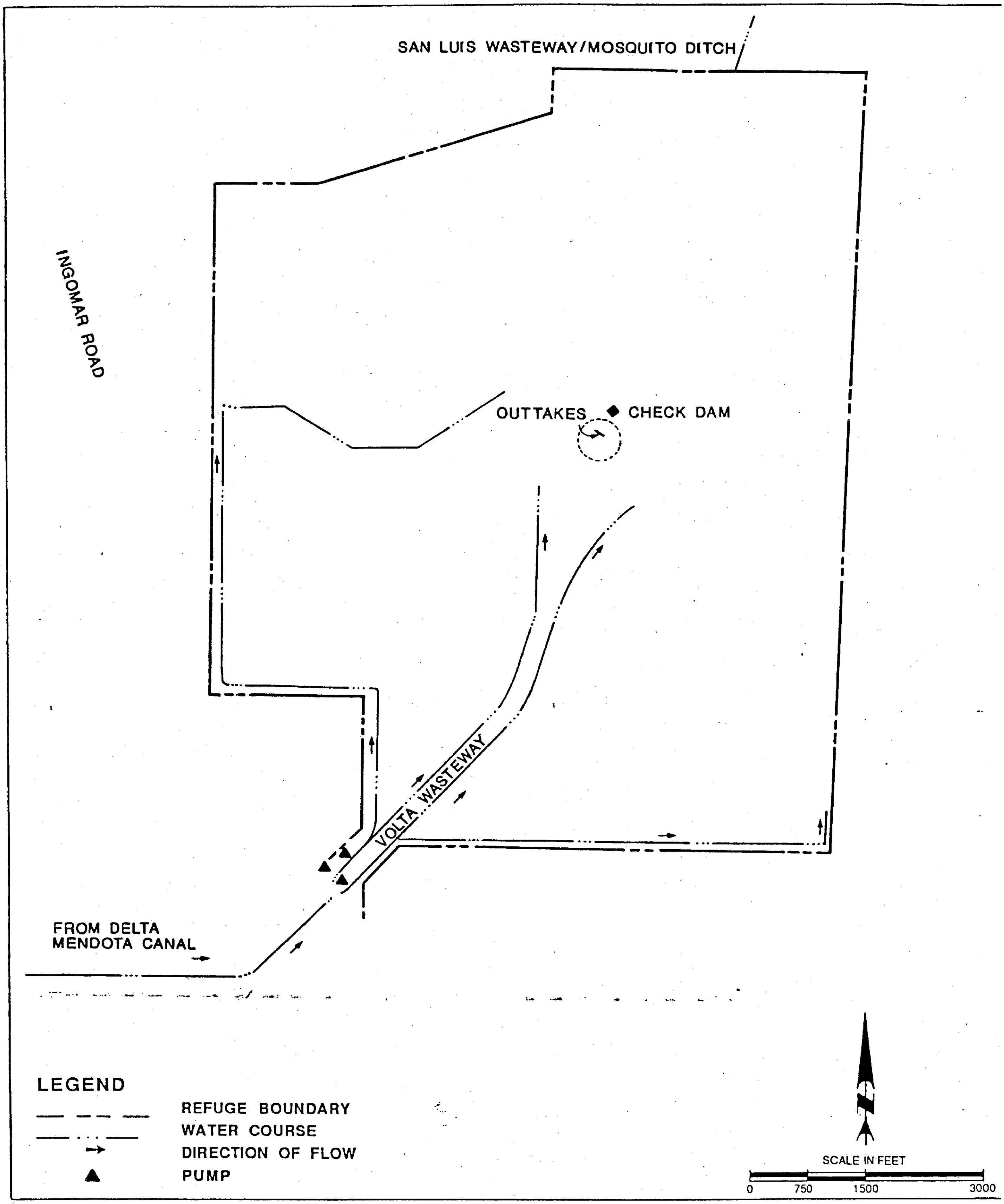

FIGURE IV H-1

VOLTA WILDLIFE MANAGEMENT AREA

EXISTING WATER SUPPLY FACILITIES

TABLE IV H-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE VOLTA WMA

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac—ft	Supply Level 4 ac-ft
January	200	200	200	500
February	200	200	200	500
March	200	200	200	500
April	200	200	200	500
May	1,000	1,000	2,000	2,000
June	1,200	1,200	2,000	2,000
July	600	600	800	1,800
August	1,400	1,400	1,400	2,400
September	1,800	1,800	1,800	1,800
October	2,000	2,000	2,000	2,000
November	600	600	1,100	1,000
December	600	600	1,100	1,000
Total	10,000	10,000	13,000	16,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum mangement

Source: USFWS, 1986g

The 18-inch diameter corrugated metal pipe (CMP) outtake located near the check dam in the Volta Wasteway would be replaced by a 24-inch diameter outtake, as shown in Figure IV H-2.

Alternative 3B - Implement a Conjunctive Use Plan. Four wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. The groundwater contains relatively high concentrations of boron, therefore, surface water may be required to dilute the groundwater.

4. Delivery Alternatives for Level 4 (16,000 acre-feet)

Water deliveries under Level 4 are similar to deliveries under Level 3. The same alternatives considered for Level 3 would be considered for Level 4.

Alternative 4A - Construct Turnout at Main Canal and Upgrade Outtakes. Alternative 4A is identical to Alternative 3A.

Alternative 4B - Implement a Conjunctive Use Plan. Five wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative would be similar to Alternative 3B.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to criteria listed in Chapter III. There were no alternatives for Levels 1 and 2, the existing firm water supply.

Alternatives 3B and 4B would cause a groundwater overdraft because the water needs would exceed the safe yield under the Refuge. In addition, surface water would be required to dilute the boron concentrations in the groundwater. Alternatives 3B and 4B would require implementation of Alternatives 3A and 4A to provide surface water during the wet years.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Levels 2, 3, and 4 are presented in Table IV H-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local costs to deliver water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in Merced County

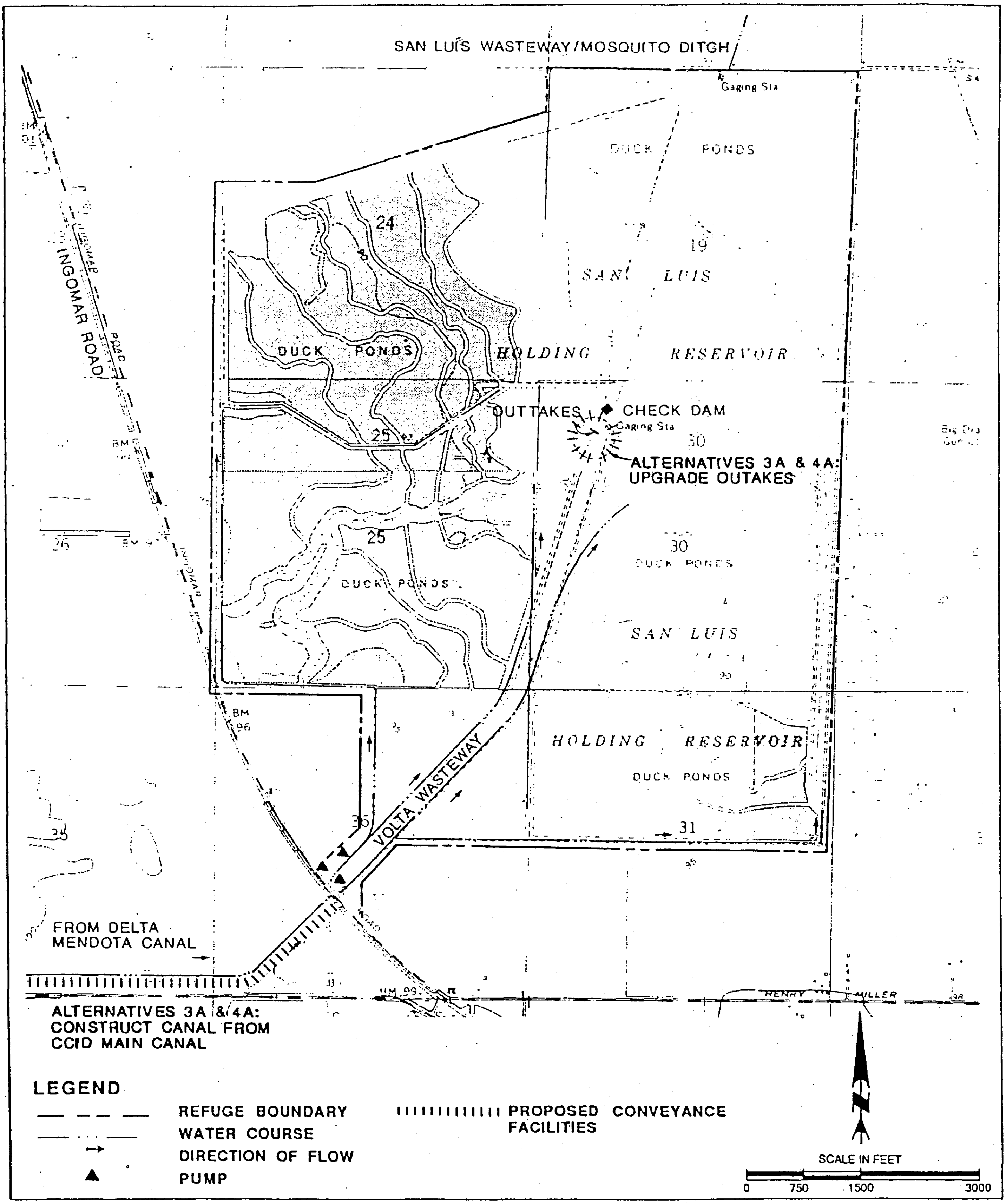

FIGURE IV H-2

VOLTA WILDLIFE MANAGEMENT AREA

ALTERNATIVE WATER SUPPLY FACILITIES

TABLE IV H-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

VOLTA WMA

Items	Alternatives 3A	3B	4A	4B
Additional Water (ac-ft)	3,000	3,000	6,000	6,000
Construction Costs				
Wells	$ --	$246,000[b]	$ --	$307,500[d]
Diversion Structures	23,000[a]	--	23,000[a]	--
Pipelines/Canals	--	--	--	--
Pump Stations	--	--	--	--
Subtotal	$ 23,000	$246,000	$ 23,000	$307,500
Other Costs	--	23,000[c]	--	23,000[c]
Total	$ 23,000	$269,000	$ 23,000	$330,500
Annualized Construction Costs (8.87%, 30 yrs)	$ 2,200	$ 25,900	$ 2,210	$ 31,800
Additional Annual Cost				
Operation & Maintenance[e]	$ 500	$ 8,400	$ 500	$ 10,500
Power	--	12,000[g,h]	--	24,000[g,h]
Local Conveyance Cost	2,250[f]	--	4,500[f]	--
Subtotal	$ 2,750	$ 20,400	$ 5,000	$ 34,500
Other Costs	--	1,400[c,h]	--	2,500[c,h]
Total	$ 2,750	$ 21,800	$ 5,000	$ 37,000
Total Annual Costs	$ 4,950	$ 47,700	$ 7,210	$ 68,800
Cost/Additional Acre-Foot	$ 1.70	$ 15.90	$ 1.20	$ 11.50

TABLE IV H-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

VOLTA WMA

(Continued)

Notes: Alternatives 3A and 4A - Construct Turnout at Main Canal and Upgrade Outtakes.
Alternatives 3B and 4B - Implement a Conjunctive Use Plan.

(a) Two turnouts, two 24-inch diameter outtake.

(b) 4 wells, 600 feet deep, 70-foot lift.

(c) Alternative 3B would require implementation of Alternative 3A, and Alternative 4B would require implementation of Alternative 4A.

(d) 5 wells, 600 feet deep, 70-foot lift.

(e) Basis for O&M costs are discussed in Appendix F.

(f) Unit Conveyance Cost = $0.75/af.

(g) Unit Pumping Cost = $8/af.

(h) Value is multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

during construction. The construction could be completed within one summer season by construction workers who reside within the area.

Currently, the annual public use is about 7,000 visits per year. If additional water is provided, the attendance levels would increase.

D. WILDLIFE RESOURCES

The annual bird use in the Refuge is approximately 25,000,000 use-days. The listed threatened and endangered species are the San Joaquin kit fox, Vulpes macrotis mutica; the Valley elderberry longhorn beetle, Desmocerus californicus dimorphus, bald eagle, Haliaeetus leucocephalus; peregrine falcon, Falco peregrines anatum; and Aleutian Canada goose, Branta canadensis leucopareia, as listed in Table IV H-3. Numerous candidate species may occur in this area, as presented in Table IV H-4.

Alternatives 3A and 3B and Alternatives 4A and 4B would improve habitat on the Refuge. The improved habitat would increase the number of wildlife-use days and recreational benefits, as presented in Table IV H-5.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species. Detailed field investigations would be completed during the advanced planning phase of the project. Implementation of the plan would result in overall beneficial environmental effects. The No Action Alternative would result in the management of the refuge under the current water supply conditions. Additional regional environmental analyses would be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the plans would be positive due to the potential increase in wildlife use and subsequently public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

TABLE IV H-4

FEDERAL LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

VOLTA WMA

Listed Species

Mammals

San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Birds

Bald eagle, *Haliaeetus leucocephalus* (E)
American peregrine falcon, *Falco peregrinus anatum* (E)
Aleutian Canada goose, *Branta canadensis leucopareia* (E)

Invertebrates

Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds

Swainson's hawk, *Buteo swainsoni* (2)
White-faced ibis, *Plegadis chihi* (2)
Western snowy plover, *Charadrius alexandrinus nivosus* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Reptiles

Giant garter snake, *Thamnophis couchi gigas* (2)
California tiger salamander, *Ambystoma tigrinium californiense* (2)

Invertebrates

Molestan blister beetle, *Lytta molesta* (2)

Plants

Hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
Delta coyote-thistle, *Eryngium racemosum* (1)
Bearded allocarya, *Plagiobothrys hystriculus* (2)
Valley spearscale, *Atriplex patula* subsp. *spicata* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (C H)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV H-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

VOLTA WMA

	No Action Alternative	Alternatives 3A	3B	4A	4B
Habitat Acres					
Permanent Water	200	225	225	250	250
Brood Water	150	200	200	250	250
Watergrass	50	600	600	850	850
Aquatics	600	550	550	500	500
Un-Irrigated Native Marsh	1,650	1,175	1,175	1,000	1,000
Uplands	350	250	250	150	150
Bird Use Days					
Coots	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Ducks	3,500,000	5,000,000	5,000,000	6,500,000	6,500,000
Geese	300,000	300,000	300,000	300,000	300,000
Wading Birds	200,000	250,000	250,000	300,000	300,000
Shore Birds	20,000,000	20,000,000	20,000,000	20,000,000	20,000,000
Total	25,000,000	26,550,000	26,550,000	28,100,000	28,100,000
Public Use Days					
Consumptive	3,900	5,600	5,600	7,400	7,400
Non-Consumptive	3,100	4,300	4,300	5,600	5,600
Total	7,000	9,900	9,900	13,000	13,000
Total Annual Cost	--	$ 4,950	$ 47,700	$ 7,210	$ 68,800
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 3.20	$ 30.80	$ 2.30	$ 22.20
Incremental Cost/Additional Public Use Day	N/A	$ 1.70	$ 16.50	$ 1.20	$ 11.50

Notes: Alternatives 3A and 4A - Construct Turnout at Main Canal and Upgrade Outtakes.
Alternatives 3B and 4B - Implement a Conjunctive Use Plan.

G. PERMITS

Construction activities would require several permits. Merced County would issue approvals for construction of wells. If the CCID facilities are utilized, their approval would be required. Stream Alteration Permits would be required from the DFG for Alternatives 3A and 4A. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors under all alternatives.

CHAPTER IV I

LOS BANOS WILDLIFE MANAGEMENT AREA

Los Banos Wildlife Management Area (Refuge) was purchased in 1929 and originally called the Los Banos State Game Refuge. The 5,586 acre refuge was the first in a series of waterfowl refuges established throughout California. The DFG manages the Refuge which is located approximately four miles northeast of the City of Los Banos. The Refuge is centrally located in the San Joaquin River floodplain and is included within the Grassland Resource Conservation District (GRCD), as discussed in Chapter IV G. The management of the Refuge is oriented toward the maintenance of native marsh habitat (USBR,1986a).

A. WATER RESOURCES

The Refuge receives 6,200 acre-feet of CVP water through an exchange contract for water rights lost from the San Joaquin River. The Grassland Water District (GWD) delivers 2,200 acre-feet of firm water. The Refuge also receives 4000 acre-feet of CVP water through the San Luis Canal Company (SLCC). This water cannot be supplied when the Mendota Pool is dewatered for periodic maintenance.

The Refuge also can obtain up to 6,500 acre-feet of agricultural return flows when available in the GWD Boundary Drain. Water from the GWD Boundary Drain is of poorer quality than the CVP water supplies due to high salt content. Selenium has not been identified at high concentrations in the Boundary Drain.

The Refuge also has 2,000 acre-feet of riparian water rights on Mud Slough. Mud Slough is a natural drain that flows through the area joining the GWD Boundary Drain at the middle of the Refuge. At times, the Mud Slough has high flows and could be used to create ponds through the western sections of the Refuge. However, recent studies have shown high selenium levels in Mud Slough. Therefore, this water would not be used on the Refuge until the water quality improves (DFG, 1987d).

The Refuge purchased additional land in October 1987 and January 1988. Through these purchases, the Refuge obtained water rights on Salt Slough for 18 and 20 cfs. The Refuge also obtained a water contract through these purchases for 15 cfs of Salt Slough water. However, Salt Slough has unusable agricultural return flows north of the junction with Mud Slough. Because of the water contamination, water deliveries under the contracts only can be made during a limited period of time.

1. Surface Waters

The GWD delivers the 2,200 acre-feet of water in the winter through the SLCC San Luis Canal, shown in Figure IV I-1.

Approximately 1,400 acre-feet of water is delivered between September 15 and November 1. The remaining 800 acre-feet is delivered between November 1 and December 31.

In the past, the SLCC San Luis Canal was used to convey poor quality agricultural return water. However, the Porter-Blake Bypass which was recently constructed, as described in Chapter IV G, allows freshwater deliveries to be made via the SLCC San Luis Canal into the Refuge.

In addition, SLCC delivers 4,000 acre-feet of exchange water through the SLCC San Pedro and West Delta Canals.

2. Water Conveyance Facilities

The main source of water to the west side of the Refuge is the San Luis Canal. Water is diverted at several points along the western boundary of the Refuge to supply the lakes and marsh areas west of Mud Slough. This system provides an adequate means for water delivery to the west side provided the water delivered is of acceptable quality.

The eastern area of the Refuge is served through the SLCC San Pedro and West Delta Canals and the GWD Boundary Drain. The water supply for the San Pedro and West Delta Canal is the SLCC Arroyo Canal which receives usable agricultural return flows from GWD. The San Pedro Canal can deliver 15 to 20 cfs, and the West Delta Canal can deliver approximately 10 cfs. The capacity of these facilities are less than required for maximum month flows. In addition, these 50-year old systems require extensive maintenance to maintain maximum capacity (DFG, 1987d).

The GWD Boundary Drain is a deep agricultural drain which enters the Refuge from the southeast. This is the primary water source for the east-central portion of the Refuge. The water is lifted by 20 cfs low-lift pumps and conveyed through a pipe across private land to the eastern area of the Refuge. At one time, water from the GWD Boundary Drain and Mud Slough was lifted into Ruth Lakes at the north end of Lower Ruth Lake. The water was then lifted from the lakes to supply water to the southeast area of the Refuge. However, SLCC has dredged the GWD Boundary Drain and Mud Slough system three feet deeper than the original depth, and removed all structures in the ditch. Therefore, water cannot always be backed up for diversion by the low-lift pumps (DFG, 1987d).

3. Groundwater

Groundwater levels are generally within 25 feet of the land surface. The Refuge has similar geologic conditions to the GRCD, as described in Chapter IV G of this report.

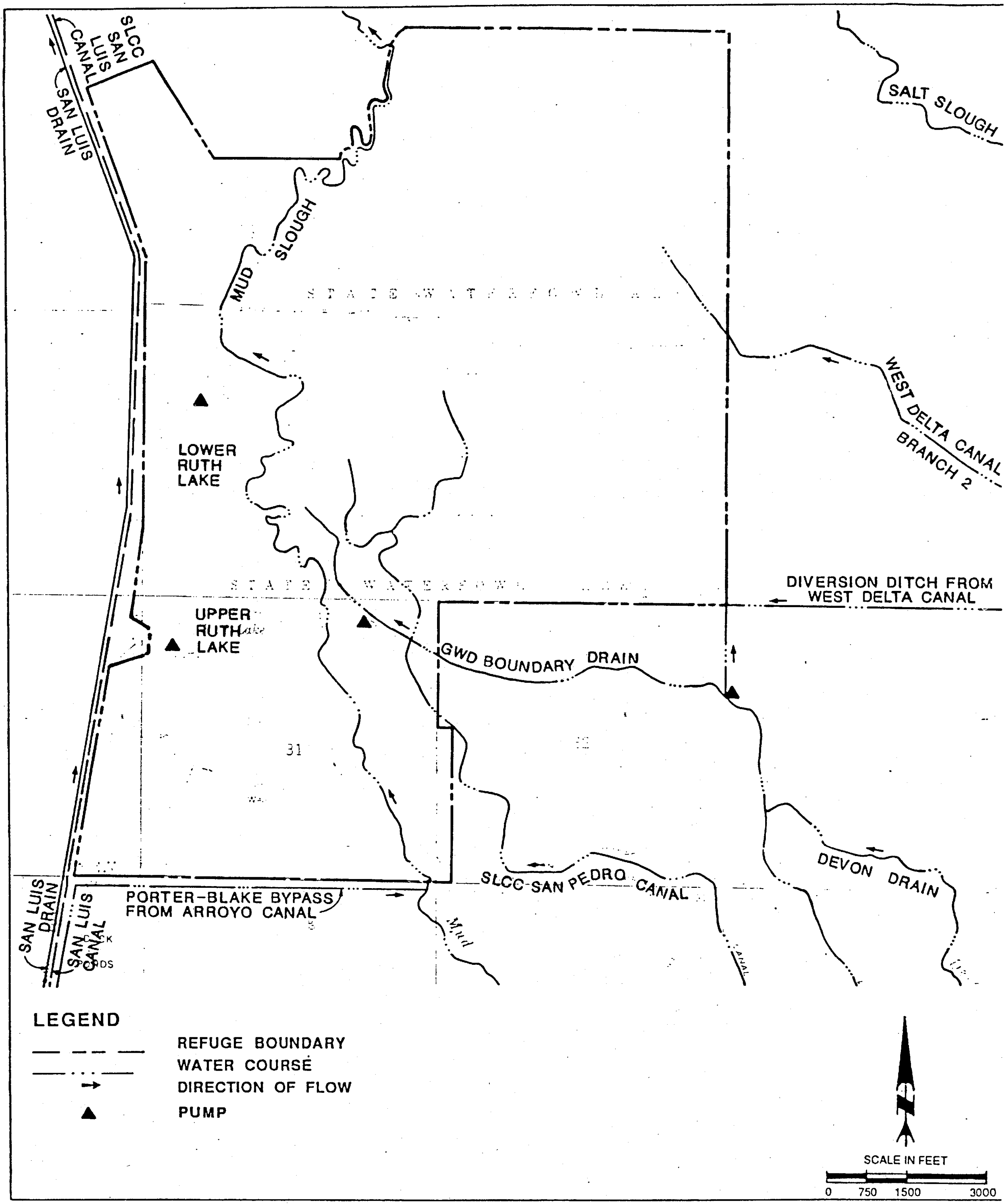

FIGURE IV I-1

LOS BANOS WILDLIFE MANAGEMENT AREA

EXISTING WATER SUPPLY FACILITIES

JMM

In 1981, a small dam was removed from the GWD Boundary Drain which caused the groundwater level to drop due to decreased seepage. This lowering of the water level resulted in an increase in refuge water requirements (USBR, 1986a).

Historically the Refuge has used five wells. High power costs, well cave-ins, and poor water quality due to high boron content have caused the groundwater system to be abandoned. The Reclamation estimates that the safe yield of the Refuge is 6,800 acre-feet (USBR, 1986c).

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The DFG estimates that 50,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV I-1. Each of the water supply levels provides a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (6,200 acre-feet

No new facilities would be required to deliver the existing firm water supply. However to ensure that good quality water is provided to the Refuge through the SLCC San Luis Canal, the Zahm-Sansoni-Nelson Plan would need to be implemented. The Zahm-Sansoni-Nelson Plan was described in Chapter IV G.

2. Delivery Alternatives for Level 2 (16,700 acre-feet)

Alternative 2A was developed to provide an additional diversion point and conveyance facilities for the southeastern portion of the Refuge. Alternative 2B would provide a conjunctive use program for the Refuge. Both of these alternatives assume that the Zahm-Sansoni-Nelson Plan would be implemented to provide good quality water to the Refuge.

Alternative 2A - Reconstruct San Luis Canal Company Facilities. An abandoned diversion ditch was used to convey water from the SLCC West Delta Canal to the southeast corner of the Refuge. Under this alternative, this 7,500-foot canal would be reconstructed, as shown

TABLE IV I-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE LOS BANOS WMA

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	200	500	500	500
February	0	500	500	500
March	0	1,000	1,000	1,500
April	0	1,000	1,000	1,500
May	700	2,000	3,000	3,000
June	500	1,500	4,000	4,000
July	0	1,500	3,000	3,000
August	0	1,670	2,000	2,500
September	1,500	2,000	2,000	2,500
October	2,000	3,000	3,000	3,000
November	1,000	1,500	1,500	2,000
December	300	500	1,000	1,000
Total	6,200	16,670	22,500	25,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum mangement

Source: USBR, 1986a; CDFG, 1986c; USFWS, 1986g in Figure IV I-2. Portions of the the West Delta Canal also would be rehabilitated to reduce maintenance, increase capacity, and improve reliability.

Alternative 2B - Implement a Conjunctive Use Program. Eight wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Adequate surface water would need to be provided when groundwater is used to dilute the boron concentrations. Implementation of this alternative also would require implementation of Alternative 2A and the Zahm-Sansoni-Nelson Plan.

3. Delivery Alternatives for Level 3 (22,500 acre-feet)

The alternatives considered for Water Level 3 are similar to those considered for Water Level 2.

Alternative 3A - Reconstruct San Luis Canal Company Facilities. This alternative is identical to Alternative 2A.

Alternative 3B - Implement a Conjunctive Use Program. This alternative would be similar to Alternative 2B, except that 13 wells would be constructed on the Refuge. The exact locations of the wells would be determined in a future study. Implementation of this alternative also would require implementation of Alternative 3A and the Zahm-Sansoni-Nelson Plan.

4. Delivery Alternatives for Level 4 (25,000 acre-feet)

The alternatives considered for Water Level 4 are similar to those considered for Water Level 2.

Alternative 4A - Reconstruct San Luis Canal Company Facilities. This alternative is identical to Alternative 2A.

Alternative 4B - Implement a Conjunctive Use Program. This alternative would be similar to Alternative 2B, except that 13 wells would be constructed on the Refuge. The exact locations of the wells would be determined in a future study. Implementation of this alternative also would require implementation of Alternative 4A and the Zahm-Sansoni-Nelson Plan.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1; however to ensure that good quality water is provided, the Zahm-Sansoni-Nelson Plan described in Chapter IV G would need to be implemented.

Alternatives 2A, 3A, and 4A would improve operations and decrease maintenance of existing facilities, as well as increasing operational flexibility.

Alternatives 2B, 3B, and 4B would provide a conjunctive use program. Implementation of a conjunctive use program would result in a groundwater overdraft because the amount of water needed during dry years will exceed the safe yield of the Refuge. During dry years when groundwater is used, adequate surface water is needed to dilute the boron concentrations. These alternatives would require implementation of Alternatives 2A, 3A, and 4A to deliver surface water during the wet years.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Water Supply Levels 2, 3,and 4 are presented in Table IV I-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local costs of delivering water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in Merced County during construction. The construction could be completed within one summer season by construction workers who reside in Merced, Madera or Fresno County.

Currently (Level 2), the annual public use at the Refuge is about 34,400 visits per year. If additional water is provided, the attendance levels would increase. If the water supply is decreased to Level 1, public use would decrease significantly.

D. WILDLIFE RESOURCES

The annual bird use in the Refuge is approximately 23,768,000 use-days. Wildlife and fishery resources associated with the Refuge are presented in Table IV I-3. There are no listed threatened or endangered species at the Refuge. Numerous candidate species may occur in this area and are summarized in Table IV I-4.

The alternative plans would provide additional water to improve habitat in the Refuge. The improved habitat would increase the number of wildlife-use days and recreational benefits as presented in Table IV I-5.

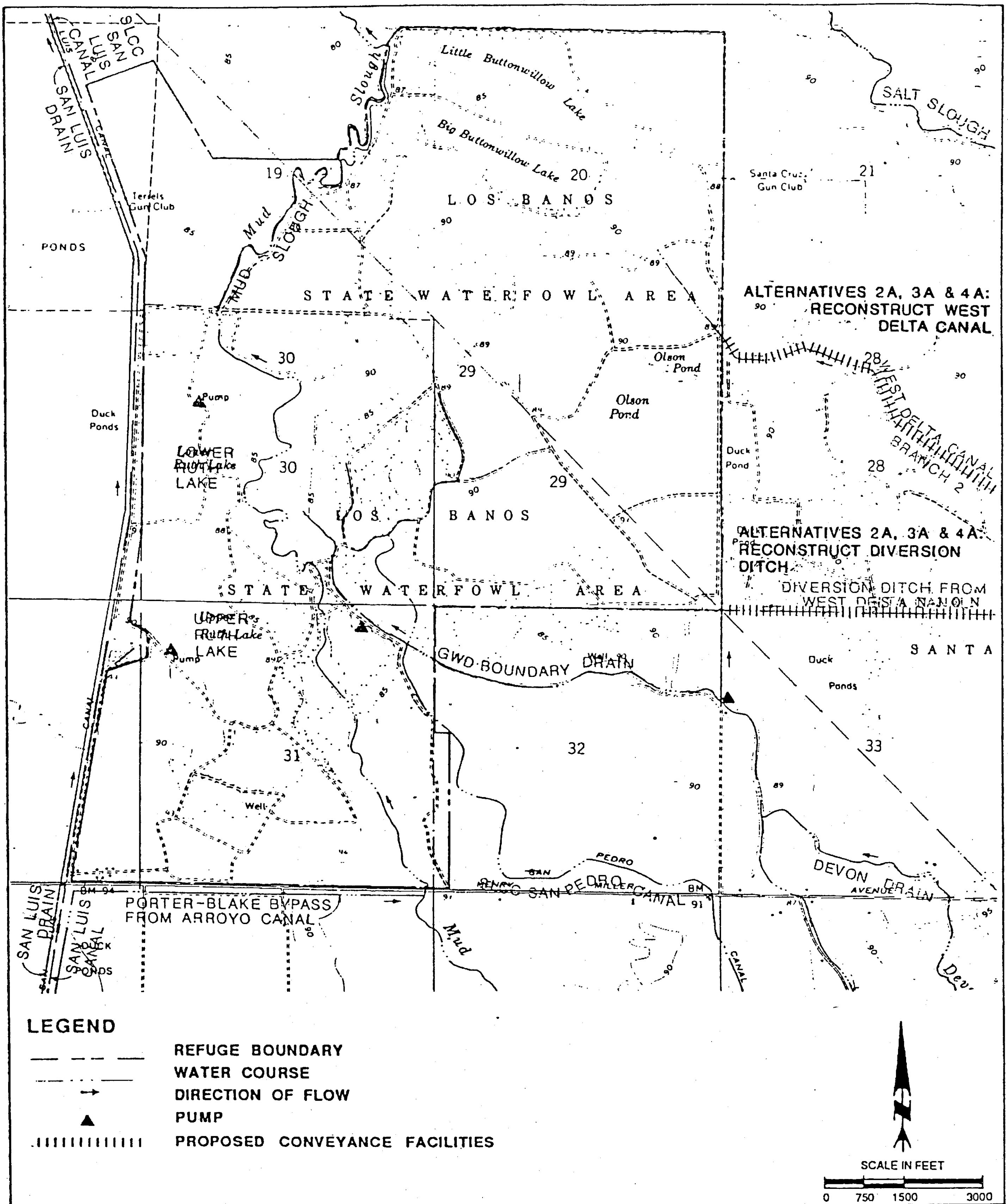

FIGURE IV I-2

LOS BANOS WILDLIFE MANAGEMENT AREA

ALTERNATIVE WATER SUPPLY FACILITIES

TABLE IV I-3

FISH AND WILDLIFE RESOURCES

LOS BANOS WMA

Ducks

Pintail[a]	Mallard[a]	Green-winged Teal
Gadwall[a]	Shoveler[a]	Cinnamon Teal[a]
Ring-necked Duck	Canvasback	Ruddy Duck[a]
		Widgeon

Geese and Swans

Ross' Goose	Cackling Goose	White-fronted Goose
Snow Goose	Tundra Swan	

Coots

American Coot[a]

Shore and Wading Birds

Pied-billed Grebe	Snowy Egret	Great Yellowlegs
White-faced Ibis	American Bittern	Sandpiper
Lesser Sandhill Crane	Black-crowned Night Herons	Killdeer[a]
Common Snipe	American Avocet	Rail[a]
Long-billed Curlew	Black-necked Stilt[a]	Sora[a]
Great Blue Heron	Dowitchers	Gallinule[a]
Common Egret		

Upland Game

Ring-necked Pheasant[a]	Black-tailed Jackrabbits
Cottontail Rabbits	Dove

TABLE IV I-3

FISH AND WILDLIFE RESOURCES

LOS BANOS WMA
(Continued)

Raptorial Birds		
Northern Harrier[a]	Red-tailed Hawk[a]	American Kestrel
Black-Shouldered Kite[a]	Cooper's Hawk	Turkey Vulture
Sparrow Hawk[a]	Golden Eagle	
Fish		
Brown Bullhead	Channel Catfish	Striped Bass
Carp	Large Mouth Bass	
Furbearers		
Coyotes	Muskrats	Raccoon
Opossum	Striped Skunk	Grey Fox
Beaver	Mink	Badger
Spotted Skunk		

Notes:

(a) Birds nesting on refuge

Source: Environmental Assessment Reports, Los Banos Wildlife Area, and Refuge records

TABLE IV I-4

FEDERAL LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

LOS BANOS WMA

Listed Species

Mammals
San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Birds
Bald eagle, *Haliaeetus leucocephalus* (E)
American peregrine falcon, *Falco peregrinus anatum* (E)
Aleutian Canada goose, *Branta canadensis leucopareia* (E)

Invertebrates
Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds
Swainson's hawk, *Buteo swainsoni* (2)
White-faced ibis, *Plegadis chihi* (2)
Western snowy plover, *Charadrius alexandrinus nivosus* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Reptiles
Giant garter snake, *Thamnophis couchi gigas* (2)
California tiger salamander, *Ambystoma tigrinium californiense* (2)

Invertebrates
Molestan blister beetle, *Lytta molesta* (2)

Plants
Hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
Delta coyote-thistle, *Eryngium racemosum* (1)
Bearded allocarya, *Plagiobothrys hystriculus* (2)
Valley spearscale, *Atriplex patula* subsp. *spicata* (2)

Source: USFWS, June 4, 19?7

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

CHAPTER IV J

KESTERSON NATIONAL WILDLIFE REFUGE

Kesterson National Wildlife Refuge (Refuge) was purchased by Reclamation in 1969 as part of the San Luis Drain Project. Originally, the 5,900-acre refuge was to be used as a regulating reservoir for drain water. The Refuge consists of natural marshlands and grassland/vernal pool habitat. The Refuge is located four miles east of Gustine, as shown in Figure IV J-1.

As discussed in Chapter IV G, a portion of the refuge was contaminated due to high selenium concentrations. These areas are currently managed by Reclamation under the Kesterson Cleanup Program and are not discussed in this document. The Service manages the remainder of the Refuge.

The management objectives of the portion of the Refuge managed by the Service are to provide habitat for migratory waterfowl and shorebirds, and to maintain habitats and populations of endangered species, native plants, and animals. From October to April, the Refuge provides flooded wetlands for loafing, nesting, and feeding waterfowl. Flooded wetlands are available in closed areas to provide sanctuary for waterfowl and in hunting areas to provide hunting opportunities.

Management activities are directed at providing marsh food plants through moist soil management practices. Swamp timothy, smartweed, spikerush, and alkali bulrush are the major food producing species. Production of these species require drawdown of the waters in the spring and irrigation during the summer (USBR, 1986a).

At full development, additional wetlands would be provided and food production would be less intensive with swamp timothy and alkali bulrush being the major species managed. This would provide a more open marsh. The eastern side of the Refuge would have some permanent water and thicker stands of cattail and bulrush to partially compensate for the loss of the contaminated Kesterson Reservoir and to provide nesting habitat for critical species such as the tri-colored blackbird. Periodic flushings would occur in the fall and winter to maintain acceptable salt balances.

A. WATER RESOURCES

The Refuge receives 3,500 acre-feet of firm CVP water each year through the Grassland Water District (GWD). Drain water is not used for refuge management due to unacceptable levels of selenium. As discussed in Chapter IV G of this report, water quality has been a problem at the Refuge.

1. Surface Waters

The GWD conveys water to the Refuge from September 15 to November 15 through the San Luis Canal Company (SLCC) San Luis Canal and the GWD Santa Fe Canal.

The San Luis Drain terminates in the central area of the Refuge at the GWD Mud Slough. Water from the San Luis Drain and the GWD Mud Slough is not used due to selenium contamination.

2. Water Conveyance Facilities

The GWD delivers water to the east side of the Refuge through the San Luis Canal and a deep well. The capacity of the SLCC San Luis Canal is limited to 20 cfs due to the size of control structures and shape of the canal. Cleaning and reshaping of the SLCC San Luis Canal, rehabilitation of levees, and improvements to drainage channels are needed to assure adequate water delivery capacities.

Water is delivered to the west side of the Refuge through the GWD Santa Fe Canal and Eagle Ditch. The GWD Santa Fe Canal is located near the southwestern end of the Refuge and drains into the GWD Mud Slough and the wetlands outside of the Refuge. The GWD Santa Fe Canal has adequate capacity to deliver water to the Refuge.

Eagle Ditch is located just outside the west-central side of the Refuge. The Eagle Ditch receives water from the GWD Santa Fe Canal. Water from the Eagle Ditch must be conveyed to the Refuge through private wetlands within Grassland Resource Conservation District (GRCD).

Conveyance system problems within the Refuge are due to the lack of facilities to supply water to the Refuge boundaries. For example, there is no adequate means of delivering water through Eagle Ditch to the northwest portion the Refuge.

3. Groundwater

Groundwater levels are generally within 25 feet of the land surfaces. The Refuge has similar geologic conditions as the GRCD described in Chapter IV G.

One well on the Refuge has been reactivated and provides water to a portion of the east side. The reactivated well produces 20,000 gpm. The well produces water with a fairly high salt content, therefore, surface water with a low salt level is added periodically for dilution. Reclamation estimates the safe yield to be 11,900 acre-feet per year.

TABLE IV I-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

LOS BANOS WMA

	No Action Alternative	Alternatives					
		2A	2B	3A	3B	4A	4B
Habitat Acres							
Permanent Water	100	484	484	484	484	600	600
Watergrass	--	500	500	700	700	850	850
Aquatics	--	--	--	200	200	300	300
Native Marsh	--	1,500	1,500	1,200	1,200	1,000	1,000
Un-irrigated Native Marsh	1,000	--	--	--	--	--	--
Uplands	2,108	724	724	624	624	458	458
Bird Use Days							
Coots	200,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Ducks	4,000,000	12,000,000	12,000,000	12,000,000	12,000,000	14,500,000	14,500,000
Geese	1,000,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
Cranes	1,000	18,000	18,000	19,000	19,000	19,000	19,000
Wading Birds	80,000	250,000	250,000	300,000	300,000	350,000	350,000
Shorebirds	2,000,000	8,000,000	8,000,000	8,500,000	8,500,000	8,500,000	8,500,000
Total	7,281,000	23,768,000	23,768,000	24,319,000	24,319,000	26,869,000	26,869,000
Public Use Days							
Consumptive	2,200	3,400	3,400	3,800	3,800	4,200	4,200
Non-Consumptive	11,600	31,000	31,000	33,000	33,000	35,000	35,000
Total	13,800	34,400	34,400	36,800	36,800	39,200	39,200
Total Annual Cost	$ --	$ 116,480	$ 162,730	$ 165,480	$ 248,550	$ 190,480	$ 272,610
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 7.10	$ 9.90	$ 9.70	14.60	$ 9.70	$ 13.90
Incremental Cost/Additional Public Use Day	N/A	$ 5.70	$ 7.90	$ 7.20	$ 10.80	$ 7.50	$ 10.70

Notes: Alternatives 2A, 3A, and 4A - Reconstruct San Luis Canal Company Facilities.
Alternatives 2B, 3B, and 4B - Implement a Conjunctive Use Plan.

Implementation of any of the alternative plans probably would not adversely affect the candidate threatened and endangered species. Detailed field investigations would be necessary during the advanced planning phase of the project. Implementation of a plan would result in overall beneficial environmental effects. The No Action Alternative would result in loss of marsh habitat. Additional regional environmental analyses would be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the alternatives would be positive due to the potential increase in wildlife use and subsequently public use.

F. POWER ANALYSIS

The Pacific Gas and Electric serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Merced County would issue approvals for construction along roads and drainage courses to ensure that the existing drainage facilities would not be adversely affected. In addition, Merced County would issue permits for wells. Stream Alteration Permits would be required from the DFG for Alternatives 2A, 3A, and 4A. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors under Alternatives 2A, 3A, and 4A.

TABLE IV I-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

LOS BANOS WMA

Items	Alternatives 2A	2B	3A	3B	4A	4B
Additional Water (ac-ft)	10,500	10,500	16,300	16,300	18,800	18,800
Construction Costs						
Wells	$ --	$424,000[b]	$ --	$689,000[d]	$ --	$689,000[d]
Pipelines/Canals	15,300[a]	--	15,300[a]	--	15,300[a]	--
Subtotal	$ 15,300	$424,000	$ 15,300	$689,000	$ 15,300	$689,000
Other Costs	--	15,300[c]	--	15,300[c]	--	15,300
Total (e)	$ 15,300	$439,300	$ 15,300	$704,300	$ 15,300	$704,300
Annualized Construction Cost (8.87%, 30 yrs)	$ 1,480	$ 42,260	$ 1,480	$ 67,760	$ 1,480	$ 67,760
Additional Annual Cost						
Operation & Maintenance[f]	$ 1,000	$ 14,400	$ 1,000	$ 23,400	$ 1,000	$ 23,400
Power	--	48,570[g,h]	--	75,390[g,h]	--	86,950[g,h]
Local Conveyance Cost[i]	105,000	--	163,000	--	188,000	--
Subtotal	$106,000	$ 62,970	$164,000	$ 98,790	$189,000	$110,350
Other Costs	--	53,000[c,h]	--	82,000[c,h]	--	94,500[c,h]
Total (e)	$106,000	$115,970	$164,000	$180,790	$189,000	$204,850
Total Annual Costs	$107,480	$158,230	$165,480	$248,550	$190,480	$272,610
Cost/Additional Acre-Foot	$ 7.00	$ 15.10	$ 10.20	$ 15.30	$ 10.20	$ 14.50

TABLE IV I-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

LOS BANOS WMA

(Continued)

Notes: Alternatives 2A, 3A, and 4A - Reconstruct San Luis Canal Company Facilities.
Alternatives 2B, 3B, and 4B - Implement a Conjunctive Use Plan.

(a) Reconstruct 7,500 feet of unlined canal and portions of West Canal.

(b) 8 wells, 500 feet deep, 80-foot lift.

(c) Alternative 2B would require implementation of Alternative 2A, Alternative 3B would require implementation of Alternative 3A, and Alternative 4B would require implementation of Alternative 4A.

(d) 13 wells, 500 feet deep, 80-foot lift.

(e) Does not include cost for Zahm-Sansoni-Nelson Plan which is discussed in Chapter IVG.

(f) Basis for O&M costs are discussed in Appendix F.

(g) Unit Pumping Cost = $9.25/af.

(h) Values multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(i) Unit Conveyance Cost = $10/af.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 10,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as are presented in Table IV J-1. Each of the water supply levels provides a different volume of water, and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (3,500 acre-feet)

No new facilities would be required to deliver the existing firm water supply. However to ensure that good quality water is provided to the Refuge through the SLCC San Luis Canal, the Zahm-Sansoni-Nelson Plan would need to be implemented. The Zahm-Sansoni-Nelson Plan was described under Alternative 2A for the Grassland Resource Conservation District in Chapter IV G.

2. Delivery Alternative for Level 2 (3,500 acre-feet)

Alternative 2A would increase water delivery efficiency on the Refuge. This alternative would require implementation of the Zahm-Sansoni-Nelson Plan to provide good quality water to the Refuge.

Alternative 2A - Rehabilitate Santa Fe Canal. To maximize water delivery efficiency, the existing terminals of the GWD Santa Fe Canal would be rehabilitated and extended, and a weir would be replaced or rehabilitated, as shown in Figure IV J-2.

3. Delivery Alternatives for Level 3 (10,000 acre-feet)

Alternatives 3A, 3B, 3C, and 3D would increase the water supplies available to developed areas of the Refuge. Alternative 3E would provide a conjunctive use program. All of these alternatives would require implementation of the Zahm-Sansoni-Nelson Plan and Alternative 2A.

Alternative 3A - Extend Eagle Ditch into the Refuge. Eagle Ditch would be extended northward through the Lone Tree Duck Club to Teal

TABLE IV J-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE KESTERSON NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac—ft	Supply Level 4 ac-ft
January	0	0	500	500
February	0	0	500	500
March	0	0	750	750
April	0	0	1,000	1,000
May	0	0	1,000	1,000
June	0	0	600	600
July	0	0	600	600
August	0	0	800	800
September	500	500	1,000	1,000
October	1,500	1,500	1,500	1,500
November	1,500	1,500	1,000	1,000
December	0	0	750	750
Total	3,500	3,500	10,000	10,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum mangement

Source: USFWS, 1986

water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in Merced County during construction. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use to Kesterson NWR averages 2,100 visits per year (Level 2). If additional water is provided, the attendance levels would increase.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 3,757,900 use-days. Wildlife and fishery resources associated with the Refuge are presented in Table IV J-3. The listed threatened and endangered species associated with the Refuge are the San Joaquin kit fox, Vulpes macrotis mutica; the bald eagle, Haliaeetus leucocephalus; the American peregrine falcon, Falco peregrinus anatum, and the Aleutian Canada goose, Branta canadensis leucopareia. Numerous candidate species may occur in this area and are also presented in Table IV J-4.

The Refuge may have the highest populations of the endangered San Joaquin kit fox in the GRCD area. It also has the largest associations of native plants of any San Joaquin Valley refuge. A nesting colony of snowy egrets and black crowned night herons use the bulrushes in Sprig Lake, a deep water marsh. The Refuge has one of the best remaining native prairie/vernal pool associations in the area. These vernal pools are the homes of rare plants and are used by waterfowl and resident species.

Implementation of any of the alternatives probably would not adversely affect listed, proposed, and candidate threatened and endangered species. Detailed field investigations will be necessary during the advanced planning phase of the project. Implementation of any of the alternatives would improve habitat, increase bird use, and result in overall beneficial environmental effects, as indicated in Table IV J-5. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the alternative plans would be positive due to the potential increase in public use.

TABLE IV J-3

WILDLIFE RESOURCES

KESTERSON NWR

Ducks

Mallard[a]	Gadwall[a]	American Wigeon[a]
Green-winged Teal[a]	Blue-winged Teal	Northern Shoveler[a]
Pintail[a]	Bufflehead	Canvasback[a]
Ruddy Duck[a]	Wood Duck	
Redhead[a]	Lesser Scaup	Ring-necked Duck
Cinnamon Teal[a]		

Geese and Swans

Snow Goose	White-fronted Goose	Cackling Canada Goose
Ross' Goose	Canada Goose	Tundra Swan

Coots

American Coot

Shore and Wading Birds

American Avocet[a]	Long-billed Curlew	Snowy Egret[a]
Black-necked Stilt[a]	Killdeer[a]	Black-crowned Night Heron[a]
Common Snipe	Pied-billed Grebe[a].	Lesser Sandhill Crane
Long-billed Dowitcher	California Gull	Greater Sandhill Crane
Least Sandpiper	White Pelican	Virginia Rail[a]
Dunlin	American Bittern[a]	Sora
Western Sandpiper	Great Blue Heron	Common Moorhen[a]
Greater Yellowlegs	Great Egret	
	White-Faced Ibis	

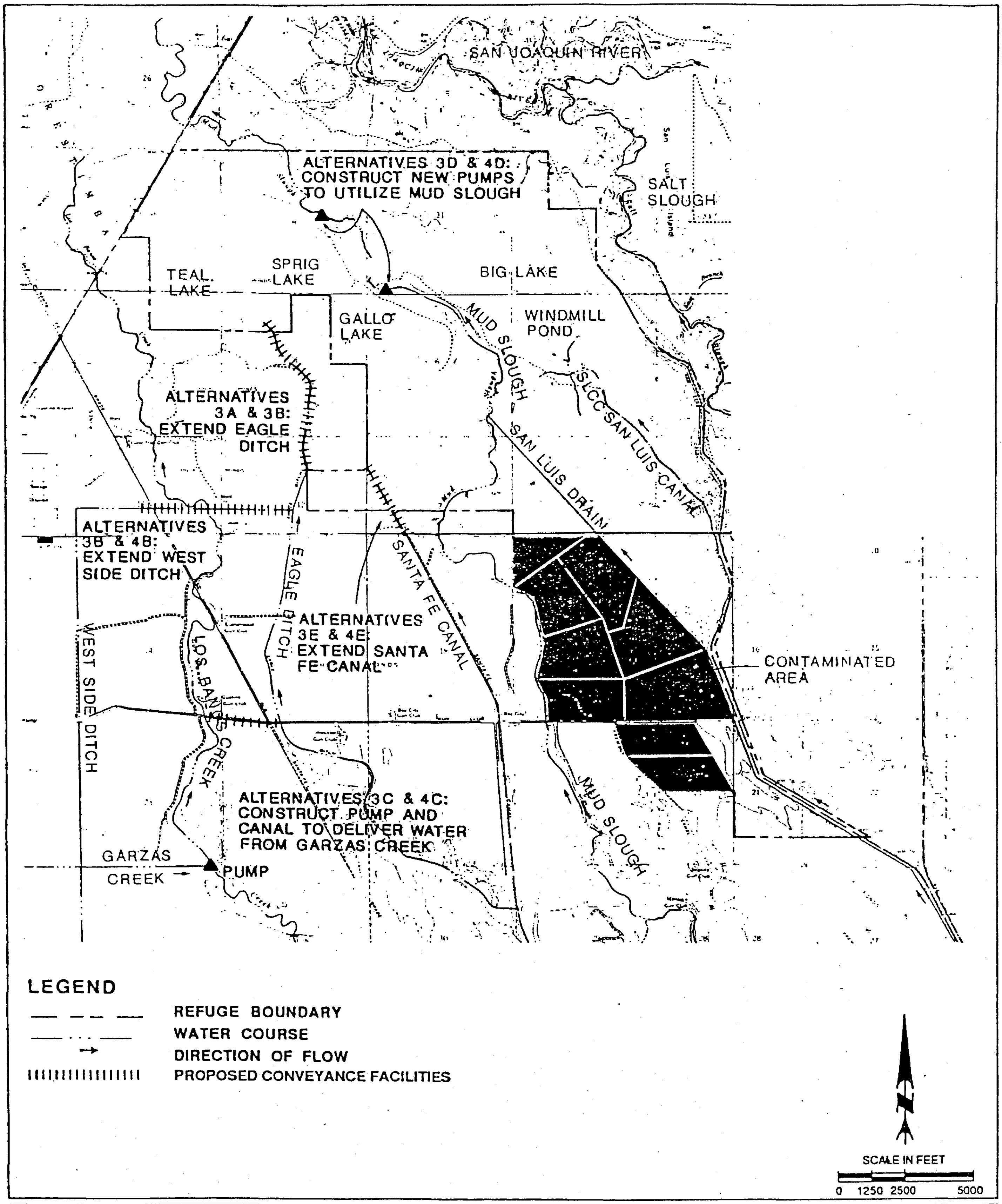

FIGURE IV J-2

KESTERSON NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

and Sprig Lakes. This plan would require construction of a 7,600-foot ditch, two 3-way control structures, six crossings, one siphon, and six turnouts.

Alternative 3B - Extend West Side Ditch to Eagle Ditch. The West Side Ditch would be used to convey water from Garzas Creek to Eagle Ditch. A 6,000-foot ditch would be constructed to connect the West Side Ditch and Eagle Ditch. The additional water would be conveyed through Eagle Ditch to Teal and Sprig Lakes. This alternative would require implementation of Alternative 3A.

Alternative 3C - Convey Water from Garzas Creek to Los Banos Creek. Water from the Central California Irrigation District (CCID) Main Canal would be routed from Garzas Creek northward through Los Banos Creek to the Refuge boundary. Ditches and a low-lift pump station would be used to convey water from Garzas Creek to Sprig and Teal Lakes.

Alternative 3D - Utilize Mud Slough. Although the Mud Slough waters are currently contaminated, this conveyance system would be utilized in the future if the quality of the Mud Slough water improves and selenium levels become acceptable for safe fish and wildlife existence. However, two low-lift pumps and a conveyance system would required.

Alternative 3E - Extend Santa Fe Canal. The GWD Santa Fe Canal would be extended onto the Refuge. Approximately 2,500 feet of existing ditches would be replaced or rehabilitated.

Alternative 3F - Implement a Conjunctive Use Plan. Four wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Surface water would be needed during dry years to be used for dilution to reduce salt concentrations in the groundwater supply. Implementation of this alternative also would require implementation of Alternative 2A; Alternatives 3A, 3B, 3C, or 3E; and the Zahm-Sansoni-Nelson Plan.

4. Delivery Alternatives for Level 4 (10,000 acre-feet)

The amount of water to be delivered under Level 4 is equal to the amount of water to be delivered under Level 3. Therefore, the alternatives considered for Level 4 would be the same as for Level 3. All of these alternatives would require implementation of the Zahm-Sansoni-Nelson Plan and Alternative 2A.

Alternative 4A - Extend Eagle Ditch into the Refuge. This alternative is identical to Alternative 3A.

Alternative 4B - Extend West Side Ditch to Eagle Ditch. This alternative is identical to Alternative 3B.

Alternative 4C - Convey Water from Garzas Creek to Los Banos Creek. This alternative is identical to Alternative 3C.

Alternative 4D - Utilize Mud Slough. This alternative is identical to Alternative 3D.

Alternative 4E - Extend Santa Fe Canal. This alternative is identical to Alternative 3E.

Alternative 4F - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 3F.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to criteria listed in Chapter III.

There were no alternatives considered for Level 1, the No Action Alternative.

Alternative 2A was developed to improve operational efficiency of the GWD Santa Fe Canal and the SLCC San Luis Canal.

Alternatives 3A through 3E and Alternatives 4A through 4E were developed to improve delivery of water to all portions of the Refuge. Alternatives 3A, 3B, 4A, and 4B would require long-term agreements with SLCC. Alternatives 3C and 4C also would require a long-term agreement with CCID. Alternatives 3D and 4D would require removal of contaminants from the Mud Slough. If the contamination is removed, Alternatives 3D and 4D provide the most flexibility to the Refuge because Mud Slough flows through the center of the Refuge.

Alternatives 3F and 4F also would require implementation of surface water alternatives (Alternatives 3A through 3E or Alternatives 4A through 4E) to provide water during wet years. In addition, surface water would be required during dry years to dilute salt concentrations in the groundwater supply.

All of the alternatives would require implementation of the Zahm-Sansoni-Nelson Plan to provide good quality water. Alternative 3B also would require implementation of Alternative 3A.

C. COSTS AND ECONOMIC ANALYSIS

Costs of the alternative plans to provide adequate water supplies under the Water Levels 2,3, and 4 are presented in Table IV J-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs only include the local costs of delivering water. The annual O&M costs do not include costs to purchase CVP

TABLE IV J-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

KESTERSON NWR

Items	Alternatives 2A	3A & 4A	3B & 4B	3C & 4C	3D & 4D	3E & 4E	3F & 4F
Additional Water (ac-ft)	0	6,500	6,500	6,500	6,500	6,500	6,500
Construction Wells							
Wells	$ --	$ --	$ --	$ --	$ --	$ --	$212,000(k)
Diversion Structures	15,000(a)	15,000(b)	15,000(b)	--	--	--	--
Pipelines/Canals	--	101,000(c)	64,700(e)	15,280(f)	5,000(h)	6,900(j)	--
Pump Stations	--	--	--	120,000(g)	240,000(i)	--	--
Subtotal	$ 15,000	$116,000	$ 79,700	$135,280	$245,000	$ 6,900	$212,000
Other Costs	--	15,000(d)	15,000(d)	15,000(d)	15,000(d)	15,000(d)	281,900(l)
Total (m)	$ 15,000	$131,000	$ 94,700	$150,280	$260,000	$ 21,900	$493,900
Annualized Construction Cost (8.87%, 30 yrs)	$ 1,450	$ 12,600	$ 9,110	$ 14,460	$ 25,010	$ 2,110	$ 47,510
Additional Annual Cost							
Operation & Maintenance(o)	$ --	$ 1,750	$ 1,200	$ 2,100	$ 2,400	$ --	$ 7,200
Power	--	--	--	6,500(q)	6,500(q)	--	30,100(s,t)
Local Conveyance Cost	--	6,500(p)	6,500(p)	4,880(r)	6,500(p)	6,500(p)	--
Subtotal	$ --	$ 8,250	$ 7,700	$ 13,480	$ 15,400	$ 6,500	$ 37,300
Other Costs	-	-	-	-	-	-	10,950(l,s)
Total (m,n)	$ --	$ 8,250	$ 7,700	$ 13,480	$ 15,400	$ 6,500	$ 48,250
Total Annual Costs	$ 1,450	$ 20,850	$ 16,810	$ 27,940	$ 40,410	$ 8,610	$ 95,760
Cost/Additional Acre-Foot	--	$ 3.20	$ 2.60	$ 4.30	$ 6.20	$ 1.30	$ 14.70

TABLE IV J-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

KESTERSON NWR

(Continued)

Notes: Alternative 2A - Rehabilitate Santa Fe Canal.
Alternatives 3A and 4A - Extend Eagle Ditch into the Refuge.
Alternatives 3B and 4B - Extend West Side Ditch to Eagle Ditch.
Alternatives 3C and 4C - Convey Water from Garzas Creek to Los Banos Creek.
Alternatives 3D and 4D - Utilize Mud Slough.
Alternatives 3E and 4E - Extend Santa Fe Canal.
Alternatives 3F and 4F - Implement a Conjunctive Use Plan.

(a) Rehabilitate 2 weirs on the Santa Fe Canal.
(b) 1 measuring device; two 3-way controls; and 6 turnouts, 25 cfs.
(c) 7,600 feet of unlined canals; 50 cfs; 6 road crossings, 50 cfs.
(d) Alternatives 3A through 3F and 4A through 4F would require implementation of Alternative 2A.
(e) 13,600 feet of unlined canals, 25 cfs; one siphon, 25 cfs; and 6 road crossings, 25 cfs.
(f) 6,000 feet of unlined canals, 25 cfs.
(g) 1 pump station, 10-foot lift, 25 cfs.
(h) 2,000 feet of unlined canal, 25 cfs.
(i) 2 pump stations, 10-foot lift, 25 cfs.
(j) 2,500 feet of unlined canal, 25 cfs.
(k) 4 wells, 500-feet deep, 80-foot lift.
(l) Alternative 3F assumes implementation of Alternatives 3D and 3E; and Alternative 4F assumes implementation of Alternatives 4D and 4E.
(m) Total costs do not include cost to implement Zahm-Sansoni-Nelson plan described in Chapter IV G.
(n) Annual O&M costs do not include cost to deliver Level 1 water supply.
(o) Basis for O&M costs are discussed in Appendix F.
(p) Unit Conveyance Cost = $1/af (GWD).
(q) Unit Pumping Cost = $1/af.
(r) Unit Conveyance Cost = $0.75/af (CCID)
(s) Unit Pumping Cost = $9.25/af.
(t) Values are multiplied by 0.5 because facilities are assumed to be used only 5 of every 10 years.

CHAPTER IV K

SAN LUIS NATIONAL WILDLIFE REFUGE

The Migratory Bird Conservation Commission created the 7,360-acre San Luis National Wildlife Refuge (Refuge) in 1966 under the Migratory Bird Conservation Act. The Refuge was expanded in 1970 to 7,430 acres with proceeds from the sale of duck stamps. The Refuge is located 12 miles northeast of the City of Los Banos and lies within the Grassland Resource Conservation District (GRCD). The Refuge is managed by the Service and provides nesting, migration, and wintering habitat for ducks and geese; habitat for other migratory birds; and recreational opportunities. The Refuge also preserves valuable native grasslands.

The Refuge is an interior island, flanked by riparian zones along the Salt Slough on the west and the San Joaquin River on the east, as shown on Figure IV K-1. Land use on the Refuge can be classified as mixed marsh, upland, and riparian habitat. Natural and man-made marshlands are managed for maximum moist-soil plant production. Native grasslands support a diversity of flora and fauna indigenous to the Central Valley.

Under current management practices, water is provided to the ponds and sloughs at least once during the summer months for volunteer perennial and annual marsh plants. Flooding of the marshes begins in mid-September. Water deliveries are continued as needed throughout the remainder of the winter. Usually, by the end of February, the seasonal rains are sufficient to maintain the marshes. The mixed marsh is flooded periodically to maintain the vegetation. Approximately 100 acres of mixed marsh are irrigated several times during the summer months and managed to produce herbaceous browse for tule elk. Riparian habitat located away from Salt Slough and the San Joaquin River requires at least one summer irrigation (USBR, 1986a).

A. WATER RESOURCES

The Refuge holds 19,910 acre-feet of water rights on Salt Slough which forms the western boundary of the Refuge. However, this water source contains high levels of selenium and cannot be used for refuge management.

The Refuge receives agricultural return flows from the San Luis Canal Company (SLCC) through deed encumbrances on an as-available basis. SLCC also conveys surplus Central Valley Project (CVP) water to the Refuge.

1. Surface Waters

Salt Slough is an intermittent stream that flows along the western refuge boundary and eventually flows into the San Joaquin River.

Most of the water in Salt Slough originates from operational spills, waste, and return flow from the SLCC and the Central California Irrigation District (CCID). However, Mud Slough flows into Salt Slough immediately upstream of the Refuge. The Mud Slough water contains high selenium concentrations. In 1985, Salt Slough water was determined to be unacceptable for refuge management due to selenium contamination (>2 ppb). Therefore, the Service has discontinued using Salt Slough for waterfowl habitat management (USFWS, 1987i).

The SLCC delivers surplus CVP water to replace the Salt Slough water. The SLCC also delivers CVP water purchased by Reclamation for the Refuge.

The Refuge has agreed, via deed encumbrances, to receive agricultural return flows from the SLCC. This water is received from neighboring lands at three points along the southern refuge boundary. The source is not dependable and, until recently, has not been measured. It is estimated by the Service to range from 800 to 4,000 acre-feet per year.

2. Water Conveyance Facilities

The SLCC is currently transporting CVP water to the Refuge through three conveyances, the Noble Ditch, Island "C" Canal, and Island "D" Canal, as shown on Figure IV K-1 (USBR, 1986a). The SLCC Noble Ditch is located along the southern boundary of the Refuge. The SLCC Island "C" Canal enters the Refuge in the southeast corner and extends to Dickenson Ferry Road. The SLCC Island "D" Canal extends into the southwestern section of the Refuge.

The SLCC Island "C" Canal could be used to transport flows from the San Joaquin River if water was available. However, the canal capacity is only 20 cfs.

Use of the SLCC facilities to convey refuge water has caused some drainage problems. Water seeps from the unlined canals into surrounding farmlands. The SLCC drains the canals during the non-irrigation season to relieve this problem and to complete maintenance procedures. However, the Refuge requires water deliveries during the non-irrigation season.

Two lift stations have been used to convey water from Salt Slough to the west side of the Refuge. Lift Station 1 contains two pumps, Pumps 1A and 1B, and has a total capacity of 50 cfs. Lift Station 5 has a total capacity of 15 cfs.

Three other lift stations are used throughout the Refuge. Lift Stations 2 and 3 are located along the southern border and have capacities of 60 and 55 cfs, respectively. Lift Station 4, with a capacity of 15 cfs, is located near the northwest corner of the Refuge.

TABLE IV J-3

WILDLIFE RESOURCES

KESTERSON NWR
(Continued)

Upland Game		
Mourning Dove[a]	Ring-necked Pheasant	
Cottontail Rabbit	Black-tailed Jackrabbit	
Raptorial Birds		
Turkey Vulture	Black-Shouldered Kite[a]	Northern Harrier[a]
Sharp-shinned Hawk	Cooper's Hawk	Red-tailed Hawk[a]
Swainson's Hawk	American Kestrel[a]	Barn Owl[a]
Short-eared Owl	Great Horned Owl[a]	Burrowing Owl[a]
Golden Eagle		
Furbearers		
Coyote	Raccoon	
Skunk	Muskrat	
Long-Tailed Weasel		

Notes:

(a) Birds nesting on refuge

Source: Birds of San Luis, Merced and Kesterson Wildlife Refuges (RF 11660.3. August 1984), NWRS Public Use Report (1) and refuge records.

TABLE IV J-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

KESTERSON NWR

Listed Species

Mammals
San Joaquin kit fox, Vulpes macrotis mutica (E)

Birds
Bald eagle, Haliaeetus leucocephalus (E)
American peregrine falcon, Falco peregrine anatum (E)
Aleutian Canada Goose, Branta canadensis leucopareia (E)

Proposed Species

None

Candidate Species

Birds
Swainson's hawk, Buteo swainsoni (2)
White-faced ibis, Plegadis chihi (2)
Western snowy plover, Charadrius alexandrinus nivosus (2)
Tricolored blackbird, Agelaius tricolor (2)

Reptiles
Giant garter snake, Thamnophis couchi gigas (2)
California tiger salamander, Ambystoma tigrinium californiense (2)

Invertebrates
Molestan blister beetle, Lytta molesta (2)

Plants
Hispid bird's-beak, Cordylanthus mollis subsp. hispidus (2)
Delta coyote-thistle, Eryngium racemosum (1)
Bearded allocarya, Plagiobothrys hystriculus (2)
Valley spearscale, Atriplex patula subsp. spicata (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV J-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

KESTERSON NWR

	No Action Alternative	Alternatives 2A	3A & 4A	3B & 4B	3C & 4C	3D & 4D	3E & 4E	3F & 4F
Habitat Acres								
Permanent Water	20	20	180	180	180	180	180	180
Seasonal Marsh	470	470	1,240	1,240	1,240	1,240	1,240	1,240
Bird Use Days								
Ducks	2,383,000	2,383,000	4,460,000	4,460,000	4,460,000	4,460,000	4,460,000	4,460,000
Geese	6,900	6,900	13,500	13,500	13,500	13,500	13,500	13,500
Wading and Shorebirds	1,366,000	1,366,000	2,680,000	2,680,000	2,680,000	2,680,000	2,680,000	2,680,000
Endangered Species	2,000	2,000	3,900	3,900	3,900	3,900	3,900	3,900
Total	3,757,900	3,757,900	7,157,400	7,157,400	7,157,400	7,157,400	7,157,400	7,157,400
Public Use Days								
Consumptive	1,800	1,800	1,900	1,900	1,900	1,900	1,900	1,900
Non-Consumptive	300	300	1,600	1,600	1,600	1,600	1,600	1,600
	2,100	2,100	3,500	3,500	3,500	3,500	3,500	3,500
Total Annual Cost	--	$ 1,450	$ 20,850	$ 16,810	$ 27,940	$ 40,410	$ 8,610	$ 95,760
Incremental Cost/Additional 1000 Bird Use Days	N/A	N/A	$ 6.10	$ 5.00	$ 8.20	$ 11.90	$ 2.50	$ 28.20
Incremental Cost/Additional Public Use Day	N/A	N/A	$ 14.90	$ 12.00	$ 20.00	$ 28.90	$ 6.20	$ 68.40

Notes: Alternative 2A - Rehabilitate Santa Fe Canal.
Alternatives 3A and 4A - Extend Eagle Ditch into the Refuge.
Alternatives 3B and 4B - Extend West Side Ditch to Eagle Ditch.
Alternatives 3C and 4C - Convey Water from Garzas Creek to Los Banos Creek.
Alternatives 3D and 4D - Utilize Mud Slough.
Alternatives 3E and 4E - Extend Santa Fe Canal.
Alternatives 3F and 4F - Implement a Conjunctive Use Plan.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction of any of the alternatives would require several permits. Merced County would issue permits for wells and approvals for all construction along roads and drainage courses to ensure that the existing drainage facilities would not be adversely affected. Alternatives 3A, 3B, 3C, and 3E and 4A, 4B, 4C, and 4E would require long-term agreements with SLCC. Alternatives 3C and 4C also would require a long-term agreement with CCID. Stream Alteration Permits would be required from the DFG for Alternatives 3A through 3E and Alternatives 4A through 4E. Approvals from the Regional Water Quality Control Board and other regulatory agencies would be required for Alternatives 3D and 4D to indicate that all contamination was removed from Mud Slough. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors.

The water conveyance system within the Refuge has had major problems caused by the inability to bypass certain areas of marshlands when needed. Many improvements have been made to allow the Service to minimize the use of energy-intensive low-lift pumps.

3. Groundwater

The general groundwater conditions of the Refuge are similar to the conditions described for the GRCD in Chapter IV G of this report.

Groundwater is only used for domestic supplies. Water table seasonal fluctuations vary from 10 to 20 feet. Reclamation has estimated that the safe yield is 18,700 acre-feet per year (USBR, 1986c).

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 19,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV K-1. Each of the water supply levels provides a different volume of water and are summarized as follows:

Level 1 -Existing firm water supply

Level 2 -Current average annual water deliveries

Level 3 -Water supply needed for full use of existing development

Level 4 -Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

The Refuge does not have a useable firm water supply. Therefore, no alternatives were identified for Level 1.

2. Delivery Alternatives for Level 2 (13,350 acre-feet)

Alternatives 2A and 2B were developed to improve the capabilities of SLCC to deliver CVP water to Refuge. Alternative 2C would provide facilities for a conjunctive use program. All of these alternatives would require implementation of the Zahm-Sansoni-Nelson Plan. This plan was described in Chapter IV G.

Alternative 2A - Enlarge and Line San Luis Canal Company Facilities. To reduce the amount of water lost in seepage from the SLCC canals and provide adequate capacity to convey both agricultural and refuge water supplies, 28,000 feet of canals would be replaced with pipelines, as shown in Figure IV K-2. The Service

TABLE IV K-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE SAN LUIS NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	500	1,000	1,000
February	0	700	1,000	1,000
March	0	1,000	1,000	1,000
April	0	550	1,250	1,250
May	0	550	1,500	1,500
June	0	1,700	1,500	1,500
July	0	350	1,250	1,250
August	0	200	1,000	1,000
September	0	1,000	1,000	1,000
October	0	3,350	4,000	4,000
November	0	2,500	3,000	3,000
December	0	950	1,500	1,500
Total	0	13,350	19,000	19,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d and 1986e

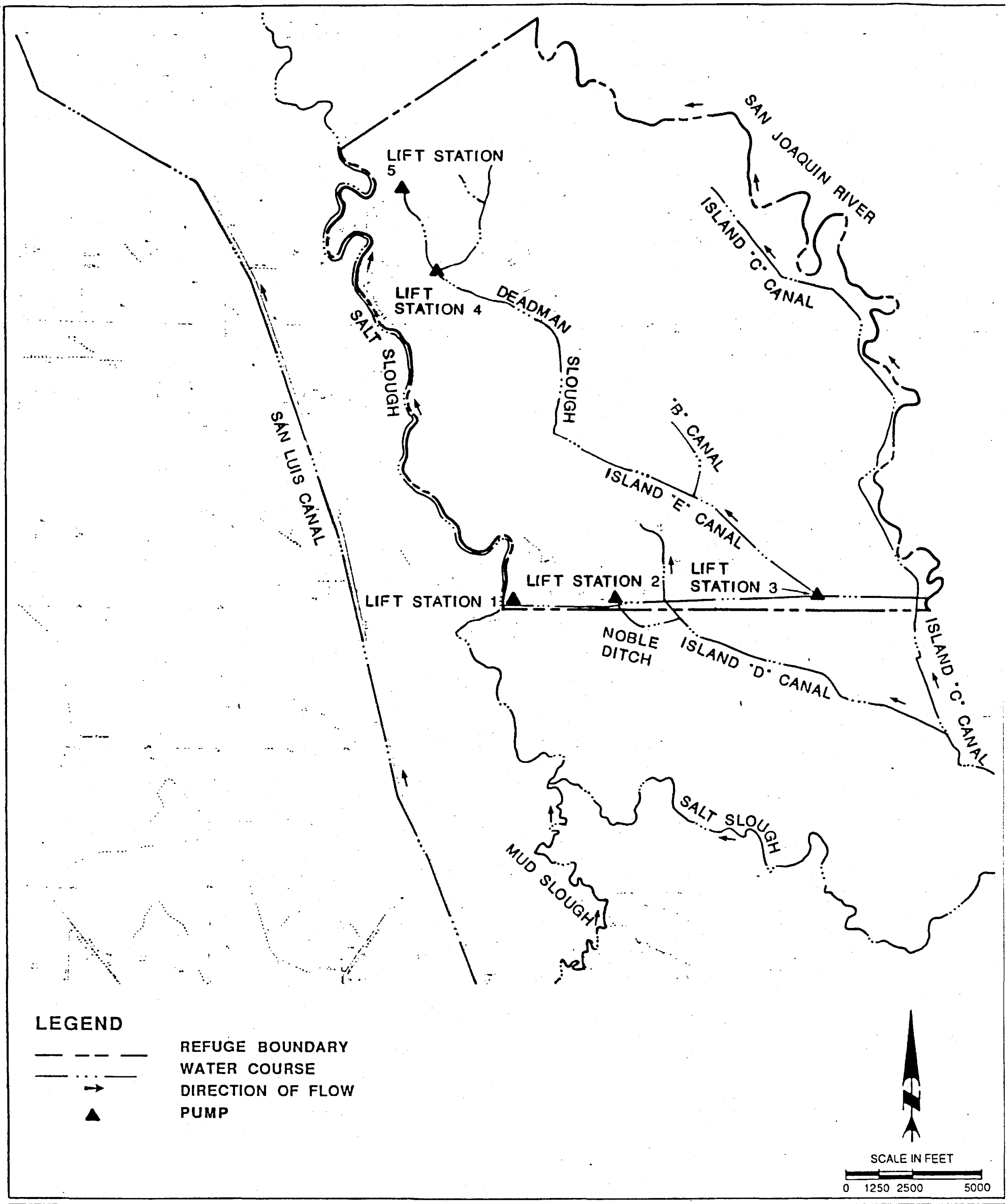

FIGURE IV K-1

SAN LUIS NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

JMM

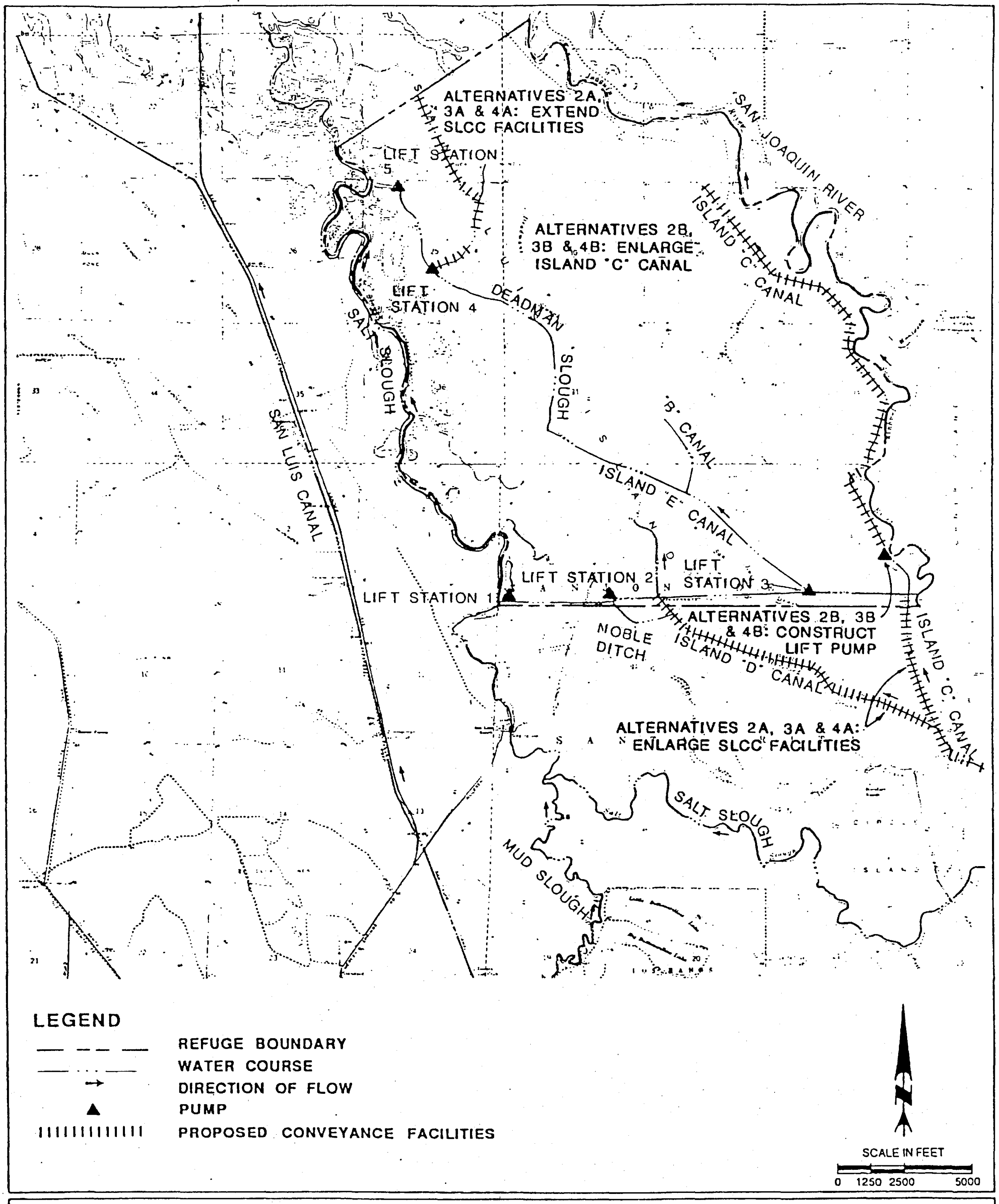

FIGURE IV K-2

SAN LUIS NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

JMM

and the SLCC would coordinate water deliveries and maintenance procedures to minimize impacts to the Refuge.

Alternative 2B - Construct Lift Pump to Utilize San Joaquin River Water. To convey water from the San Joaquin River to the Refuge through the SLCC Island "C" Canal, the capacity of the canal would be increased from 20 cfs to 40 cfs. Three existing siphon pipes would be replaced with larger pipes. A 40 cfs pump also would be installed. Internal conveyances would be changed to accommodate water deliveries from the east instead of the west. This alternative would require water rights or a CVP contract to receive water from the San Joaquin River.

Alternative 2C - Implement a Conjunctive Use Plan. Seventeen wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternative 2A or 2B to deliver surface water during wet years.

3. Delivery Alternatives for Level 3 (19,000 acre-feet)

The additional water would be used to increase permanent water and watergrass, and to provide flushing flows to improve salt balance. Alternatives for Level 3 are similar to those discussed for Level 2.

Alternative 3A - Enlarge and Line San Luis Canal Company Facilities. This alternative is identical to Alternative 2A.

Alternative 3B - Construct Lift Pump to Utilize San Joaquin River Water. This alternative is identical to Alternative 2B.

Alternative 3C - Implement a Conjunctive Use Plan. This alternative is similar to Alternative 2C. Twenty wells would be constructed on the Refuge to deliver the maximum month water demand under Level 3. Implementation of this alternative also would require implementation of Alternative 3A or 3B to deliver surface water during wet years.

4. Delivery Alternatives for Level 4 (19,000 acre-feet)

Water Supply Level 4 is equal to Level 3. Therefore, the alternatives for Level 4 are identical to alternatives for Level 3.

Alternative 4A - Enlarge and Line San Luis Canal Company Facilities. This alternative is identical to Alternatives 2A and 3A.

Alternative 4B - Construct Lift Pump to Utilize San Joaquin River Water. This alternative is identical to Alternatives 2B and 3B.

Alternative 4C - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 3C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Level 1 because the Refuge does not have a useable firm water supply.

All alternatives would require the implementation of the Zahm-Sansoni-Nelson Plan, as discussed in Chapter IV G of this report.

Alternatives 2A and 2B; 3A and 3B; and 4A and 4B would require long-term conveyance agreements with the SLCC.

The conjunctive use alternatives (Alternatives 2C, 3C, and 4C) would require implementation of a surface water alternative (Alternatives 2A or 2B, 3A or 3B, or 4A or 4B, respectively) to deliver surface water during wet years.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Water Delivery Levels 2, 3, and 4 are presented in Table IV K-2. The construction costs include factors to cover engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the improvements under the various water delivery alternatives would result in additional money being spent in Merced County during construction. The construction would probably be completed over a two to four year period by construction workers who reside in Merced County.

Currently, the annual public use to the Refuge averages 22,400 visits per year (Level 2). If additional water is provided to the Refuge, public-use levels would increase.

F. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 13,362,000 use-days. Wildlife and fishery resources associated with the Refuge are presented in Table IV K-3. The listed threatened and endangered species associated with the Refuge are the San Joaquin kit fox, Vulpes macrotis mutica; the bald eagle, Haliaeetus leucocephalus; the American peregrine falcon, Falco

TABLE IV K-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SAN LUIS NWR

Items	Alternatives					
	2A	2B	2C	3A & 4A	3B & 4B	3C & 4C
Additional Water (ac-ft)	13,350	13,350	13,350	19,000	19,000	19,000
Construction Costs						
Wells	$ --	$ --	$ 901,000 (d)	$ --	$ --	$1,060,000
Diversion Structures	627,000	--	--	627,000	--	--
Pipelines/Canals	2,062,000 (a)	19,900 (b)	--	2,062,000 (a)	19,900 (b)	--
Pump Stations	--	234,000 (c)	--	--	234,000 (c)	--
Subtotal	$2,689,000	$253,900	$ 901,000	$2,689,000	$253,900	$1,060,000
Other Costs	--	--	2,689,000 (e)	--	--	2,689,000 (e)
Total (g)	$2,689,000	$253,900	$3,590,000	$2,689,000	$253,900	$3,749,000
Annualized Construction Cost (8.87%, 30 yrs)	$ 258,680	$ 24,430	$ 345,360	$ 258,680	$ 24,430	$ 360,660
Additional Annual Cost						
Operation & Maintenance (h)	$ 10,500	$ 3,900	$ 30,600	$ 10,500	$ 3,900	$ 36,000
Power	--	20,000 (j)	61,750 (k,l)	--	28,500 (j)	87,900 (k,l)
Local Conveyance Cost	133,500 (i)	133,500 (i)	--	190,000 (h)	190,000 (i)	--
Subtotal	$ 144,000	$157,400	$ 92,350	$ 200,500	$222,400	$ 123,900
Other Costs	--	--	72,000 (e,l)	--	--	100,250 (e,l)
Total	$ 144,000	$157,400	$ 164,350	$ 200,500	$222,400	$ 224,150
Total Annual Costs	$ 402,680	$181,830	$ 509,710	$ 459,180	$246,830	$ 584,810
Cost/Additional Acre-Foot	$ 30.20	$ 13.60	$ 38.20	$ 24.20	$ 13.00	$ 30.80

TABLE IV K-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

SAN LUIS NWR

(Continued)

Notes: Alternatives 2A, 3A and 4A - Enlarge and Line San Luis Canal Company Facilities.
Alternatives 2B, 3B, and 4B - Construct Lift Pump to Utilize San Joaquin River Water.
Alternatives 2C, 3C, and 4C - Implement a Conjunctive Use Plan.

(a) Line 59,000 feet of canals with bentonite, 65 cfs; and construct 28,000 feet of 48-inch diameter pipeline.

(b) 200 feet, 42-inch diameter pressure pipelines, 40 cfs; 3 road crossings.

(c) 40 cfs pump, 20-foot lift.

(d) 17 wells, 500-feet deep, 80-foot lift.

(e) Alternative 2C assumes implementation of Alternative 2A; and Alternatives 3C and 4C assume impelmentation of Alternatives 3A and 4A, respectively.

(f) 20 wells, 500-feet deep, 80-foot lift.

(g) Total costs do not include cost to implement Zahm-Sansoni-Nelson plan described in Chapter IVG.

(h) Basis for O&M costs are discussed in Appendix F.

(i) Unit Conveyance Cost = $10/af.

(j) Unit Pumping Cost = $1.50/af.

(k) Unit Pumping Cost = $9.25/af.

(l) Values are multiplied by 0.5 because facilities are assumed to be used 5 out of 10 years.

TABLE IV K-3

FISH AND WILDLIFE RESOURCES

SAN LUIS NWR

Ducks

Mallard[a]	Northern Shoveler[a]	Bufflehead
Gadwall[a]	Northern Pintail[a]	Wood Duck[a]
American Wigeon[a]	Canvasback[a]	Lesser Scaup
Green-winged (Cinn) Teal[a]	Ring-necked Duck	Redhead[a]
Blue-winged Teal[a]	Ruddy Duck[a]	
Cinnamon Teal[a]		

Geese and Swans

White-Fronted Goose	Cackling Canada Goose	Tundra Swan
Canada Goose		Snow Goose
Ross' Goose		

Coots and Grebes

Pied-Billed Grebe[a]	American Coot	
Eared Grebe		

Shore and Wading Birds

Snowy Egret[a]	Common Moorhen[a]	Western Sandpiper
American Avocet[a]	Marbled Godwit	Black-crowned Night Heron[a]
Lesser Sandhill Crane	Black-necked Stilt[a]	Greater Yellowlegs
Greater Sandhill Crane	Common Snipe	Willet
Virginia Rail	Long-billed Dowitcher	Long-billed Curlew
Great Blue Heron[a]	White-Faced Ibis	Egret[a]
American Bittern[a]	Dunlin	Great
Green-backed Heron		Sora
		Lesser Yellowlegs

Upland Game

Mourning Dove[a]	California Quail[a]	
Ring-Necked Pheasant[a]	Cottontail Rabbit	
Black-Tailed Jackrabbit		

TABLE IV K-3

FISH AND WILDLIFE RESOURCES

SAN LUIS NWR

(Continued)

Raptorial Birds		
Black-shouldered Kite[a]	Northern Harrier[a]	Sharp-shinned Hawk
Cooper's Hawk	Red-tailed Hawk[a]	Swainson's Hawk[a]
Rough-legged Hawk	American Kestrel (Sparrow Hawk)[a]	Barn Owl[a]
Short-eared Owl[a]	Great Horned Owl[a]	Burrowing Owl[a]
Golden Eagle	Screech Owl[a]	Red-shouldered Hawk[a]
Turkey Vulture		
Fish		
Bass	Catfish	
Carp	Striped Bass	
Crappie	Sacramento Blackfish	
Bluegill		
Furbearers		
Muskrats	Beaver	Mink
Long-tailed Weasel	Coyote	River Otter
Gray Fox	Skunk	Raccoon
Badger		
Others		
Tule Elk		

Notes:

(a) Birds nesting on refuge

Source: Birds on San Luis, Merced and Kesterson National Wildlife Refuges (RF 11660-3. August 1984). NWRS Public Use Report (1)) and refuge records.

peregrinus _anatum_; the Valley elderberry longhorn beetle, _Desmocerus_ _californicus_ _dimorphus_; and the Aleutian Canada goose, _Branta_ _canadensis_ _leucopareia_. Numerous candidate species may occur in this area and are also presented in Table IV K-4.

All of the alternative plans would improve the habitat quality and bird use, as indicated in Table IV K-5. The improved habitat also would result in increased public use.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species and would improve their habitat. Detailed field investigations will be necessary during the advanced planning phase of the project. The No Action Alternative would result in the loss of habitat. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the selected plan would be positive due to the potential increase in public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction of any of the alternatives would require several permits. Merced County would issue permits for well construction and approvals for construction along all roadways and within drainage courses to ensure that the existing drainage facilities would not be adversely affected. Alternatives 2A and 2B, 3A and 3B, and 4A and 4B would require permits and approvals from the SLCC. Stream Alteration Permits would be required from the DFG for construction in the San Joaquin River for Alternatives 2B, 3B, and 4B. A Corps of Engineers permit may be required for construction activities in wetlands or riparian corridors.

TABLE IV K-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

SAN LUIS NWR

Listed Species

Mammals
San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Birds
Bald eagle, *Haliaeetus leucocephalus* (E)
American peregrine falcon, *Falco peregrinus anatum* (E)
Aleutian Canada goose, *Branta canadensis leucopareia* (E)

Invertebrates
Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Proposed Species

None

Candidate Species

Birds
Swainson's hawk, *Buteo swainsoni* (2)
White-faced ibis, *Plegadis chihi* (2)
Western snowy plover, *Charadrius alexandrinus nivosus* (2)
Tricolored blackbird, *Agelaius tricolor* (2)

Reptiles
Giant garter snake, *Thamnophis couchi gigas* (2)
California tiger salamander, *Ambystoma tigrinium californiense* (2)

Invertebrates
Molestan blister beetle, *Lytta molesta* (2)

Plants
Hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
Delta coyote-thistle, *Eryngium racemosum* (1)
Bearded allocarya, *Plagiobothrys hystriculus* (2)
Valley spearscale, *Atriplex patula* subsp. *spicata* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat
(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

TABLE IV K-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

SAN LUIS NWR

	No Action Alternative	Alternatives 2A	2B	2C	3A & 4A	3B & 4B	3C & 4C
Habitat Acres							
Permanent Water	--	80	80	80	150	150	150
Seasonal Marsh	--	2,950	2,950	2,950	3,400	3,400	3,400
Bird Use Days							
Ducks	--	10,702,000	10,702,000	10,702,000	15,630,000	15,630,000	15,630,000
Geese	--	270,000	270,000	270,000	800,000	800,000	800,000
Shorebirds & Wading	--	2,380,000	2,380,000	2,380,000	3,483,000	3,483,000	3,483,000
Endangered Species	--	10,100	10,100	10,100	14,200	14,200	14,200
Total	--	13,362,100	13,362,100	13,362,100	19,927,200	19,927,200	19,927,200
Public Use Days							
Consumptive	--	3,800	3,800	3,800	4,100	4,100	4,100
Non-Consumptive	--	18,600	18,600	18,600	31,000	31,000	31,000
Total	--	22,400	22,400	22,400	35,100	35,100	35,100
Total Annual Cost	--	$ 402,680	$ 181,830	$ 509,710	$ 459,180	$ 246,830	$ 584,810
Incremental Cost/Additional 1000 Bird Use Days	N/A	$ 30.10	$ 13.60	$ 38.10	$ 23.00	$ 12.40	$ 29.30
Incremental Cost/Additional Public Use Day	N/A	$ 18.00	$ 8.10	$ 22.80	$ 13.10	$ 7.00	$ 16.70

Notes: Alternatives 2A, 3A and 4A - Enlarge and Line San Luis Canal Company Facilities.
Alternatives 2B, 3B and 4B - Construct Lift Pump to utilize San Joaquin River.
Alternatives 2C, 3C and 4C - Implement a Conjunctive Use Plan.

CHAPTER IV L

MERCED NATIONAL WILDLIFE REFUGE

The Merced National Wildlife Refuge (Refuge) was established in 1951 by authority of the Lea Act for the purpose of alleviating crop depredation and providing habitat for migratory and wintering waterfowl. The 2,562-acre refuge is managed by the Service and is one of the most important wintering areas in California for up to 30,000 snow and Ross' geese and up to 10,000 lesser sandhill cranes. The Refuge is located in Merced County approximately nine miles southwest of the City of Merced.

Water is primarily used for management of seasonal marshes and croplands. The seasonal marshes are disced and seeded with wild millet every three to five years and flooded in the fall. Grain and forage crops are grown on the Refuge as wildlife food crops. During 1982, 80 acres of cropland were converted to pasture for goose and sandhill crane habitat. Another 80 acres were converted in 1986. Much of the upland areas have been designated potential habitat for the endangered blunt-nose leopard lizard.

A. WATER RESOURCES

Water is diverted by the Refuge from Deadman Creek and the East Side Bypass on an as-available basis. Most of the water supply for the Refuge is provided by groundwater.

1. Surface Waters

Deadman Creek flows through the northern portion of the Refuge, as shown in Figure IV L-1. The Refuge obtained water rights in Deadman Creek in 1985 for 3,000 acre-feet per year to be taken between December 15 and May 31. However, under the conditions of the water rights, the Refuge cannot divert water from this stream except during high flow periods. Therefore, this water source is not considered to be a firm water supply. Periodic water quality sampling has indicated no water quality problems. Deadman Creek has adequate capacity to transport additional flows to the Refuge.

Water is also obtained from the East Side Bypass which is part of the Lower San Joaquin River Flood Control Project. The East Side Bypass diverts San Joaquin River floodwaters around San Joaquin River channel from a point upstream of the Mendota Pool to the junction of the San Joaquin River and Bear Creek. The East Side Bypass also intercepts waters from the Fresno River, Berenda and Ash Sloughs (tributaries of the Chowchilla River), the Chowchilla River, Deadman Creek, Owens Creek, and Bear Creek. Water quality in the East Side Bypass is unknown, however, the Service estimates that no quality problems exist (USBR, 1986a).

2. Water Conveyance Facilities

Water is delivered from Deadman Creek and the East Side Bypass through several pumps and diversions dams. Both the surface water and groundwater are distributed throughout the Refuge in a series of ditches. Ditches and open pipelines supplying the Refuge lands located along both sides of the East Side Bypass do not have adequate capacity to convey additional water without extensive rehabilitation (USFWS, 1986h).

3. Groundwater

The Refuge is located on the floodbasin deposits of the San Joaquin River and is bordered on the west and southwest by unconsolidated younger alluvial river deposits. The groundwater level is usually 50 feet below the land surface. Reclamation estimates the safe groundwater yield to be 16,000 acre-feet per year (USBR, 1986a). Of the 23 existing wells located on the Refuge, 16 are active.

Groundwater quality is generally good. The total dissolved solids (TDS) concentrations are usually less than 1,000 ppm. One well was reported to have 2,600 ppm TDS. Boron concentrations are less than 3 ppm. There has been a reduction in groundwater pumping in recent years due to increased energy costs and more efficient marsh management techniques.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

Service estimates that 16,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impact of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV L-1. Each of the water supply levels provides a different volume of water and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

The Refuge does not have an available firm water supply. Therefore, no alternatives were developed for Level 1.

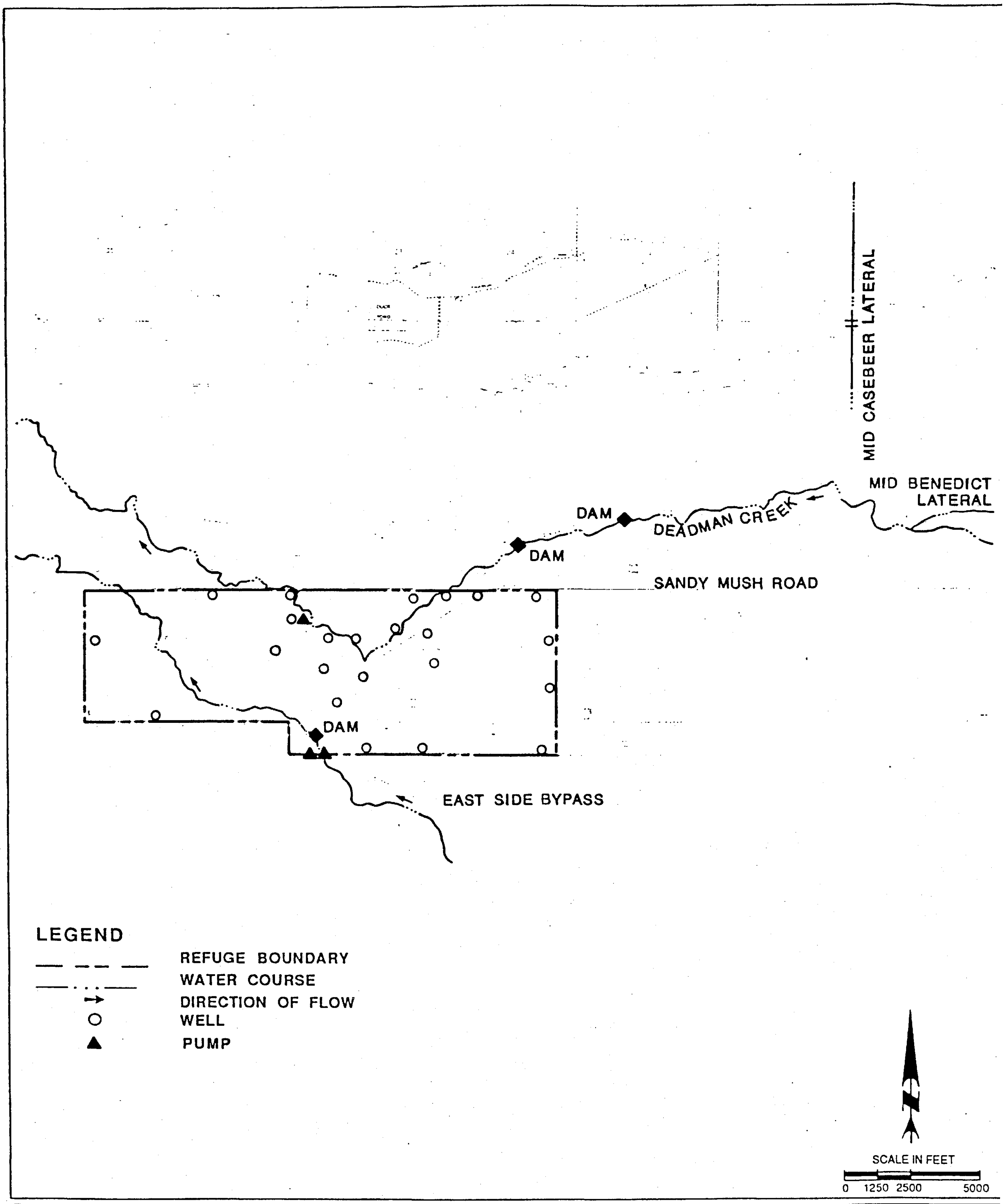

FIGURE IV L-1

MERCED NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

JMM

TABLE IV L-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE MERCED NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	800	1,000	1,000
February	0	100	500	500
March	0	200	600	600
April	0	500	950	950
May	0	500	800	800
June	0	800	1,000	1,000
July	0	1,100	1,050	1,050
August	0	1,200	1,500	1,500
September	0	2,300	2,700	2,700
October	0	2,300	2,700	2,700
November	0	2,000	2,000	2,000
December	0	1,700	1,200	1,200
Total	0	13,500	16,000	16,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d and 1986e

2. Delivery Alternatives for Level 2 (13,500 acre-feet)

Alternative 2A was developed to provide additional surface water to the Refuge.

Alternative 2A - Utilize the East Side Bypass. This alternative would provide water to the Refuge from the El Nido Water District via the East Side Bypass. Water would be pumped onto the eastern portion of the Refuge from an existing pump on the East Side Bypass. An additional pump would be constructed at this location to deliver water to the western side of the Refuge. In addition, a canal would be constructed to convey water to the eastern part of the Refuge, and a 500-foot ditch would be constructed to convey water to a new 20 cfs pump along the southern border, as shown in Figure IV L-2.

Alternative 2B - Implement a Conjunctive Use Plan. The existing wells would be used to deliver the maximum month water demand. The wells would be operated as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternative 2A.

3. Delivery Alternatives for Level 3 (16,000 acre-feet)

Alternatives 3A through 3D were developed to provide additional water to the Refuge. Alternatives 3A through 3D would require implementation of Alternative 2A. Additional water provided under Level 3 would extend the duration of flooding earlier in the fall and later in the spring. The water also would increase circulation through the Refuge which would result in a decrease in waterfowl disease.

Alternative 3A - Extend Casebeer Lateral to Refuge Boundary. This alternative would provide water to the Refuge from the Merced Irrigation District (MID) Casebeer Lateral. This lateral receives water from the Merced River. The capacity of the MID Casebeer Lateral would be increased from 20 cfs to 50 cfs from the junction of Spilber Lateral to the end of the Casebeer Lateral. In addition, the MID Casebeer Lateral would be extended south to Sandy Mush Road and west along Sandy Mush Road to the Refuge, as shown in Figure IV L-2. A flume across Deadman Creek and siphons under four roads would be constructed along the lateral extension. No water would be delivered to the Refuge when MID dewaters the canals from the end of September until April. Internal refuge construction and/or modification of water conveyance systems will be necessary to efficiently distribute the MID water.

Alternative 3B - Extend Casebeer Lateral to Deadman Creek. Deadman Creek would deliver 20 cfs from the MID Benedict Lateral and 20 cfs from Casebeer Lateral. This alternative would extend the

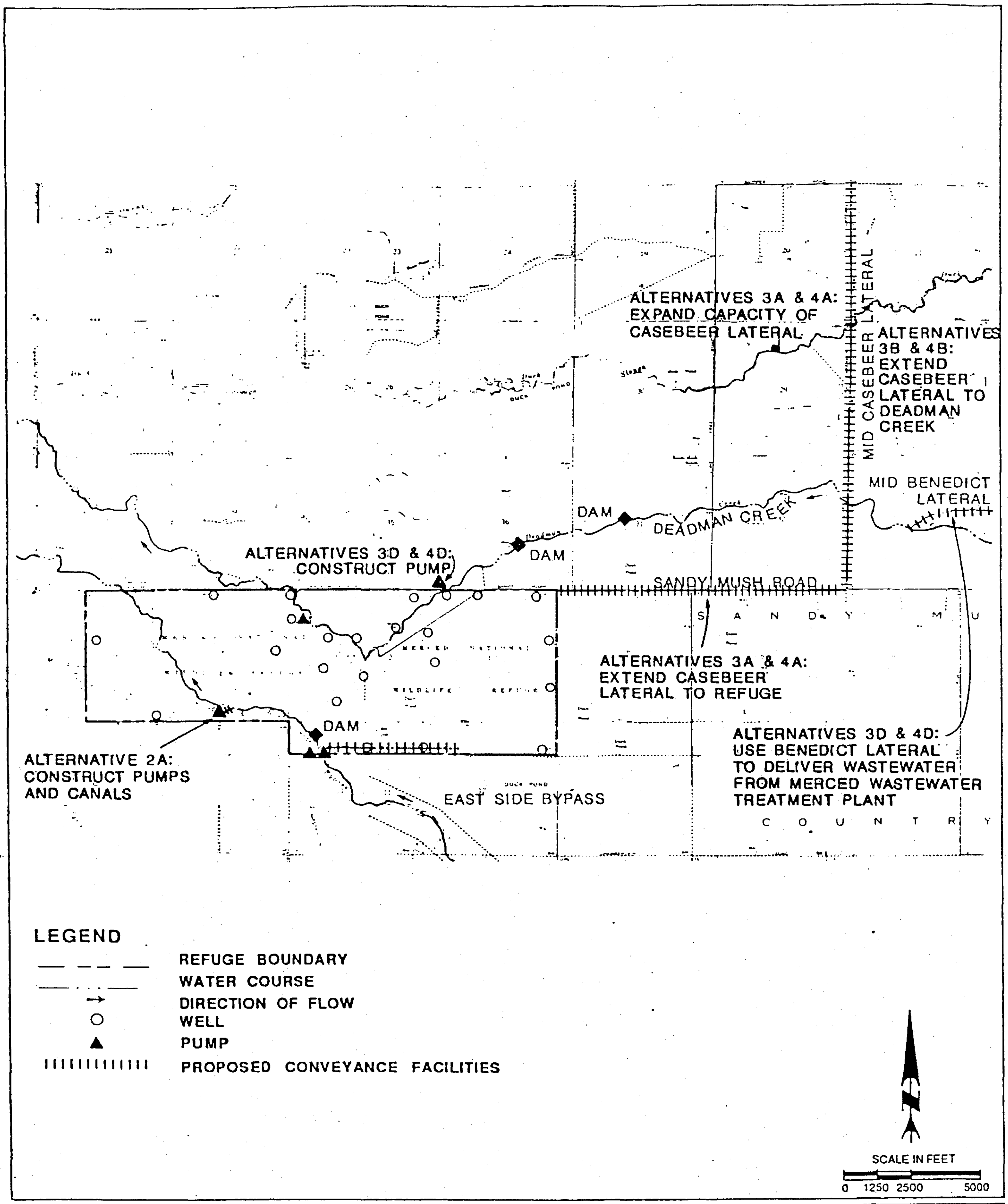

FIGURE IV L-2

MERCED NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

MID Casebeer Lateral to Deadman Creek. Water would be pumped from Deadman Creek onto the Refuge. No water would be delivered to the Refuge when MID dewaters the canals from the end of September until April.

Alternative 3C - Implement a Conjunctive Use Plan. Sixteen existing wells and four reactivated wells would be used to deliver the maximum month water demand. This alternative would be similar to Alternative 2B. Implementation of this alternative also would require implementation of Alternative 3A or 3B.

Alternative 3D - Utilize Treated Wastewater from the Merced Wastewater Treatment Plant. Secondary effluent from the City of Merced wastewater treatment plant would be delivered from Hartley Slough through the MID Benedict Lateral to Deadman Creek. Water would be pumped from Deadman Creek onto the Refuge. No water would be delivered to the Refuge when MID dewaters the canals from the end of September until April.

4. Delivery Alternatives for Level 4

Water Supply Level 4 is equal to Level 3, therefore the alternatives considered under Level 4 are identical to those considered for Level 3. Alternatives 3A through 3D would require implementation of Alternative 2A.

Alternative 4A - Extend Casebeer Lateral to Refuge Boundary. This alternative is identical to Alternative 3A.

Alternative 4B - Extend Casebeer Lateral to Deadman Creek. This alternative is identical to Alternative 3B.

Alternative 4C - Implement a Conjunctive Use Plan. This alternative is identical to Alternative 3C. Implementation of this alternative also would require implementation of Alternative 4A or 4B.

Alternative 4D - Utilize Treated Wastewater from the Merced Wastewater Treatment Plant. This alternative is identical to Alternative 3D.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

The Refuge does not have a dependable firm water supply, therefore no alternatives were developed for Level 1.

Alternative 2A would require a long-term conveyance agreement with the El Nido Water District. Alternatives 3A, 3B, and 3D and Alternatives 4A, 4B, and 4D would require long-term agreements with MID. Alternatives 3B and 3D and Alternatives 4B and 4D would have high conveyance losses due to use of Deadman Creek and would require pumps to divert water onto the Refuge. Alternatives 3A and 4A may have lower conveyance losses due to the use of canals and would not require pumps to divert refuge water.

All of the alternatives for Level 3 and Level 4 would require implementation of Alternative 2A. Alternatives 3C and 4C would require implementation of surface water alternatives (Alternatives 3A, 3B, or 3D or Alternatives 4A, 4B, or 4D) to provide water during the wet years.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternatives to provide adequate water supplies under Levels 2, 3,and 4 are presented in Table IV L-2. The construction costs include factors to cover engineering, contingencies, and overhead costs. Annual operation and maintenance (O&M) costs include only the local costs of delivering water. The annual O&M costs do not include costs to purchase CVP water or reclaimed wastewater from the Merced Wastewater Treatment Plant. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in Merced County during construction. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use to the Refuge is about 2,800 visits per year. If Level 4 water is provided, the attendance levels would increase significantly.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 7,522,400 use-days. Approximately 54 and 24 percent of the bird-use days are by ducks and geese, respectively. Wildlife resources associated with the Refuge are presented in Table IV L-3. The only listed threatened and endangered species associated with the Refuge are the San Joaquin kit fox, _Vulpes macrotis mutica_; Aleutian Canada goose, _Branta canadensis leucopareia;_ American peregrine falcon, _Falco peregrinus anatum_; and bald eagle, _Haliaeetus leucocephalus_. Numerous candidate species may occur in this area and are also presented in Table IV L-4.

The additional water would be used to improve habitat in the Refuge. The improved habitat would increase the number of wildlife-use days and public-use days, as presented in Table IV L-5.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered wildlife species. Detailed field investigations would be necessary during the advanced planning phase of the project. Implementation

TABLE IV L-3

WILDLIFE RESOURCES

MERCED NWR

Ducks

Mallard[a]	Gadwall[a]	American Wigeon[a]
Green-winged Teal[a]	Blue-winged Teal	Northern Shoveler[a]
Pintail[a]	Bufflehead	Canvasback[a]
Ruddy Duck[a]	Wood Duck	
Redhead[a]	Lesser Scaup	Ring-necked Duck
Cinnamon Teal[a]		

Geese and Swans

Snow Goose	White-fronted Goose	Cackling Canada Goose
Ross' Goose	Canada Goose	Tundra Swan

Coots

American Coot

Shore and Wading Birds

American Avocet[a]	Long-billed Curlew	Snowy Egret[a]
Black-necked Stilt[a]	Killdeer[a]	Black-crowned Night Heron[a]
Common Snipe	Pied-billed Grebe[a]	Lesser Sandhill Crane
Long-billed Dowitcher	California Gull	Greater Sandhill Crane
Least Sandpiper	White Pelican	Virginia Rail[a]
Dunlin	American Bittern[a]	Sora
Western Sandpiper	Great Blue Heron	Common Moorhen[a]
Greater Yellowlegs	Great Egret	
	White-Faced Ibis	

TABLE IV L-3

WILDLIFE RESOURCES

MERCED NWR
(Continued)

Upland Game		
Mourning Dove[a]	Ring-necked Pheasant	
Cottontail Rabbit	Black-tailed Jackrabbit	
Raptorial Birds		
Turkey Vulture	Black-Shouldered Kite[a]	Northern Harrier[a]
Sharp-shinned Hawk	Cooper's Hawk	Red-tailed Hawk[a]
Swainson's Hawk	American Kestrel[a]	Barn Owl[a]
Short-eared Owl	Great Horned Owl[a]	Burrowing Owl[a]
		Golden Eagle
Furbearers		
Coyote	Raccoon	
Skunk	Muskrat	
	Long-Tailed Weasel	

Notes:

(a) Birds nesting on refuge

Source: Birds of San Luis, Merced and Kesterson Wildlife Refuges (RF 11660.3. August 1984), NWRS Public Use Report (1) and refuge records.

TABLE IV L-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

MERCED NWR

Items	Alternatives					
	2A	2B	3A & 4A	3B & 4B	3C & 4C	3D & 4D
Additional Water (ac-ft)	13,500	13,500	16,000	16,000	16,000	16,000
Construction Costs						
Wells	$ --	$ --	$ --	$ --	$ 20,000[h]	$ --
Diversion Structures	--	--	--	15,520[e]	--	--
Pipelines/Canals	128,500[a]	--	142,780[c]	5,650[f]	--	--
Pump Stations	132,600[b]	--	--	183,000[g]	--	--
Subtotal	$261,100	$ --	$142,780	$204,170	$ 20,000	$ --
Other Costs	--	261,100	261,100[d]	261,100[d]	403,880[i]	--
Total	$261,100	$261,100	$403,880	$465,270	$423,880	$ --
Annualized Construction Cost (8.87%, 30 yrs)	$ 25,120	$ 25,120	$ 38,850	$ 44,760	$ 40,780	$ --
Additional Annual Cost						
Operation & Maintenance[j]	$ 3,200	$ 24,500	$ 2,140	$ 3,000	$ 36,000	$ 3,000
Power	13,500[k]	62,440[l,m]	--	16,000[k]	124,000[l,m]	16,000[k]
Local Conveyance Cost[n]	13,500	--	2,500	2,500	--	2,500
Subtotal	$ 30,200	$ 86,940	$ 4,640	$ 21,500	$160,000	$21,500
Other Costs	--	15,100[m]	30,200[d]	30,200[d]	17,420[i,m]	30,200[d]
Total	$ 30,200	$102,040	$ 34,840	$ 51,700	$177,420	$51,700
Total Annual Costs	$ 55,320	$127,160	$ 73,690	$ 96,460	$218,200	$51,200
Cost/Additional Acre/Foot	$ 4.10	$ 9.40	$ 4.60	$ 6.00	$ 13.70	$ 3.30

TABLE IV L-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

MERCED NWR
(Continued)

Notes: Alternative 2A - Utilize the East Side Bypass.
Alternative 2B - Implement a Conjunctive Use Plan.
Alternatives 3A and 4A - Extend Casebeer Lateral to Refuge Boundary.
Alternative 3B and 4B - Extend Casebeer Lateral to Deadman Creek.
Alternative 3C and 4C - Implement a Conjunctive Use Plan.
Alternative 3D and 4D - Utilize Treated Wastewater from Merced Wastewater Treatment Plant.

(a) 500 feet, unlined canal, 20 cfs; and 5,000 feet, 30-inch diameter pipeline.

(b) 10 cfs pump, 10-foot lift; and 20 cfs pump, 10 foot lift.

(c) Enlarge 8,300 feet of unlined canal, 50 cfs; construct 15,700 feet of unlined canal, 50 cfs; 42-inch diameter crossing, three 66-inch diameter crossings, and 50 cfs flume.

(d) Alternatives 3A through 3D and 4A through 4D would require Alternative 2A.

(e) 48-inch diameter turnout at Deadman Creek.

(f) 1,000 feet unlined canal, 26 cfs; 48-inch diameter crossing with riser.

(g) 20 cfs pump, 10-foot lift; and 8 cfs pump, 10-foot lift.

(h) Reactivate 4 wells.

(i) Alternatives 3C and 4C assume implementation of Alternatives 3A and 4A, respectively.

(j) Basis for O&M costs are discussed in Appendix F.

(k) Unit Pumping Cost = $1/af.

(l) Unit Pumping Cost = $9.25/af.

(m) Values are multiplied by 0.5 because facilities are assumed to be used only 5 out of 10 years.

(n) Unit Conveyance Cost = $1/af.

TABLE IV L-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

MERCED NWR

Listed Species

Mammals
- San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Birds
- Bald eagle, *Haliaeetus leucocephalus* (E)
- American peregrine falcon, *Falco peregrine anatum* (E)
- Aleutian canada goose, *Branta canadensis leucopa* (E)

Proposed Species

None

Candidate Species

Birds
- Swainson's hawk, *Buteo swainsoni* (2)
- White-faced ibis, *Plegadis chihi* (2)
- Western snowy plover, *Charadrius alexandrinus nivosus* (2)
- Tricolored blackbird, *Agelaius tricolor* (2)

Reptiles and Amphibians
- Giant garter snake, *Thamnophis couchi gigas* (2)
- California tiger salamander, *Ambystoma tigrinium californiense* (2)

Invertebrates
- Molestan blister beetle, *Lytta molesta* (2)

Plants
- Hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
- Delta coyote-thistle, *Eryngium racemosum* (1)
- Bearded allocarya, *Plagiobothrys hystriculus* (2)
- Valley spearscale, *Atriplex patula* subsp. *spicata* (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

of any of the plans would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to the potential increase in wildlife use and subsequently public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company (PG&E) serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to delivery CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Merced County would issue approvals for construction along roads and drainage courses to ensure that the existing drainage facilities would not be adversely affected. Alternative 2A would require approvals from El Nido Water District for construction in the East Side Bypass. Alternatives 3A and 3B and Alternatives 4A and 4B would require approvals from MID for construction in the MID laterals. Stream Alteration Permits would be required from the DFG for construction in Deadman Creek. A Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors.

TABLE IV L-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

MERCED NWR

	No Action Alternative	Alternatives 2A	2B	3A & 4A	3B & 4B	3C & 4C	3D & 4D
Habitat Acres							
Permanent Water	--	20	20	60	60	60	60
Seasonal Marsh	--	680	680	1140	1140	1140	1140
Bird Use Days							
Ducks	--	4,110,000	4,110,000	5,360,000	5,360,000	5,360,000	5,360,000
Geese	--	1,870,000	1,870,000	2,440,000	2,440,000	2,440,000	2,440,000
Wading and Shorebirds	--	1,540,000	1,540,000	2,005,000	2,005,000	2,005,000	2,005,000
Endangered Species	--	2,400	2,400	3,100	3,100	3,100	3,100
Total	--	7,522,400	7,522,400	9,808,100	9,808,100	9,808,100	9,808,100
Public Use Days							
Consumptive	--	900	900	900	900	900	900
Non-Consumptive	--	1,900	1,900	9,300	9,300	9,300	9,300
Total	--	2,800	2,800	10,200	10,200	10,200	10,200
Total Annual Cost	--	$ 55,320	$ 127,160	$ 73,600	$ 96,460	$ 218,200	$ 51,700
Incremental Cost/Additional 1000 Bird Use Day	N/A	$ 7.40	$ 16.60	$ 7.50	$ 9.80	$ 22.30	$ 5.30
Incremental Cost/Additional Public Use Day	N/A	$ 19.80	$ 45.40	$ 7.20	$ 9.50	$ 21.40	$ 5.10

Notes: Alternative 2A - Utilize the East Side Bypass.
Alternative 2B - Implement a Conjunctive Use Plan.
Alternatives 3A and 4A - Extend Casebeer Lateral to Refuge Boundary.
Alternatives 3B and 4B - Extend Casebeer Lateral to Deadman Creek.
Alternatives 3C and 4C - Implement a Conjunctive Use Plan.
Alternatives 3D and 4D - Utilize Treated Wastewater from Merced Wastewater Treatment Plant.

of any of the plans would result in overall beneficial environmental effects. The No Action Alternative would result in the loss of habitat. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to the potential increase in wildlife use and subsequently public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company (PG&E) serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to delivery CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction under any of the alternatives would require several permits. Merced County would issue approvals for construction along roads and drainage courses to ensure that the existing drainage facilities would not be adversely affected. Alternative 2A would require approvals from El Nido Water District for construction in the East Side Bypass. Alternatives 3A and 3B and Alternatives 4A and 4B would require approvals from MID for construction in the MID laterals. Stream Alteration Permits would be required from the DFG for construction in Deadman Creek. A Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors.

CHAPTER IV M

MENDOTA WILDLIFE MANAGEMENT AREA

The Mendota Wildlife Management Area (Refuge) was purchased by the State Wildlife Conservation Board within the period from 1954 through 1966. It was established to provide waterfowl habitat, to reduce crop degradation, and to provide public hunting. The Refuge comprises 12,105 acres and is managed by DFG. The Refuge is located along Fresno Slough, three miles southwest of the City of Mendota, as shown in Figure IV M-1. An ecological reserve of almost 900 acres lies adjacent to the Refuge and provides protection for endangered plant species.

The management plan for the Refuge was developed to encourage natural food crops such as swamp timothy, alkali bulrush, smartweed, and millet.

A. WATER RESOURCES

The Refuge has a contract for 25,463 acre-feet per year from Reclamation. However, the Refuge only receives an average of 18,500 acre-feet per year. There are several reasons for the difference in water available and the water delivered. First, the Mendota Pool is dewatered every four to five years for maintenance during the winter. During this period, the Refuge does not receive any water. Second, the refuge canals are periodically dewatered to control cattails. Third, ditch and levee maintenance and construction on the Refuge requires periodic dewatering (USBR, 1986a).

1. Surface Waters

The contract with Reclamation includes 8,143 acre-feet of Section 2 water, 12,000 acre-feet of Section 6 water, 4,000 acre-feet of mitigation water, and 1,320 acre-feet of firm water rights. In addition, the Refuge holds 3,120 acre-feet of supplemental water rights which are not always available.

The Section 2 water is provided free of charge from the Mendota Pool, and the Section 6 water is purchased by the State of California. No more than 5,800 acre-feet of the Section 2 water can be delivered after June 30 due to capacity problems in the conveyance facilities. The Section 6 water is available from September 1 through November 30. The 4,000 acre-foot contract with Reclamation for Los Banos Creek mitigation water is supplied March 15 through May 31.

The need to provide a more dependable water supply to the Refuge was demonstrated in 1977 when the available water was 76 percent below normal and large amounts of land were left fallow (USBR, 1986a).

2. Water Conveyance Facilities

Reclamation maintains the portion of Fresno Slough that runs through the Refuge as a facility to convey water to the Refuge. Gates and pumps divert water from the Fresno Slough onto the Refuge. Fresno Slough receives water from the Mendota Pool. The Mendota Pool is operated by the Central California Irrigation Company (CCID) and is drawn down generally every 4 to 5 years for maintenance on the Mendota Dam. Maintenance work on the Mendota Dam usually occurs between mid-November and December. Water cannot be diverted to the Refuge when the Mendota Pool is dewatered. Fresno Slough has sufficient conveyance capacity to serve the ultimate development demand of the Refuge.

The loss of the water supply in November constrains management of habitat. Before the water supply is cut off, the ponds must be flooded deeper than desirable to ensure adequate water coverage remains through the waterfowl season. If the water is too deep, food availability is reduced because the waterfowl generally feed on seeds at the bottom of the pool. If the water is too shallow, some waterfowl will avoid ponds (USBR, 1986a).

The internal conveyance system consists of nine lift pumps and open ditches. The pumps have capacities ranging from 20 to 100 horsepower. Drainage problems have occurred on 2,680 acres located on the west side of the Refuge. Improved drainage of this area would increase food production significantly and allow the conversion of 400 acres of upland to marsh.

3. Groundwater

The groundwater level is approximately 100 to 250 feet deep with considerable seasonal fluctuations. Reclamation has monitored well operations and groundwater levels within the Tranquility Irrigation District for many years. The District is adjacent to the southeast corner of the Refuge. Geohydrologic conditions in the two areas are probably similar although production zone groundwater levels may be deeper in the Refuge. Reclamation estimates that the safe yield for the Refuge is 5,500 acre-feet. Three groundwater wells at the Refuge were abandoned during the early 1950's due to high boron concentrations.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The DFG estimates that 29,650 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as

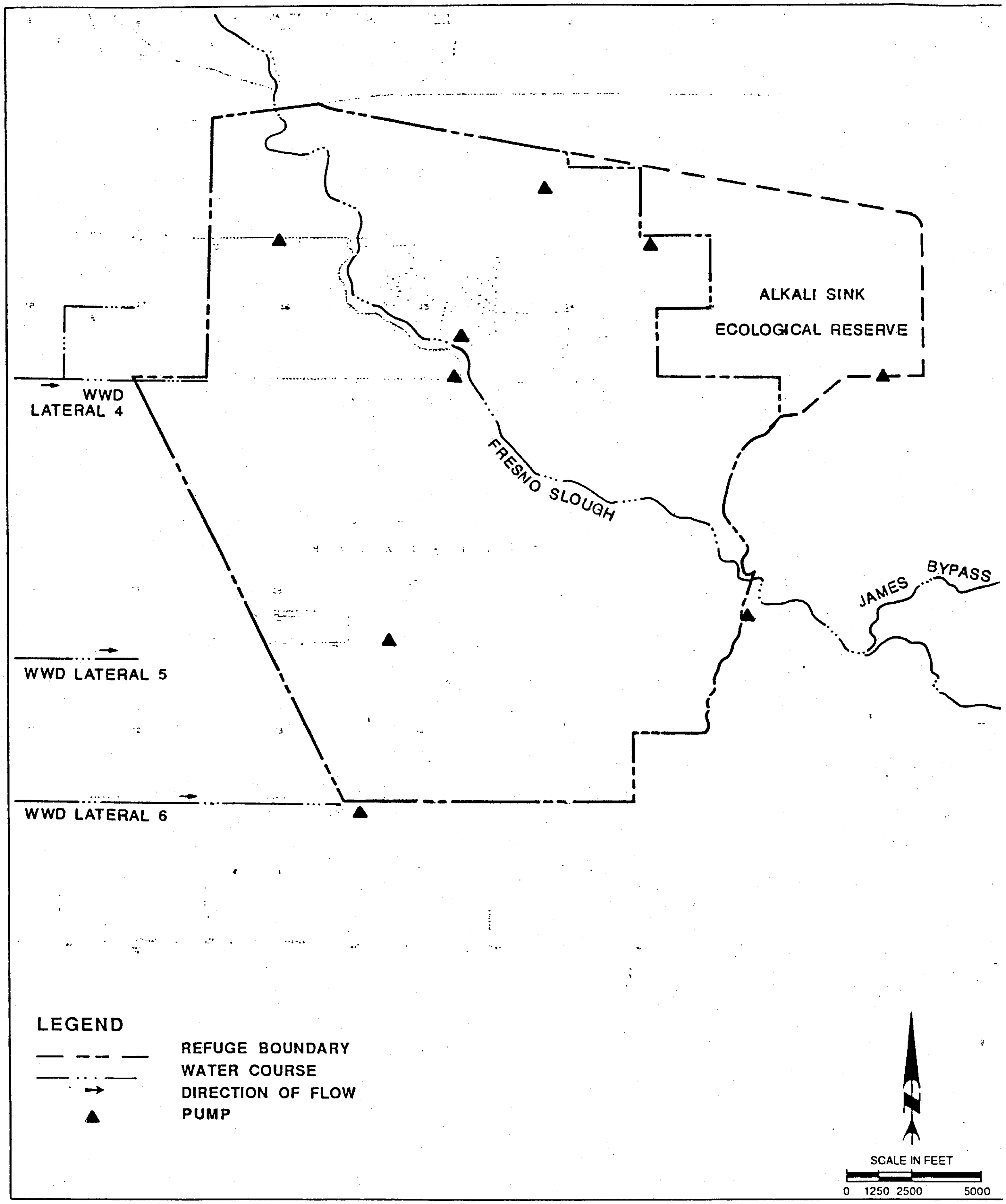

FIGURE IV M-1

MENDOTA WILDLIFE MANAGEMENT AREA

EXISTING WATER SUPPLY FACILITIES

presented in Table IV M-1. Each of the water supply leve provides a different volume of water and are summarized a follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (18,500 acre-feet)

The existing facilities can take delivery of Level 1 water supplies.

2. Delivery Alternative for Level 2 (18,500 acre-feet)

No alternatives were required for Level 2 which is currently delivered to the Refuge.

3. Delivery Alternative for Level 3 (25,463 acre-feet)

The Refuge has water contracts for 25,463 acre-feet of water. However, the Refuge can only take delivery of 18,500 acre-feet of water due to restrictions with existing facilities. The alternative developed for Level 3 would provide the entire water contract amount to the Refuge.

Alternative 3A - Change Operation of Mendota Pool. The most feasible method of increasing water deliveries to the Refuge is to change the current practice by CCID of lowering the water level in the Mendota Pool every mid-November. If CCID would delay the lowering of the Mendota Pool until early December, a dependable water supply could be provided in the critical months.

The impacts of this delay on the CCID maintenance schedule have not been fully identified at this time. It may be necessary to improve the Mendota Dam or CCID canals to minimize the required maintenance work. Further analysis is required to determine the feasibility of changing maintenance schedules or the need for facilities improvements.

4. Delivery Alternatives for Level 4 (29,650 acre-feet)

The alternatives developed for Level 4 would provide additional water for currently undeveloped portions of the Refuge. Alternative 4A would provide additional surface water. Alternative 4B would provide a conjunctive use program.

TABLE IV M-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE MENDOTA WMA

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	850	850	1,000	1,250
February	850	850	1,000	1,250
March	750	750	950	1,150
April	750	750	950	1,150
May	1,350	1,350	2,250	2,800
June	1,400	1,400	1,750	2,150
July	1,400	1,400	1,750	2,150
August	1,600	1,600	2,050	2,500
September	3,250	3,250	4,200	5,150
October	3,100	3,100	4,000	5,000
November	2,250	2,250	2,900	3,600
December	950	950	1,200	1,500
Total	18,500 (a)	18,500	24,000	29,650

Notes:

(a) Total Existing Firm water supply of 25,463 af is unavailable due to conveyance problems.

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d and 1986e

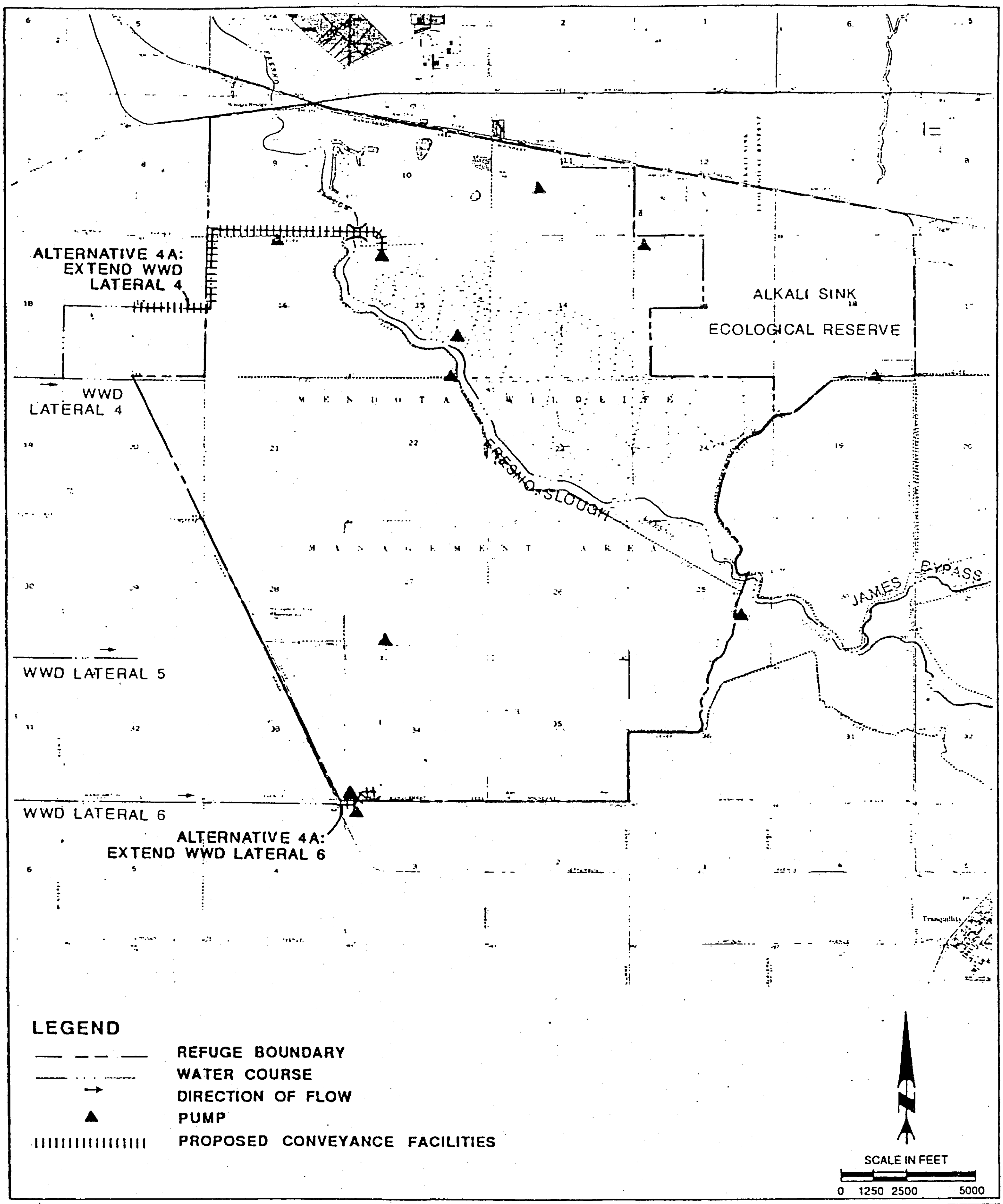

FIGURE IV M-2

MENDOTA WILDLIFE MANAGEMENT AREA

ALTERNATIVE WATER SUPPLY FACILITIES

Alternative 4A - Extend Westland Water District Laterals 4 and 6 to Refuge. Westland Water District (WWD) would extend Laterals 4 and 6, as shown in Figure IV M-2. Lateral 4 would be extended approximately two miles and a pump station would be constructed to divert water on the Refuge. This lateral would serve both the western and undeveloped eastern sides of the Refuge. The existing capacity of Lateral 4 is 8 cfs. Lateral 6 would be extended into the southwestern portion of the Refuge and a pump station would be constructed to divert water onto the Refuge. The capacity of Lateral 6 is 15 cfs. In addition, a new ditch system would need to be constructed on the eastern sections of the Refuge. This alternative would require implementation of Alternative 3A.

Alternative 4B - Implement Conjunctive Use Plan. Five wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Surface water would be used in the dry years to dilute the boron concentrations in the groundwater. This alternative would require implementation of Alternative 3A and 4A.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

No alternatives were considered for Levels 1 and 2 because existing facilities could deliver available firm water supplies.

Alternative 3A would be the only alternative considered for Level 3. This alternative would not include facility construction, but would modify operations of the Mendota Pool. This alternative would allow complete delivery of the CVP water contracts.

Alternative 4A would require a long-term agreement with WWD and construction of improvements to the WWD facilities. Alternative 4A also would require implementation of Alternative 3A.

Alternative 4B would provide wells for a conjunctive use program. Alternative 4A would need to be implemented as part of this alternative.

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Water Supply Levels 3 and 4 are presented in Table IV M-2. The construction costs include factors to cover engineering, contingencies, and overhead costs. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to

TABLE IV M-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

MENDOTA WMA

Items	Alternatives 3A	4A	4B
Additional Water (ac-ft)	5,500	11,150	11,150
Construction Costs			
Wells	$ --	$ --	$424,500 (c)
Pipelines/Canals	--	36,000 (a)	--
Pump Stations	--	55,000 (b)	--
Subtotal	$ --	$ 91,000	$424,500
Other Costs	--	--	91,000 (d)
Total	$ --	$ 91,000	$515,500
Annualized Construction Cost (8.87%, 30 yrs)	$ --	$ 8,760	$ 49,600
Additional Annual Cost			
Operation & Maintenance (e)	$ --	$ 1,000	$ 14,400
Power	--	95,890 (g)	103,700 (j,k)
Local Conveyance Cost	4,130 (f)	11,150 (h)	--
Subtotal	$4,130	$108,040	$118,100
Other Costs	--	4,130 (i)	56,090 (d,k)
Total	$4,130	$112,170	$174,190
Total Annual Costs	$4,130	$120,930	$223,790
Cost/Additional Acre-Foot	$ 0.80	$ 10.80	$ 20.10

TABLE IV M-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

MENDOTA WMA
(Continued)

Notes: Alternative 3A - Change Operation of Mendota Pool.
Alternative 4A - Extend Westland Water District Laterals 4 and 6 to Refuge.
Alternative 4B - Implement a Conjunctive Use Plan.

(a) 2,500 feet of unlined canal, 4 cfs; 10,000 feet of unlined canal, 6 cfs; 1,500 feet of unlined canal, 15 cfs; 600 feet of 24-inch diameter pressure pipeline; and one crossing.

(b) 6 cfs pump, 10-foot lift.

(c) 5 wells, 950-feet deep, 150-foot lift.

(d) Alternative 4B would require implementation of Alternative 4A.

(e) Basis for O&M costs are discussed in Appendix F.

(f) Unit Conveyance Cost = $0.75/af.

(g) Unit Pumping Cost = $8.60/af.

(h) Unit Conveyance Cost = $1/af.

(i) Alternative 4A would require implementation of Alternative 3A.

(j) Unit Pumping Cost = $18.60/af.

(k) Values are multiplied by 0.5 because facilities will be used only 5 out of 10 years.

(l) Costs to provide Water Supply Level 1 are not included.

purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under Alternatives 4A and 4B will result in additional money being spent in Fresno County during construction. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use to the Refuge is about 14,800 visits per year. If water is provided throughout the year, there would be an increase in the number of wildlife-use days and recreational benefits.

D. WILDLIFE RESOURCES

The average annual bird use on the Refuge is about 2,600,000 use-days. Wildlife and fishery resources associated with the Refuge are presented in Table IV M-3. The only listed threatened and endangered species associated with the Refuge are the San Joaquin kit fox, *Vulpes macrotis mutica*; the Valley elderberry longhorn beetle, *Desmocerus californicus dimorphys*; and the palmate-bracted bird's beak, *Cordylanthus palmatus*. Numerous candidate species may occur in this area and are also presented in Table IV M-4.

The additional water would be used to improve habitat in the Refuge. The improved habitat would increase the number of public use days, as presented in Table IV M-5.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered wildlife species. Detailed field investigations would be necessary during the advanced planning phase of the project. Implementation of any of the plans would result in overall beneficial environmental effects. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of any of the alternatives would be positive due to the potential increase in wildlife use and subsequently public use.

F. POWER ANALYSIS

The Pacific Gas & Electric Company (PG&E) serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to delivery CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

TABLE IV M-3

FISH AND WILDLIFE RESOURCES

MENDOTA WMA

Ducks

Pintail[a]	Mallard[a]	Green-winged Teal[a]
Gadwall[a]	Shoveler[a]	Ring-necked Duck
Canvasback	Ruddy Duck[a]	Wigeon
Cinnamon Teal[a]		

Geese and Swans

Snow Goose	White-fronted Goose	Tundra Swan
Ross' Goose	Canada Goose	

Coots

American Coot		

Shore and Wading Birds

Pied-billed Grebe[a]	Common Egret	Dowitchers
White-faced Ibis	Snowy Egret	Great Yellowlegs
Lesser Sandhill Crane	American Bittern[a]	Sandpiper
Common Snipe	Killdeer	Black-crowned Night Heron[a]
Long-billed Curlew	American Avocet[a]	Avocets[a]
Great Blue Heron	Black Necked Stilt[a]	Western Grebe[a]
Ruddy Duck[a]		

TABLE IV M-3

FISH AND WILDLIFE RESOURCES

MENDOTA WMA
(Continued)

Upland Game		
Ring-necked Pheasant	Black-tailed Jackrabbits	
Cottontail Rabbit	Dove	

Raptorial Birds		
Northern Harrier[a]	Red-tailed Hawk	American Kestrel[a]
Black-tailed Kite	Cooper's Hawk	Turkey Vulture
Barn Owl[a]	Great Horned Owl[a]	Burrowing Owl[a]

Fish		
Brown Bullhead	Channel Catfish	Striped Bass
Threadfin Shad	Carp	Largemouth Bass

Furbearers		
Coyote	Opossum	Mink
Muskrat	Striped Skunk	Badger
Raccoon	Beaver	Spotted Skunk

Notes:

(a) Birds nesting on refuge

Source: Environmental Assessment Report, Mendota Wildlife Area, and checklist of the birds of the Mendota Wildlife Area

TABLE IV M-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

MENDOTA WMA

Listed Species

Mammals
San Joaquin kit fox, Vulpes macrotis mutica (E)

Invertebrates
Valley elderberry longhorn beetle, Desmocerus californicus dimorphus (T)

Plants
Palmate-bracted bird's-beak, Cordylanthus palmatus (E)

Proposed Species

None

Candidate Species

Birds
Tricolored blackbird, Agelaius tricolor (2)
White-faced ibis, Plegadis chihi (2)

Reptiles
Giant garter snake, Thamnophis couchi gigas (2)

Invertebrates
Hopping's blister beetle, Lytta hoppingi (2)
Molestan blister beetle, Lytta molesta (2)
Moestan blister beetle, Lytta moesta (2)
Morrison's blister beetle, Lytta morrisoni (2)
Ciervo aegialian scarab beetle, Aegialia concinna (2)
San Joaquin dune beetle, Coleus gracilis (2)
Wooly hydroporus diving beetle, Hydroporus hirsutus (2)

Plants
Valley spearscale, Atriplex patula subsp. spicata (2)
Hispid bird's-beak, Cordylanthus mollis subsp. hispidus (2)
Hoover's wooly-star, Eriastrum hooveri (2)
Congdon's wooly-threads, Lembertia congdonii (2R)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat
(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(2R)—Recommended addition to Category 2.

TABLE IV M-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

MENDOTA WMA

	No Action Alternative	Alternatives 3A	4A	4B
Habitat Acres				
Seasonal Marsh	2,072	5,000	4,026	4,026
Watergrass (millet)	--	2,000	3,374	3,374
Cereal Grains	--	400	--	--
Uplands	1,940	1,940	1,940	1,940
Administration	100	100	100	100
Fallow	5,328	--	--	--
Bird Use Days				
Ducks and Geese	2,300,000	10,600,000	10,600,000	10,600,000
Other Waterbirds	300,000	1,600,000	1,600,000	1,600,000
Total	2,600,000	12,200,000	12,200,000	12,200,000
Public Use Days				
Consumptive	12,200	14,000	15,800	15,800
Non-Consumptive	2,600	3,500	6,700	6,700
Total	14,800	17,500	22,500	22,500
Total Annual Cost	--	$ 4,130	$ 120,930	$ 223,790
Incremental Cost/Additional 1,000 Bird Use Days	N/A	$ 0.40	$ 12.60	$ 23.30
Incremental Cost/Additional Public Use Day	N/A	$ 1.60	$ 15.70	$ 29.10

Notes: Alternative 3A - Change Operation of Mendota Pool.
Alternative 4A - Extend Westlands Water District Laterals 4 and 6 to Refuge.
Alternative 4B - Implement a Conjunctive Use Plan.

G. PERMITS

Construction activities would require several permits. Fresno County would issue permits for wells constructed under Alternative 4B and approvals for construction along roads and drainage facilities under Alternative 4A. WWD would need to approve all construction that would occur under Alternative 4A. Stream Alteration Permits would be required from the DFG for Alternative A. A Corps of Engineers permit would be required for Alternatives 4A and 4B for construction activities in wetlands or riparian corridors.

CHAPTER IV N

PIXLEY NATIONAL WILDLIFE REFUGE

The Pixley National Wildlife Refuge (Refuge) was established in 1959 when reverted homestead tracts were transferred to the Service from the California Department of Food and Agriculture. The Refuge boundaries have since expanded and currently include 5,200 acres controlled by the Service, 800 acres controlled by the U.S. Forest Service, and 2,800 acres owned by private land owners. The Refuge is managed by the Service and is located in southwest Tulare County.

The Refuge has grassland vegetation with some riparian plants along Deer Creek. Approximately 3,700 acres are set aside as habitat for the endangered blunt-nosed leopard lizard, and are currently used for livestock grazing. The primary objective of the Refuge is to restore wildlife habitat, particularly for migratory waterfowl and endangered species (USFWS, 1978).

A. WATER RESOURCES

The Refuge does not have any firm water supplies. Water is diverted from Deer Creek or provided by Pixley Irrigation District (PID).

1. Surface Water

The Refuge does not have water rights, riparian or appropriative. Deer Creek traverses the western half of the Refuge, as shown in a Figure IV N-1. This creek is an intermittent stream which carries flood flows during wet years (USFWS,1978). During wet years, upstream irrigation districts also allow excess water to flow down Deer Creek to the Refuge. Deer Creek also could be used to convey water from the Friant-Kern Canal (FKC) to the Refuge. Deer Creek does have a high potential for conveyance losses due to percolation, evaporation, and diversions along the creek. The quality of Deer Creek flood flows is suitable for irrigation and waterfowl management.

Another intermittent water source on the Refuge is the groundwater recharge basins maintained by PID. The two-cells provide about 200 acres of wetlands (USFWS, 1986).

2. Water Conveyance Facilities

Water is diverted from Deer Creek at a sand dam near Road 88. This sand dam needs to be maintained to prevent sand inundation or wash-out during flooding events. The Refuge internal conveyance system is generally in fair condition, however, minor improvements are needed.

3. Groundwater

The Refuge is located in the lower San Joaquin Valley which has a serious groundwater overdraft problem. The water level is 100 to 200 feet deep with considerable seasonal fluctuations. One well was drilled on the Refuge in 1963. Use of this well was discontinued in 1969 because of a receding water table and escalating energy costs. Groundwater from this well was of poor quality for irrigation, but suitable for waterfowl habitat management. Reclamation has estimated that the safe yield of the Refuge is 1,600 acre-feet.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 6,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV N-1. Each of the water supply levels provides a different volume of water and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

The Refuge does not have a firm water supply, therefore no alternatives were developed for Level 1.

2. Delivery Alternative for Level 2 (1280 acre-feet)

Since this level represents the current average annual water supply, additional facilities would not be necessary.

3. Delivery Alternatives for Level 3 (3,000 acre-feet)

Under this level, construction and/or the use of the existing conveyance facilities may be required to fully serve the existing Refuge with an increased water supply.

Alternative 3A - Obtain Friant-Kern Canal Water Via Deer Creek. A dependable supply of water would be obtained from the FKC. This water would be conveyed to the Refuge by the Lower Tule River Irrigation District and PID. Water would be diverted from the FKC

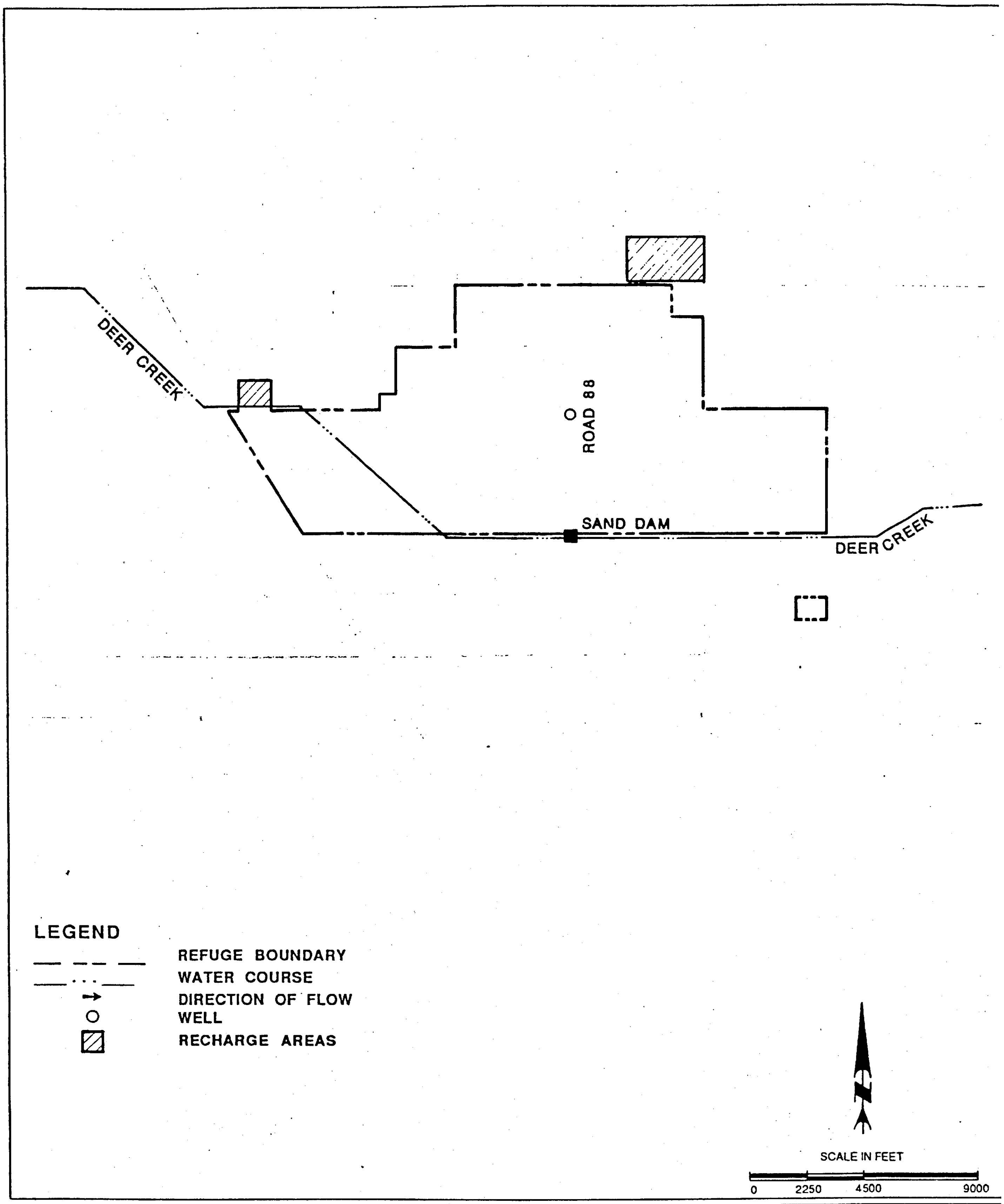

FIGURE IV N-1

PIXLEY NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

TABLE IV N-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE PIXLEY NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	500[a]	100	200
February	0	600[a]	50	100
March	0	100[a]	0	0
April	0	80[a]	150	300
May	0	0	300	600
June	0	0	400	800
July	0	0	450	900
August	0	0	150	300
September	0	0	400	800
October	0	0	500	1,000
November	0	0	350	700
December	0	0	150	300
Total	0	1,280[a]	3,000	6,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

(a) Estimated amounts, flood flows are not measured.

Sources: USBR, 1986a; USFWS, 1986d and 1986e

to Deer Creek at a point 15 miles upstream from the Refuge. Water would be delivered to the Refuge through Deer Creek, as shown in Figure IV N-2.

The internal distribution system would be improved through construction of a pump station at Deer Creek, 1 mile of delivery ditch, 6 miles of new levees, 3 miles of levee repairs, and 16 control structures.

Alternative 3B - Utilize Mid-Valley Canal Water Via Deer Creek. If the proposed Mid-Valley Canal (MVC) is constructed by Reclamation, CVP water could be delivered through the MVC to Deer Creek. The Canal would cross Deer Creek approximately seven miles upstream of the Refuge. This alternative would have less conveyance losses than Alternative 3A. However, the MVC has not been authorized for construction.

The internal distribution system would be improved through construction of a pump station at Deer Creek, 1 mile of delivery ditch, 6 miles of new levees, 3 miles of levee repairs, and 16 control structures.

Alternative 3C - Obtain CVP Water via the California Aqueduct. Water would be conveyed through the California Aqueduct to Lateral B of the Tulare Basin Water Storage District. This water would be pumped into Bull Slough and conveyed to the Homeland/Lakeland Canal. Water would be delivered through the Homeland/Lakeland Canal to Deer Creek. The water would flow in the reverse direction of the natural flow in Deer Creek to the Refuge.

The internal distribution system would be improved through construction of a pump station at Deer Creek, 1 mile of delivery ditch, 6 miles of new levees, 3 miles of levee repairs, and 16 control structures.

Alternative 3D - Implement a Conjunctive Use Plan. Seven wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternative 3A, 3B, or 3C.

The internal distribution system would be improved through construction of a pump station at Deer Creek, 1 mile of delivery ditch, 6 miles of new levees, 3 miles of levee repairs, and 16 control structures.

TABLE F-1

UNIT COSTS FOR MATERIALS AND CONSTRUCTION (1987 COSTS)

Items	Unit	Unit Cost/# of Units
o Clearing and Grubbing	acre	$5,000.00
o Pipe Trench Excavation	cu yd	$10.00
o Handling: Stringing and Laying		
12" Pipe	lin ft	$1.45
18" Pipe	lin ft	$1.60
24" Pipe	lin ft	$1.85
30" Pipe	lin ft	$1.90
36" Pipe	lin ft	$2.40
48" Pipe	lin ft	$3.75
60" Pipe	lin ft	$6.20
66" Pipe	lin ft	$6.85
o Pipe Trench Backfill	cu yd	$13.00
o Rip Rap	sq yd	$31.00
o Trench Excavation Cross Section		
12" Pipe	sq ft/ft of trench	10.50
18" Pipe	sq ft/ft of trench	14.00
24" Pipe	sq ft/ft of trench	18.00
30" Pipe	sq ft/ft of trench	22.50
36" Pipe	sq ft/ft of trench	27.50
o Ditch Excavation	cu yd	$5.50
o Ditch Rehabilitation	lin ft	$1.50
o Gunite	sq ft	$1.20
o Reinforced Concrete	cu yd	$600.00
o Trench Backfill Cross Section		
12" Pipe	sq ft	$9.7
18" Pipe	sq ft	$12.2
24" Pipe	sq ft	$14.9
30" Pipe	sq ft	$17.6
36" Pipe	sq ft	$20.4

TABLE F-1

UNIT COSTS FOR MATERIALS AND CONSTRUCTION
(1987 COSTS)
(Continued)

Items	Unit	Unit Cost/# of Units
o Blow Off Assemblies		
6" Blow Off for All Siphons	lump sum	$1,800.00
o Air Release Assemblies		
4" Air Valves for All Siphons	lump sum	$1,100.00
o Road Crossings		
Materials	dia inch/ft	$1.00
Labor	dia inch/ft	$2.00
Site Preparation & Cleanup	lump sum	$1,000.00
o Repaving and Restoration for Open Cut Roads	lump sum	$2,000.00
o Bentonite Lining	lin ft/cfs	$0.20
o Rights of Way		
Width of Siphons	ft	$80.00
Land	acre	$2,000.00
o Corrugated Metal Pipes Road Crossing		
24" CMP	lump sum	$1,630.00
30" CMP	lump sum	$1,750.00
36" CMP	lump sum	$1,830.00
42" CMP	lump sum	$2,050.00
48" CMP	lump sum	$2,260.00
54" CMP	lump sum	$2,480.00
60" CMP	lump sum	$3,450.00
66" CMP	lump sum	$4,000.00
o Foot Bridges	ea	$1,400.00
o Driveway Bridges	ea	$8,200.00

TABLE F-1

UNIT COSTS FOR MATERIALS AND CONSTRUCTION
(1987 COSTS)
(Continued)

Items	Unit	Unit Cost/# of Units
o Cast-in-Place Pipe		
30" C.I.P.P.	lin ft	$25.50
36" C.I.P.P.	lin ft	$29.65
42" C.I.P.P.	lin ft	$36.35
48" C.I.P.P.	lin ft	$46.25
60" C.I.P.P.	lin ft	$58.50
o Control Box/Turnout		
30" Dia.	lump sum	$10,350.00
36" Dia.	lump sum	$11,000.00
42" Dia.	lump sum	$13,580.00
48" Dia.	lump sum	$15,520.00
54" Dia.	lump sum	$17,000.00
60" Dia.	lump sum	$18,000.00
66" Dia.	lump sum	$20,000.00
78" Dia.	lump sum	$24,000.00
o Pressure Pipe		
15"	lin ft	$20.25
18"	lin ft	$26.40
21"	lin ft	$32.00
24"	lin ft	$40.30
30"	lin ft	$41.50
36"	lin ft	$53.40
42"	lin ft	$68.55
48"	lin ft	$78.70
o Allowance, Unlisted	%	15
o Contractor's Overhead & Profit	%	10
Engineering & Administration	%	10

TABLE F-2

ASSUMPTIONS USED IN DEVELOPMENT OF
ANNUAL OPERATION AND MAINTENANCE COSTS

Items	Basis of Cost
Pumping	10.0 of Equipment Cost
Pipeline	0.5 of Construction Cost
Concrete Structure	0.2 of Construction Cost
Wells	3.4 of Construction Cost
Ditch Enlargements	0.5 $(Q_2/Q_1 - 1)$* of Construction Cost
Culverts	0.5 of Construction Cost
Control Gates	0.5 of Construction Cost
Lined Canals	1.0 of Construction Cost
Unlined Canals	2.0 of Construction Cost
Irrigation Distribution Works	3.0 of Construction Cost

*Assumes cost is proportional to the hydraulic radius and that the cost of the existing ditch is already included in another item. Q_1 = existing capacity, Q_2 = enlarged capacity.

COST OF POWER

The energy costs for agricultural power were taken from 1987 Schedule PA-1 of Pacific Gas and Electric Company. This schedule is applicable to reclamation service and to general agricultural service on the farm. A total energy charge of $0.07635 per kilowatt-hour was used for cost estimates.

CONVEYANCE LOSS FACTORS

Items	Percent Loss
Unlined Canals	20
Lined Canals	10
Pipelines	2

USEFUL LIFE OF FACILITIES

Items	Lifetime (Years)
Pumps	30
Wells	30
Well Equipment	15
Unlined Canals	7
Lined Canals	30
Pipelines	30

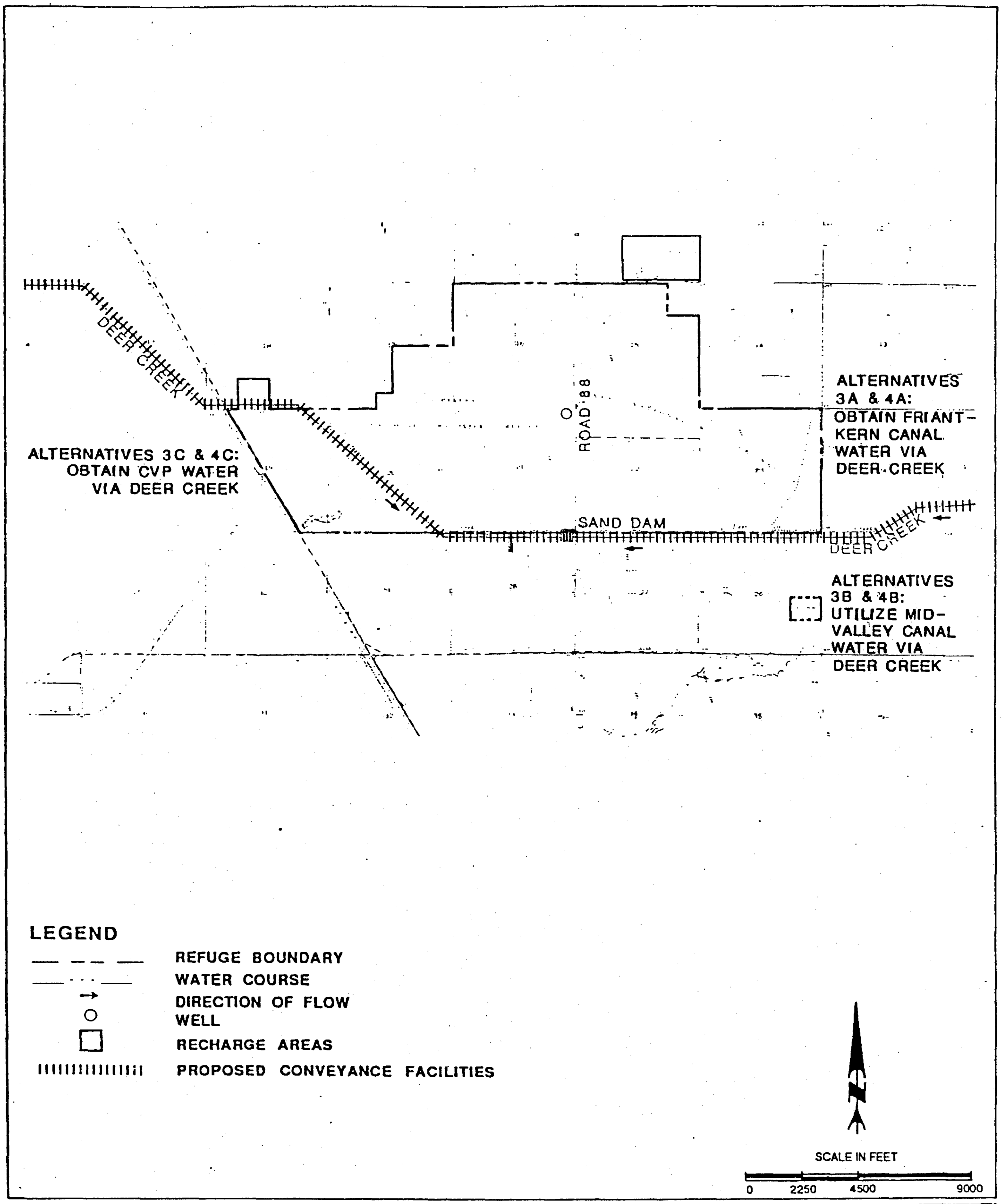

FIGURE IV N-2

PIXLEY NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

4. Delivery Alternatives for Level 4 (6,000 acre-feet)

Water Supply Level 4 would be conveyed through facilities discussed for Level 3.

Alternative 4A - Obtain Friant-Kern Canal Water Via Deer Creek. This alternative is identical to Alternative 3A.

Alternative 4B - Utilize Mid-Valley Canal Water Via Deer Creek. This alternative is identical to Alternative 3B.

Alternative 4C - Obtain CVP Water via the California Aqueduct. This alternative is identical to Alternative 3C.

Alternative 4D - Implement a Conjunctive Use Plan. Fourteen wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative would be similar to Alternative 3D. Implementation of this alternative also would require implementation of Alternative 4A, 4B, or 4C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

There are no alternatives for Water Supply Levels 1 and 2.

Alternatives 3A and 4A utilize the existing creek and require minimal additional facilities. Alternatives 3A and 4A would require long-term agreements with PID or Lower Tule River Irrigation District.

Alternatives 3B and 4B may be considered in the future if the MVC is authorized.

Alternatives 3C and 4C would require extensive operation costs due to the pumping requirements. Long-term conveyance agreements with the Tulare Basin Water Storage District would be required for Alternatives 3C and 4C.

Alternatives 3D and 4D would result in overdraft conditions because the water need during the dry years would exceed the safe yield of the Refuge. These alternatives would require implementation of surface water alternatives (Alternatives 3A through 3C and Alternatives 4A through 4C) to convey surface water during wet years.

C. COSTS AND ECONOMICS ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Water Supply Levels 3 and 4 are presented in Table IV N-2. The construction costs include factors to cover

TABLE IV N-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

PIXLEY NWR

Items	Alternatives							
	3A	3B	3C	3D	4A	4B	4C	4D
Additional Water (ac-ft)	3,000	3,000	3,000	3,000	6,000	6,000	6,000	6,000
Construction Costs								
Wells	$ --	$ --	$ --	$ 594,300[g]	$ --	$ --	$ --	$1,188,600[i]
Diversion Structures	--	11,000[c]	11,000[e]	--	--	11,000[e]	11,000[e]	--
Pipelines/Canals	406,000[a]	406,000[a]	406,000[a]	--	406,000[a]	406,000[a]	406,000[a]	--
Pump Stations	200,000[a]	200,000[b]	400,000[f]	--	200,000[b]	200,000[b]	400,000[f]	--
Subtotal	$606,000	$617,000	$817,000	$ 594,300	$606,000	$617,000	$817,000	$1,188,600
Other Costs	--	--	--	606,000[h]	--	--	--	606,000[h]
Total	$606,000	$617,000[d]	$817,000	$1,200,300	$606,000	$617,000[d]	$817,000	$1,794,600
Annualized Construction Cost (8.87%, 30 yrs)	$ 58,300	$ 59,360	$ 78,600	$ 115,470	$ 58,300	$ 59,360	$ 78,600	$ 172,640
Additional Annual Cost								
Operation & Maintenance[j]	$ 2,400	$ 2,400	$ 5,800	$ 20,210	$ 2,400	$ 2,400	$ 5,800	$ 40,400
Power	7,950[k]	7,950[k]	15,900[k]	48,000[m,n]	15,900[k]	15,900[k]	31,800[k]	96,000[m,n]
Local Conveyance Cost	12,750[l]	12,750[l]	12,750[l]	--	25,500[l]	25,500[l]	25,500[l]	--
Subtotal	$ 23,100	$ 23,100	$ 34,450	$ 68,210	$ 43,800	$ 43,800	$ 63,100	$ 136,400
Other Costs	--	--	--	11,550[h,n]	--	--	--	21,900[h,n]
Total	$ 23,100	$ 23,100[d]	$ 34,450	$ 79,760	$ 43,800	$ 43,800	$ 63,100	$ 158,300
Total Annual Costs	$ 81,400	$ 82,460	$113,050	$ 195,230	$102,100	$103,160	$141,700	$ 330,940
Cost/Additional Acre/Foot	$ 27.20	$ 27.50	$ 37.70	$ 65.10	$ 17.00	$ 17.20	$ 23.60	$ 55.20

TABLE IV N-2

SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES

PIXLEY NWR

(Continued)

Notes: Alternatives 3A and 4A - Obtain Friant-Kern Canal Water via Deer Creek
Alternatives 3B and 4B - Utilize Mid-Valley Canal Water via Deer Creek
Alternatives 3C and 4C - Obtain CVP Water via the California Aqueduct
Alternatives 3D and 4D - Implement a Conjunctive Use Plan

(a) 5,280 feet of ditches; 31,680 feet of new levees; 15,840 feet of levee repairs; and 16 control structures.

(b) 20 cfs pump, 30-foot lift.

(c) 36-inch diameter turnout on Mid-Valley Canal at Deer Creek, 12 cfs

(d) Costs do not include costs for Mid Valley Canal.

(e) 36-inch diameter turnout on Homeland/Lakeland Canal, 12 cfs.

(f) Two 20 cfs pump, 30-foot lift.

(g) 7 wells, 900-feet deep, 250-foot lift.

(h) Alternatives 3D and 4D assume implementation of Alternatives 3A and 4A, respectively.

(i) 14 wells, 900-feet deep, 250-foot lift.

(j) Basis for O&M costs are discussed in Appendix F.

(k) Unit Pumping Cost = $2.65/af.

(l) Unit Conveyance Cost = $4.25/af.

(m) Unit Pumping Cost = $32/af.

(n) Values are multiplied by 0.5 because facilities will be used 5 out of 10 years.

engineering, contingencies, and overhead. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include the cost to purchase CVP water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under any of the alternatives would result in additional money being spent in Tulare County during construction. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use at the Refuge is about 300 visits per year. If additional water is provided, attendance levels would increase significantly. (USFWS, 1986).

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is limited to wetland dependent endangered, candidate, and sensitive species. The Service estimates that the Refuge receives approximately 6,000 use-days annually. Wildlife resources associated with the Refuge are presented in Table IV N-3. The listed threatened and endangered species associated with the Refuge are the peregrine falcon, <u>Falco peregrinus anatum</u>; bald eagle, <u>Haliaeetus leucocephalus</u>; San Joaquin kit fox, <u>Vulpes macrotis mutica</u>; and the blunt-nosed leopard lizard, <u>Gambelia silus</u>. Numerous candidate species may occur in this area and are presented in Table IV N-4.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species and may improve habitat that would be used by the San Joaquin kit fox and the blunt-nosed leopard lizard. Table IV N-5 describes the increase in wildlife resources as a result of the various water supply levels. Detailed field investigations will be necessary during the advanced planning phase of the project. Additional regional environmental analyses will be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of alternatives for Levels 3 or 4 would be positive due to the potential increase in public use.

F. POWER ANALYSIS

The Pacific Gas and Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water Supply Planning Report. A more detailed discussion of project-uses power and wheeling agreements is provided in the Power Analysis

TABLE IV N-3

WILDLIFE RESOURCES

PIXLEY NWR

Ducks

Pintail	Mallard	Cinnamon Teal
Wigeon	Gadwall	Wood Duck
Northern Shoveler	Green-winged Teal	

Geese and Swans

Canada Goose	Snow Goose
White-fronted Goose	Ross' Goose

Coots

American Coot

Shore and Wading Birds

Pied-billed Grebe[a]	American Avocet	Killdeer[a]
American Bittern	Black-neck Stilt	Long-billed Curlew
Great Blue Heron	Common Snipe	Snowy Egret
Long-billed Dowitcher	Green-backed Heron	Least Sandpiper
Black-crowned Night Heron	Western Sandpiper	Greater Sandhill Crane
White-faced Ibis		Mountain Plover

TABLE IV N-3

WILDLIFE RESOURCES

PIXLEY NWR
(Continued)

Upland Game		
Ring-necked Pheasant	Mourning Dove[a]	
Raptorial Birds		
Black-shouldered Kite	Northern Harrier	Red-tailed (Harlan) Hawk[a]
Rough-legged Hawk	American Kestrel (Sparrow Hawk)[a]	Golden Eagle
Swainson's Hawk	Prairie Falcon	Burrowing Owl
Ferruginous Hawk	Merlin	Sharp-shinned Hawk
Furbearers		
Raccoon	Badger	
Coyote	Long-tailed Weasel	
San Joaquin Kit Fox	Skunks	

Notes:

(a) Birds nesting on refuge

Source: Environmental Assessment Report, Mendota Wildlife Area, and checklist of the birds of the Mendota Wildlife Area.

TABLE IV N-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

PIXLEY NWR

Listed Species

Mammals
San Joaquin kit fox, Vulpes macrotis mutica (E)

Reptiles
Blunt-nosed leopard lizard, Gambelia silus (E)

Birds
Bald eagle, Haliaeetus leucocephalus (E)
American peregrine falcon, Falco peregrine anatum (E)

Proposed Species

None

Candidate Species

Mammals
Tipton kangaroo rat, Dipodomys n. nitratoides (2)
Nelson's Antelope Ground Squirrel, Ammo spermophilus nelson (2)

Birds
White-faced ibis, Plegadis chihi (2)
Tricolored blackbird, Agelaius tricolor (2)
Mountain Plover, Charadrius mountanaso (2)
Ferruginous Hawk, Buteo regalis (2)
Long-Billed Curlew, Numenins americanus (2)

Invertebrates
Hopping's blister beetle, Lytta hoppingi (2)
Moestan blister beetle, Lytta moesta (2)
Molestan blister beetle, Lytta molesta (2)
Morrison's blister beetle, Lytta morrisoni (2)
A land snail, Helminoglypta callistoderma (2)

Plants
Lost Hills saltbush, Atriplex vallicola (2)
Hispid bird's-beak, Cordylanthus mollis subsp. hispidus (2)
California jewelflower, Caulanthus californicus (2)
Congdon's wooly-threads, Lembetia congdonii (2R)
Hoover's wooly-star, Eriastrum hooveri (2)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat
(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.
(2R)—Recommended addition to Category 2.

TABLE IV N-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

PIXLEY NWR

	No Action Alternative	Alternatives 3A	3B	3C	3D	4A	4B	4C	4D
Habitat Acres									
Seasonal Marsh	--	400	400	400	400	550	550	550	550
Irrigated Marsh	--	400	400	400	400	400	400	400	400
Irrigated Crops	--	--	--	--	--	650	650	650	650
Bird Use Days									
Geese	--	133,600	133,600	133,600	133,600	267,200	267,200	267,200	267,200
Ducks	--	907,200	907,200	907,200	907,200	1,815,000	1,815,000	1,815,000	1,815,000
Waterbirds and Other Migratory Birds	--	405,600	405,600	405,600	405,600	811,200	811,200	811,200	811,200
Endangered Species	6,000	477,700	477,700	477,700	477,700	1,300,000	1,300,000	1,300,000	1,300,000
	6,000	1,924,100	1,924,100	1,924,100	1,924,100	4,193,400	4,193,400	4,193,400	4,193,400
Public Use Days									
Consumptive	--	3,300	3,300	3,300	3,300	6,500	6,500	6,500	6,500
Non-consumptive	300	2,000	2,000	2,000	2,000	3,800	3,800	3,800	3,800
Total	300	5,300	5,300	5,300	5,300	10,300	10,300	10,300	10,300
Total Annual Cost	$ --	$ 81,400	$ 82,460	$ 113,050	$ 195,230	$ 102,100	$ 103,160	$ 141,700	$ 330,940
Incremental Cost/Additional 1,000 Bird Use Days	N/A	$ 42.40	$ 43.00	$ 58.90	$ 101.80	$ 24.40	$ 24.60	$ 33.80	$ 79.00
Incremental Cost/Additional Public Use Day	N/A	$ 16.30	$ 16.50	$ 22.60	$ 39.00	$ 10.20	$ 10.30	$ 14.20	$ 33.10

Notes: Alternatives 3A and 4a: Obtain Friant-Kern Canal Water via Deer Creek.
Alternatives 3B and 4B: Utilize Mid-Valley Canal Water via Deer Creek.
Alternatives 3C and 4C: Obtain CVP Water via the California Aqueduct.
Alternatives 3D and 4D: Implement a Conjunctive Use Plan.

power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction activities would require several permits. Tulare County would issue permits for well construction under Alternatives 3D and 4D. Approvals for construction of pump stations would be required from the Tulare Lake Basin Water Storage District under Alternatives 3C and 4C. For construction activities in wetlands or riparian corridors, Stream Alteration Permits from DFG and an Army Corps of Engineers permit would be required.

CHAPTER IV O

KERN NATIONAL WILDLIFE REFUGE

The Migratory Bird Conservation Commission created the 10,618 acre Kern National Wildlife Refuge (Refuge) in 1961. The Refuge was established to restore a small segment of the wetland habitat impacted by the drainage of Buena Vista, Kern, Goose, and Tulare lakes. As shown in Figure IV 0-1, the Refuge is divided by the Goose Lake Canal which terminates in the Tulare Lake basin. The Refuge, located 35 miles northwest of Bakersfield, is managed by the Service.

Land uses at the Refuge can be classified as wetlands, croplands, and uplands. Approximately 2,260 acres has been set aside as a natural research area for desert plants and to provide a critical habitat for two endangered species, the blunt-nosed leopard lizard and the San Joaquin kit fox. Due to its strategic location along the Pacific Flyway, the Refuge serves as winter waterfowl habitat for the thousands of early migrant pintail ducks which concentrate in the Tulare Lake Basin during August and September. Major food plants grown on the Refuge include wild millet, alkali bulrush, and swamp timothy (USFWS, 1978). The plants are irrigated in the spring and summer and flooded with six to nine inches of water in the fall for waterfowl feeding (USFWS, 1978). Grazing by cattle is permitted when winter rains are sufficient to provide adequate forage from winter annual grasses (USBR, 1986a).

A. WATER RESOURCES

The Refuge does not have any firm water supplies. The Refuge has purchased water in the past from the Friant-Kern Canal (FKC) which has been delivered via Poso Creek. The Refuge also has purchased water from the Kern County Water Agency (KCWA). Groundwater has also been utilized.

1. Surface Waters

The majority of water used by the Refuge has been surplus State Water Project water purchased from the KCWA. This water is delivered through the California Aqueduct to the Buena Vista Water Storage District (BVWSD) facilities. These contracts are renewed annually. The State Department of Water Resources has stated that no additional water is available, however the Refuge could continue to obtain surplus water from the KCWA through the California Aqueduct (USFWS, 1978). The existing surface water quality appears to be good for use on the Refuge.

Another source of water is from Poso Creek, an intermittent stream, which spills floodwaters onto the Refuge during wet years. No water is available for appropriation in Poso Creek from June

15 until the fall rains. Securing an appropriative right on these floodwaters would not give the Refuge a firm supply. It is unlikely that the State would issue a permit for diversion along the stream.

Poso Creek terminates on the Refuge and has caused flood control problems on the Refuge. The Service and the Pond-Poso Soil Conservation District have agreed to receive all floodwaters that reach the Refuge. When the volume of water does not spill over the levee, this agreement benefits both the farmers and the Refuge. However, in the winter of 1982-83, floodwaters significantly damaged refuge facilities (USBR, 1986a).

The Kern River, located 1.5 miles west of the Refuge, is considered a critical stream by the State Water Resources Control Board. Decision 1196 by the State Water Resources Control Board determined that no water is available for appropriation from Kern River at any time (USFWS, 1978). Therefore, this source of water has been removed from consideration.

2. Water Conveyance Facilities

The BVWSD conveys surplus water between January to mid-March from the California Aqueduct through the No. 1 North Lateral to the Main Drain Canal and the West Side Canal. The water is conveyed through the BVWSD Main Drain Canal and the BVWSD West Side Canal to the BVWSD Goose Lake Canal which delivers the water directly to the Refuge. The BVWSD Goose Lake Canal does not have additional capacity in the month of August. However, adequate capacity exists in the BVWSD facilities during the other months.

Water from the FKC is released to the Semitropic Water Storage District (SWSD) Poso Creek at a point 20 miles upstream from the Refuge. Both the FKC and Poso Creek have sufficient capacity to transport the water to the Refuge during the fall, winter, and spring months. However, during the summer irrigation season, capacity is not available in the FKC. High conveyance losses occur in Poso Creek due to percolation, evaporation, and diversions along the creek.

The Refuge's internal distribution system is generally in good condition, although minor improvements are needed.

3. Groundwater

The Refuge, located in the lake deposits of the Tulare Lake Basin, has nine groundwater wells. These wells were used to supply water until the early 1970's. At that time, three of the wells were abandoned due to a receding water table coupled with escalating energy costs (USFWS, 1986a).

The six operating wells are located along the southern boundary of the Refuge and along the Goose Lake Canal. These wells are

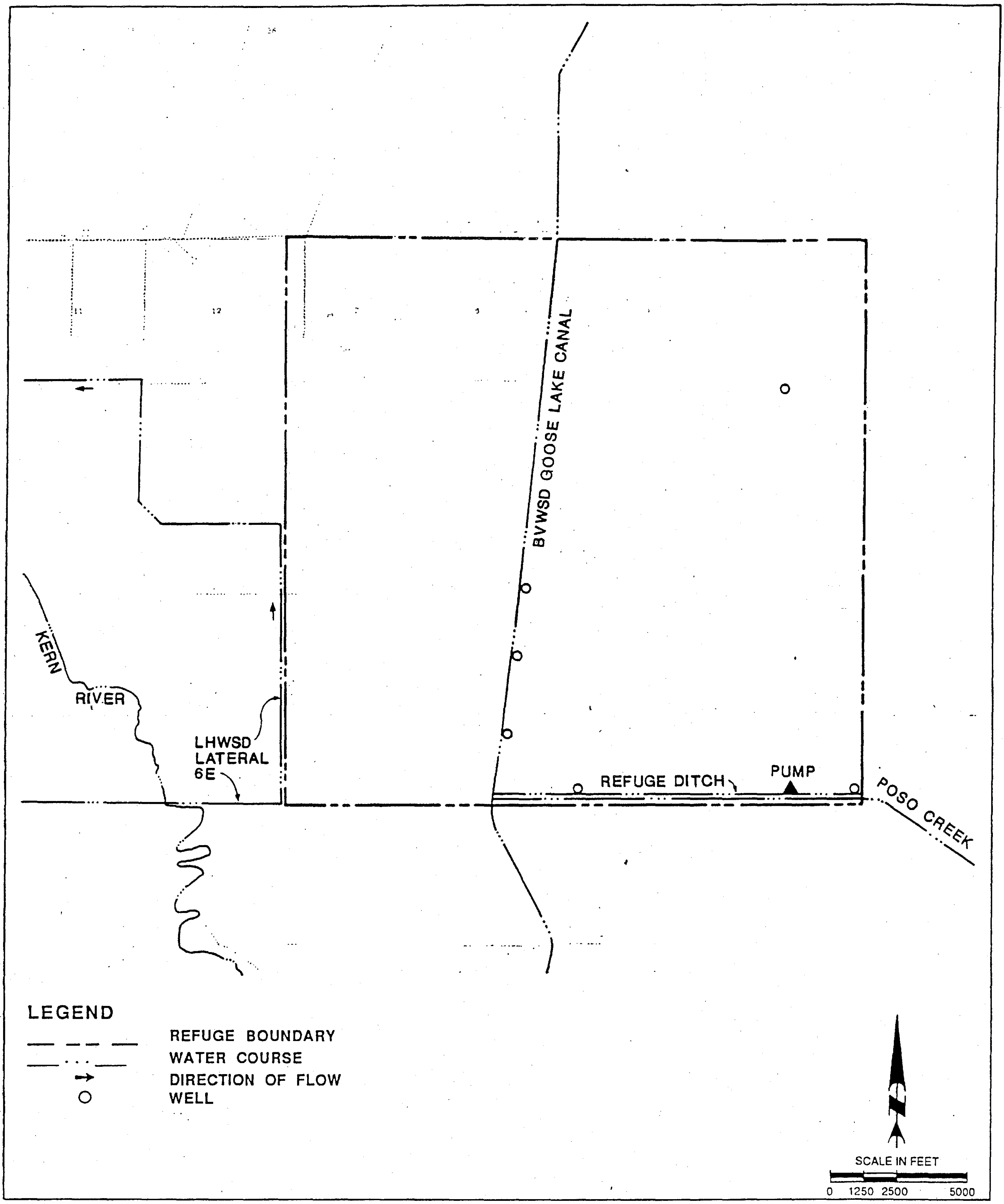

FIGURE IV 0-1

KERN NATIONAL WILDLIFE REFUGE

EXISTING WATER SUPPLY FACILITIES

used on an as-needed basis in conjunction with surface water. The irrigation wells are 800 to 1,200 feet deep. Water levels in these wells were at least 280 feet below the surface in 1977. Reclamation estimates that the safe yield of the Refuge is 5,500 acre-feet.

B. FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

The Service estimates that 25,000 acre-feet of water would be required for full development and optimum management of the entire Refuge. For the purposes of assessing the impacts of water delivery alternatives, four levels of water supply have been identified, as presented in Table IV O-1. Each of the water supply levels provides a different volume of water and are summarized as follows:

Level 1 - Existing firm water supply

Level 2 - Current average annual water deliveries

Level 3 - Water supply needed for full use of existing development

Level 4 - Water delivery needed for optimum management

1. Delivery Alternative for Level 1 (No Action Alternative) (0 acre-feet)

The Refuge has no firm water supply, therefore no alternatives were developed for Level 1.

2. Delivery Alternatives for Level 2 (9,900 acre-feet)

Alternatives 2A through 2C would provide a dependable source of surface water from the CVP or the State Water Project. Alternative 2D would provide wells to be used in a conjunctive use program.

Alternative 2A - Transport CVP Water Through the Buena Vista Water Storage District Facilities. A long-term contract would be negotiated with BVWSD to convey water from the California Aqueduct through the BVWSD No. 1 North Lateral to the BVWSD West Side Canal and the BVWSD Main Drain Canal which would flow into the BVWSD Goose Lake Canal. The BVWSD Goose Lake Canal would convey the water to the Refuge, as shown in Figure IV O-2. The Goose Lake Canal may not have sufficient capacity above the confluence with the Main Drain Canal and the West Side Canal in August when water is required for irrigation of cotton. The internal distribution system would be improved through the construction of two lift pumps and 8.5 miles of new levees. In addition, about eight miles of levees would be repaired.

TABLE IV O-1

DEPENDABLE WATER SUPPLY NEEDS

ALTERNATIVE SUPPLY LEVELS FOR THE KERN NWR

Month	Supply Level 1 ac-ft	Supply Level 2 ac-ft	Supply Level 3 ac-ft	Supply Level 4 ac-ft
January	0	0	0	1,000
February	0	0	0	1,000
March	0	0	0	0
April	0	0	0	400
May	0	1,900	2,900	1,200
June	0	850	1,250	1,800
July	0	0	0	1,600
August	0	0	0	5,500
September	0	2,400	3,600	4,000
October	0	1,200	1,800	3,500
November	0	1,800	2,800	3,000
December	0	1,800	2,700	2,000
Total	0	9,950	15,050	25,000

Notes:

Supply Level 1: Existing firm water supply
Supply Level 2: Current average annual water deliveries
Supply Level 3: Full use of existing development
Supply Level 4: Optimum management

Sources: USBR, 1986a; USFWS, 1986d and 1986e

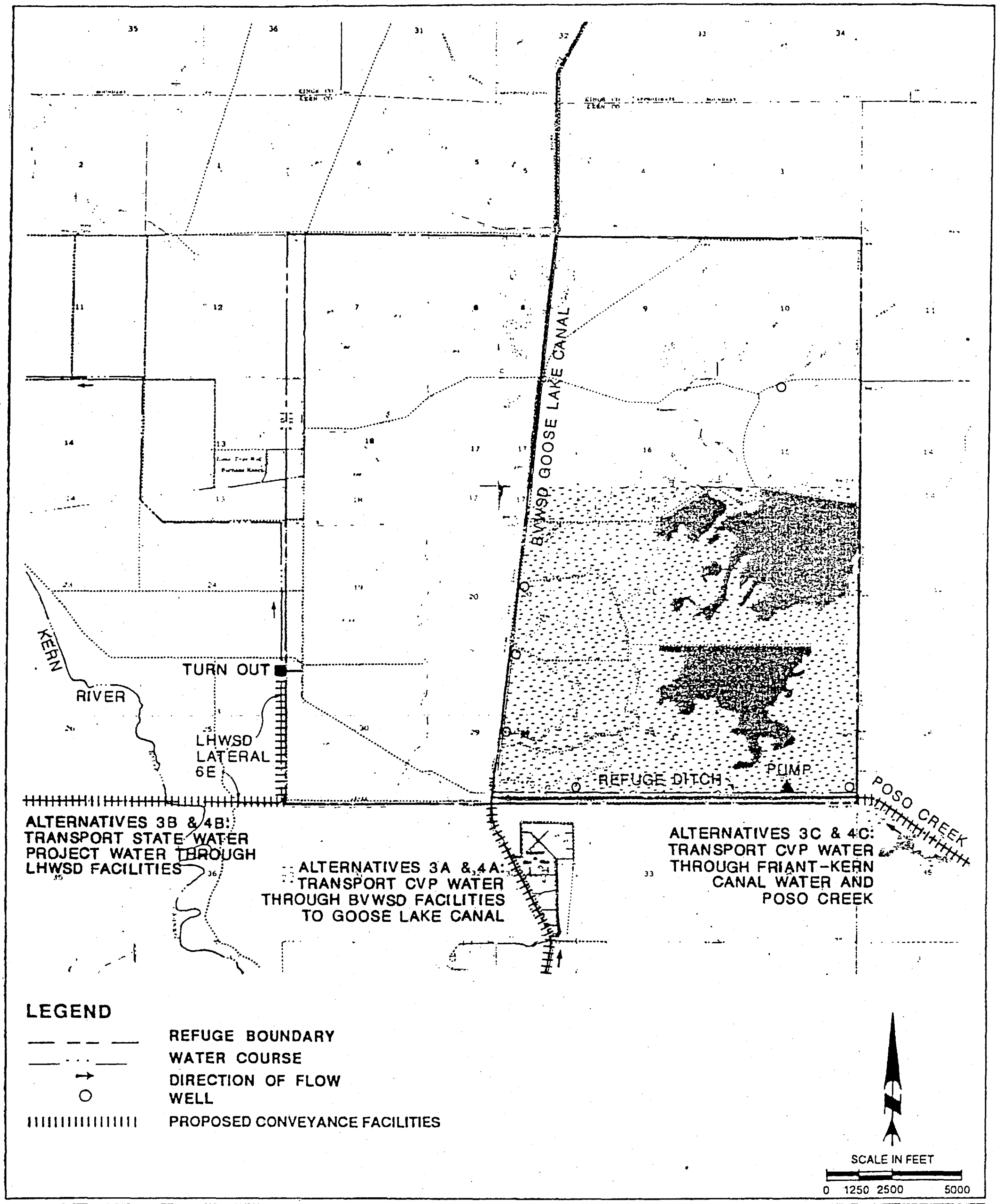

FIGURE IV 0-2

KERN NATIONAL WILDLIFE REFUGE

ALTERNATIVE WATER SUPPLY FACILITIES

Alternative 2B - Transport State Water Project Water through the Lost Hills Water Storage District Facilities. The Lost Hills Water Storage District (LHWSD) operates a lateral which terminates at the Refuge's western boundary. This lateral would be used to deliver water from the California Aqueduct to the Refuge. Under this alternative, a 150 cfs turnout would be constructed on the LHWSD lateral to divert water onto the Refuge. The internal distribution system would be improved through the construction of two lift pumps and 8.5 miles of new levees. In addition, about eight miles of levees would be repaired.

Alternative 2C - Transport CVP Water Through the Friant-Kern Canal and Poso Creek. Water from the FKC would be conveyed to the Refuge through Poso Creek. This alternative would require a long-term conveyance agreement with SWSD which operates Poso Creek. Pumping facilities currently exist to transfer the water from Poso Creek to the Refuge. Poso Creek has adequate capacity to convey the CVP water. However, the FKC has capacity limitations. The internal distribution system would be improved through the construction of two lift pumps and 8.5 miles of new levees. In addition, about eight miles of levees would be repaired.

Alternative 2D - Implement a Conjunctive Use Plan. Six additional wells would be constructed on the Refuge to deliver the maximum month water demand. The exact locations of the wells would be determined in a future study. The wells would be developed as part of a conjunctive use program. During dry years, water demands would be supplied by wells, as discussed in Chapter III. During wet years, the wells would probably not be needed if CVP water is provided. Implementation of this alternative also would require implementation of Alternatives 2A, 2B, or 2C.

3. Delivery Alternatives for Level 3 (15,050 acre-feet)

Alternatives for Water Supply Level 3 would be similar to the alternatives developed for Level 2.

Alternative 3A - Transport CVP Water Through the Buena Vista Water Storage District Facilities. This alternative is identical to Alternative 2A.

Alternative 3B - Transport State Water Project Water through the Lost Hills Water Storage District Facilities. This alternative is identical to Alternative 2B.

Alternative 3C - Transport CVP Water Through the Friant-Kern Canal and Poso Creek. This alternative is identical to Alternative 2C.

Alternative 3D - Implement a Conjunctive Use Plan. Twelve additional wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative is similar to Alternative 2D. Implementation of this alternative would require implementation of Alternative 3A, 3B, or 3C.

4. Delivery Alternatives for Level 4 (25,000 acre-feet)

Alternatives for Water Supply Level 4 would be similar to the alternatives developed for Level 3.

Alternative 4A - Transport CVP Water Through the Buena Vista Water Storage District Facilities. This alternative is identical to Alternative 2A.

Alternative 4B - Transport State Water Project Water through the Lost Hills Water Storage District Facilities. This alternative is identical to Alternative 2B.

Alternative 4C - Transport CVP Water Through the Friant-Kern Canal and Poso Creek. This alternative is identical to Alternative 2C.

Alternative 4D - Implement a Conjunctive Use Plan. Twenty-one additional wells would be constructed on the Refuge to deliver the maximum month water demand. This alternative is similar to Alternative 2D. Implementation of this alternative would require implementation of Alternative 4A, 4B, or 4C.

5. Summary of Alternatives

The beneficial and adverse effects of each alternative were compared with respect to the criteria listed in Chapter III.

No alternatives were developed for Level 1 because the Refuge does not have a firm water supply.

Alternatives 2A, 3A, and 4A would require long-term agreements with the BVWSD. Alternatives 2B, 3B, and 4B would require long-term agreements with the LHWSD. Alternatives 2C, 3C, and 4C would require long-term agreements with SWSD. Alternatives 2B, 3B, and 4B also would require construction of a turnout and a pump station. All of these alternatives would include construction of on-refuge improvements.

Alternatives 2D, 3D, and 4D would result in a groundwater overdraft because the water supply need in dry years would exceed the safe yield of the Refuge. These alternatives would require implementation of surface water alternatives (Alternatives 2A through 2D, Alternatives 3A through 3C, and Alternatives 4A through 4C).

C. COSTS AND ECONOMIC ANALYSIS

Costs for the alternative plans to provide adequate water supplies under Water Supply Levels 2, 3, and 4 are presented in Table IV O-2. The construction costs include factors to cover engineering, contingencies, and overhead costs. Annual operation and maintenance (O&M) costs include only the local cost of delivering water. The annual O&M costs do not include costs to purchase CVP or State Water Project water. During the advanced planning phase, these costs will be refined further.

Construction of the facilities under all of the alternatives would result in additional money being spent in Kern County during construction. The construction could be completed within one summer season by construction workers who reside in the area.

Currently, the annual public use at the Refuge is approximately 6,700 visits per year. If the additional water is provided, the attendance levels would increase.

D. WILDLIFE RESOURCES

The annual bird use on the Refuge is approximately 7,197,500 use-days. If the additional water is provided, wildlife-use days would increase. Wildlife and fishery resources associated with the Refuge are presented in Table IV O-3. The only listed threatened and endangered species associated with the Refuge are the peregrine falcon, Falco peregrine anatum; bald eagle, Haliaeetus leucocephalus; San Joaquin kit fox, Vulpes macrotis mutica; and the blunt-nosed leopard lizard, Gambelia silus. Numerous candidate species may occur in this area and are also presented in Table IV O-4.

Implementation of any of the alternative plans probably would not adversely affect the listed and candidate threatened and endangered species of wildlife, but would instead improve their habitat. Detailed field investigations would be completed during the advanced planning phase of the project. Implementation of the plan would result in overall beneficial environmental effects, as shown on Table IV O-5. The No Action Alternative would result in a loss of habitat. Additional regional environmental analyses would be completed as part of the Water Contracting EIS's.

E. SOCIAL ANALYSIS

The social consequences of constructing and operating the facilities under any of the alternatives would be positive due to the potential increase in public use.

F. POWER ANALYSIS

Pacific Gas and Electric Company serves the Refuge under the PA-1 rate schedule for agricultural users. A facility must be an authorized function of the CVP to receive project-use power. The authority to deliver CVP project-use power to the Refuge is currently being examined and will be detailed in the Refuge Water

TABLE IV O-2
SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES
KERN NWR

Items	Alternatives											
	2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D
Additional Water (ac-ft)	9,950	9,950	9,950	9,950	15,050	15,050	15,050	15,050	25,000	25,000	25,000	25,00
Construction Costs												
Wells				$ 621,600[c]				$1,243,200[h]				$2,175,60
Diversion Structures		$ 24,000[d]	$ 32,000[f]			$ 24,000[d]	$ 32,000[f]			$ 24,000[d]	$ 32,000[f]	
Pipelines/Canals	$1,550,000[a]	1,555,000[a,e]	1,557,400[a,g]		$1,550,000[a]	1,555,000[a,e]	1,557,400[a,g]		$1,550,000[a]	$1,555,000[a,e]	$1,557,400[a,g]	
Pump Stations	106,000[b]	106,000[b]	106,000[b]		106,000[b]	106,009[b]	106,000[b]		106,000[b]	106,000[b]	106,000[b]	
Subtotal	1,656,000	1,685,000	1,695,400	621,600	1,656,000	1,685,000	1,695,400	1,243,200	1,656,000	1,685,000	1,695,400	2,175,60
Other Costs				1,695,400[i]				1,695,400[i]				1,695,40
Total	$1,656,000	$1,685,000	$1,695,400	$2,317,000	$1,656,000	$1,685,000	$1,695,400	$2,938,600	$1,656,000	$1,685,000	$1,695,400	$3,871,00
Annualized Construction Cost (8.87%, 30 yrs)	$ 159,300	$ 162,100	$ 163,100	$ 222,900	$ 159,300	$ 162,100	$ 163,100	$ 282,690	$ 159,300	$ 162,100	$ 163,100	$ 372,39
Additional Annual Cost												
Operation & Maintenance[k]	$ 1,000	$ 1,500	$ 1,000	$ 21,140	$ 1,000	$ 1,500	$ 1,000	$ 42,270	$ 1,000	$ 1,500	$ 1,000	$ 73,97
Power	9,950[l]	9,950[l]	9,950[l]	291,040[n,o]	15,050[l]	15,050[l]	15,050[l]	440,210[n,o]	25,000[l]	25,000[l]	25,000[l]	731,25
Local Conveyance Cost	42,290[m]	42,290[m]	42,290[m]		63,960[m]	63,960[m]	63,960[m]		106,250[m]	106,250[m]	106,250[m]	
Subtotal	53,240	53,740	53,240	312,180	80,010	80,510	80,010	482,480	132,250	132,750	132,250	805,22
Other Costs				26,620[i,o]				40,000[i,o]				66,12
Total	$ 53,240	$ 53,740	$ 53,240	$ 338,800	$ 80,010	$ 80,510	$ 80,010	$ 522,480	$ 132,250	$ 132,750	$ 132,250	$ 871,34
Total Annual Costs	$ 212,540	$ 215,840	$ 216,340	$ 561,700	$ 239,310	$ 242,610	$ 243,110	$ 805,170	$ 291,550	$ 294,850	$ 295,350	$1,243,75
Cost/Additional ac-ft	$ 21.40	$ 21.70	$ 21.70	$ 56.50	$ 15.90	$ 16.10	$ 16.20	$ 53.50	$ 11.70	$ 11.80	$ 11.80	$ 49.7

TABLE IV O-2
SUMMARY OF ESTIMATED COSTS OF ALTERNATIVES
KERN NWR

(Continued)

Notes: Alternatives 2A, 3A, and 4A - Transport CVP Water through the Buena Vista Water Storage District Facilities
Alternatives 2B, 3B, and 4B - Transport State Water Project through the Lost Hills Water Storage District Facilities.
Alternatives 2C, 3C, and 4C - Transport CVP Water through the Friant-Kern Canal and Poso Creek.
Alternatives 2D, 3D, and 4D - Implement a Conjunctive Use Plan.

(a) 44,880 feet of new levees, and 42,240 feet of repaired levees.

(b) Two 30 cfs, 10-foot lift pump.

(c) 6 wells, 800-feet deep, 450-foot lift.

(d) 150 cfs, 78-inch diameter turnout.

(e) 550-foot, 150 cfs unlined canal.

(f) 800-foot, 60 cfs turnout.

(g) 800-foot, 90 cfs unlined canal.

(h) 12 wells, 800-feet deep, 450-foot lift.

(i) Alternatives 2D, 3D, and 4D assume implementation of Alternatives 2C, 3C, and 4C, respectively.

(j) 21 wells, 800-foot deep, 450-foot lift.

(k) Basis for costs for O&M are discussed in Appendix F.

(l) Unit Pumping Cost = $1/af.

(m) Unit Conveyance Cost = $4.25/af.

(n) Unit Pumping Cost = $58.50/af.

(o) Values multiplied by 0.5 because facilities are assumed to be used 5 out of 10 years.

TABLE IV O-3

FISH AND WILDLIFE RESOURCES

KERN NWR

Ducks

Pintail[a]	Cinnamon Teal[a]	Lesser Scaup[a]
Wigeon-American	Blue-winged Teal	Ring-necked Duck[a]
Shoveler[a]	Wood Duck	Bufflehead
Mallard[a]	Redhead[a]	Ruddy Duck[a]
Gadwall[a]	Canvasback[a]	Fulvous Tree Duck
Green-winged Teal	Greater Scaup	Common Goldeneye
		Common Merganser

Geese and Swans

Canada Goose	Snow Goose	White-fronted Goose
Ross' Goose		

Coots

American Coot[a]		

Shore and Wading Birds

Western Grebe[a]	Snowy backed Egret[a]	Common Snipe[a]
Eared Grebe[a]	Green Heron	White-faced Ibis[a]
Pied-billed Grebe[a]	Black-crowned Night Heron[a]	American Avocet[a]
Double-crested Cormorant	Lesser Sandhill Crane	Black-necked Stilt[a]
White Pelican	Virginia Rail[a]	Killdeer[a]
American Bittern[a]	Sora	Long-billed Curlew
Great Blue Heron[a]	Common Gallinule[a]	Greater Yellowlegs
Great (Common) Egret[a]	Long-billed Dowitcher	Dunlins
Least Sandpipers	Wilson's Phalarope	Northern Phalarope
California Gull	Ring-billed Gull	Forster's Tern
Caspian Tern[a]	Common Snipe[a]	

TABLE IV O-3

FISH AND WILDLIFE RESOURCES

KERN NWR
(Continued)

Upland Game		
Mourning Dove[a]	Ring-necked Pheasant[a]	
California Quail	Cotton Tail Rabbits	
Raptorial Birds		
Turkey Vulture	Black shouldered Kite[a]	Northern Harrier
Sharp-shinned Hawk[a]	Cooper's Hawk[a]	Red-tailed (Harlan) Hawk[a]
Rough-legged Hawk	Ferruginous Hawk	American Kestrel[a]
Barn Owl[a]	Short-eared Owl[a]	Great Horned Owl[a]
Burrowing Owl[a]	Swainson's Hawk	Prairie Falcon
Merlin	Golden Eagle	Peregrine Falcon
	Bald Eagle	
Fish		
Carp	Goldfish	Bluegill
Largemouth Bass	Threadfin Shad	Crappie
Catfish	Striped Bass	
Furbearers		
Raccoon	Skunk	Long-tailed Weasel
Badger	Muskrat	Coyote
		San Joaquin Kit Fox
Others		
Blunt-nosed Leopard Lizard		

Notes:

(a) Birds nesting on refuge

Source: USFWS computerized annual printout for NWR Birds, Department of Interior, USFWS (RF11650-2 9-79) (July 1973 to June 1974, NWRS Public Use Report (1)) and refuge records.

TABLE IV O-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE THREATENED & ENDANGERED SPECIES

KERN NWR

<u>Listed Species</u>

Birds

American Peregrine Falcon, *Falco peregines* auatum (E)
Bald Eagle, *Haliaeetus leucocephalus* (E)

Mammals

San Joaquin kit fox, *Vulpes macrotis mutica* (E)

Reptiles

Blunt-nosed leopard lizard, *Gambelia silus* (E)

<u>Proposed Species</u>

None

<u>Candidate Species</u>

Mammals

Tipton kangaroo rat, *Dipodomys n. nitratoides* (2)

Birds

White-faced ibis, *Plegadis chihi* (2)
Tricolored blackbird, *Agelaius tricolor* (2)
Swainson's Hawk, *Buteo swainsoni* (2)
Mountain Plover, *Eopoda montana* (3)
Ferruginous Hawk, *Buteo regalis* (2)
Long-Billed Curlew, *Numerius americanus* (2)

Invertebrates

Hopping's blister beetle, *Lytta hoppingi* (2)
Moestan blister beetle, *Lytta moesta* (2)
Morrison's blister beetle, *Lytta morrisoni* (2)
A land snail, *Helminoglypta callistoderma* (2)

Plants

Lost Hills saltbush, *Atriplex vallicola* (2)
Hispid bird's-beak, *Cordylanthus mollis* subsp. *hispidus* (2)
California jewelflower, *Caulanthus californicus* (2)
Congdon's wooly-threads, *Lembetia congdonii* (2R)
Hoover's wooly-star, *Eriastrum hooveri* (2)

TABLE IV O-4

FEDERALLY LISTED, PROPOSED, & CANDIDATE, THREATENED & ENDANGERED SPECIES

KERN NWR (Continued)

Source: USFWS, June 4, 1987

(E)—Endangered (T)—Threatened (CH)—Critical Habitat

(1)—Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2)—Category 2: Taxa for which existing information indicated may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

(2R)—Recommended addition to Category 2.

TABLE IV O-5

WILDLIFE RECREATIONAL BENEFITS AND RESOURCE IMPACTS

KERN NWR

	No Action Alternative	Alternatives											
		2A	2B	2C	2D	3A	3B	3C	3D	4A	4B	4C	4D
Habitat Acres													
Seasonal Marsh	--	1,600	1,600	1,600	1,600	2,400	2,400	2,400	2,400	4,300	4,300	4,300	4,300
Irrigated Marsh	--	1,200	1,200	1,200	1,200	1,900	1,900	1,900	1,900	2,700	2,700	2,700	2,700
Bird Use Days													
Geese	--	14,000	14,000	14,000	14,000	21,500	21,500	21,500	21,500	35,000	35,000	35,000	35,000
Ducks	--	5,807,000	5,807,000	5,807,000	5,807,000	8,918,000	8,918,000	8,918,000	8,918,000	14,520,000	14,520,000	14,520,000	14,520,000
Waterbirds & Other Migratory Birds	--	715,700	715,700	715,700	715,700	1,099,100	1,099,100	1,099,100	1,099,100	1,789,200	1,789,200	1,789,200	1,789,200
Endangered Species	20,000	660,800	660,800	660,800	660,800	34,799,900	34,799,900	34,799,900	34,799,900	56,651,800	56,651,800	56,651,800	56,651,800
Total	20,000	7,197,500	7,197,500	7,197,500	7,197,500	44,838,500	44,838,500	44,838,500	44,838,500	72,996,000	72,996,000	72,996,000	72,996,000
Public Use Days													
Consumptive	--	1,900	1,900	1,900	1,900	2,500	2,500	2,500	2,500	3,100	3,100	3,100	3,100
Non-Consumptive	300	4,800	4,800	4,800	4,800	8,600	8,600	8,600	8,600	12,400	12,400	12,400	12,400
Total	300	6,700	6,700	6,700	6,700	11,100	11,100	11,100	11,100	15,500	15,500	15,500	15,500
Total Annual Cost	--	$ 212,540	$ 215,840	$ 216,340	$ 561,700	$ 239,310	$ 242,610	$ 243,110	$ 805,170	$ 291,550	$ 294,850	$ 295,350	$1,243,730
Incremental Cost/Additional Bird Use Day	N/A	$ 29.60	$ 30.10	$ 30.10	$ 78.30	$ 5.30	$ 5.40	$ 5.40	$ 18.00	$ 4.00	$ 4.00	$ 4.00	$ 17.00
Incremental Cost/Additional Public Use Day	N/A	$ 33.20	$ 33.70	$ 33.80	$ 87.80	$ 22.20	$ 22.50	$ 22.50	$ 74.60	$ 19.20	$ 19.40	$ 19.40	$ 81.80

Notes: Alternative 2A - Construct Improvements to Internal Conveyance System.
Alternative 2B - Implement a Conjunctive Use Plan.
Alternatives 3A and 4A - Transport CVP Water through the Buena Vista Water Storage District Facilities.
Alternatives 3B and 4B - Transport State Water Project Water through the Lost Hills Water Storage District Facilities.
Alternatives 3C and 4C - Transport CVP Water through the Friant-Kern Canal and Poso Creek.
Alternatives 3D and 4D - Implement a Conjunctive Use Plan.

Supply Planning Report. A more detailed discussion of project-use power and wheeling agreements is provided in the Power Analysis section of Chapter II.

G. PERMITS

Construction activities would require several permits. Kern County would issue permits for construction of wells. Alternatives 3B and 4B would require approvals from LHWSD. Construction of internal conveyance improvements in streams and riparian corridors would require a Stream Alteration Permit from the DFG. An Army Corps of Engineers permit would be required for construction activities in wetlands or riparian corridors.

CHAPTER V

CONSULTATION AND COORDINATION

A. LEAD AND COOPERATING AGENCIES

Reclamation is the lead agency responsible for the preparation of this "Report on Refuge Water Supply Investigations," and the subsequent "Refuge Water Supply Planning Report," which will contain recommendations relative to refuge water supply. These studies are being conducted in cooperation with the Service, DFG, and DWR who are each providing technical expertise relative to the water and land resources for each of the study areas. In addition, the Grassland Water District has provided a significant monetary contribution to the study with funds raised by the California Waterfowl Association. Those funds have financed various investigations on private wetlands within the Grassland Resource Conservation District.

Throughout the course of this study, Reclamation and its contractor (James M. Montgomery, Consulting Engineers, Inc.) have worked closely with various Service, DFG, and DWR staff at each refuge and with each agency's respective regional and state office in developing data for this report. The data were compiled and prepared in draft report format for agency review. Their comments were used, where appropriate, in this report.

B. PUBLIC INVOLVEMENT

Since the initiation of the Refuge Water Supply Study in October 1985, numerous meetings have been held with environmental and wildlife organizations and water and irrigation districts to discuss study objectives, issues and concerns, and planning procedures. A news release discussing the initiation of the study was provided to newspapers within the study area. In addition, two public information documents were released to over two hundred agencies, organizations, legislators, and individuals providing information on the progress of the study and soliciting input on alternative water delivery plans and pertinent issues.

C. FISH AND WILDLIFE SERVICE CONSULTATION

Section 7 of the Endangered Species Act requires Federal agencies insure that their actions are not likely to jeopardize endangered or threatened species in any proposed action, and that the Service provide necessary consultation. The Service has provided Reclamation a list of endangered and candidate species which may occur within the sites investigated. Those species are included in this report.

Reclamation will request that the Service provide an informal Section 7 consultation and species list update while this report is being reviewed. Additional information will be provided to the Service through the draft "Refuge Water Supply Planning Report". The Service will then determine if a formal Section 7 consultation will be necessary.

Section 106 of the National Historic Preservation Act requires that Federal agencies consider cultural resources in their proposed actions. The Regional Cultural Resource Officer has been consulted and cultural resource inventories for archaeological sites will be conducted prior to the recommendation of proposed plans.

D. ISSUES TO BE RESOLVED

Each of the 15 wetland areas considered in this report has problems and needs relative to water supply and delivery, as discussed in Chapter IV. In general, the following issues are common to most of the areas and will need to be addressed and/or resolved prior to presenting the recommended plans for each area in the draft Refuge Water Supply Planning Report.

1. Central Valley Project Authorization

Reclamation recognizes that the delivery of water to Federal and state refuges and management areas is authorized by existing CVP legislation. However, there have been numerous amendments to the original authorizing act, as well as Federal legislation relative to the protection of waterfowl of the Pacific Flyway and endangered species. In the process of plan selection and recommendation, it will be necessary to understand the authorities and requirements of these legislative acts as they relate to the delivery and costs of water and power to each area.

2. Water Quality

Standards for maximum organic and inorganic concentrations need to be established to determine the acceptability of agricultural return flow and groundwater for refuge application. The Service will be requested to provide these standards for inclusion in the draft Refuge Water Supply Planning Report.

3. Refuge Priorities

Reclamation requested from the Service and DFG a prioritized list of refuges within the Sacramento Valley and the San Joaquin Valley to receive water. Both agencies indicated that their priorities for water supply were Water Supply Level 4 through Water Supply Level 1, with Water Supply Level 4 being the highest priority. The replies did not include priorities for specific refuges.

4. Cost Sharing

As discussed in Chapter I, non-Federal participation in the development of dependable water supplies will be an important factor in plan selection and recommendation.

5. Legal and Institutional Concerns

The current demand for CVP water exceeds the anticipated available supply. The Water Contracting EISs will address the effects of providing CVP water for various agricultural, municipal, industrial, and fish and wildlife uses. The results of the EISs and subsequent allocations could result in legal arguments by those users who do not receive their desired allocation.

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ATTACHMENT A

GLOSSARY OF TERMS

ACRE-FOOT. The quantity of water (43,560 cubic feet or 316,700 gallons) that would cover 1 acre to a depth of 1 foot.

AQUIFER. A porous soil or geological formation lying between impermeable strata in which water may move for long distances; yields groundwater to springs and wells.

AREA OF ORIGIN. A commonly used term generally defined as the area in which a water supply originates. The term is based on three statutes in the California State Water Code: the County of Origin and the Watershed Protection Statutes, and the Delta Protection Act.

CANDIDATE SPECIES (ALSO CANDIDATE THREATENED OR ENDANGERED SPECIES). Taxa (species or subspecies) of plants and animals currently being considered for listing by the U.S. Fish and Wildlife Service.

CENTRAL VALLEY PROJECT YIELD. The volume of water available over a period of time from CVP facilities.

CFS. A measure of a moving volume of water; i.e., cubic feet per second. Synonymous with "second-feet."

CLASS II. Contracts for water serviced after delivery of water to firm yield contractors on an "if and when available basis."

CONJUNCTIVE USE. A term used to describe operation of a groundwater basin in coordination with a surface water system.

CONSUMPTIVE USE. Total amount of water taken up by vegetation for transpiration or building of plant tissue, plus the unavoidable evaporation of soil moisture, and intercepted precipitation associated with vegetative growth.

CONVEYANCE CAPACITY. The volume of water that can be transported by a canal, aqueduct, or ditch. Conveyance capacity is generally measured in cubic feet per second (cfs).

CULTURAL RESOURCE. Any building site, district, structure, object, data or other materials significant in history, architecture, archaeology, or culture.

DECISION-1485 (D-1485). The SWRCB decision specifying water quality standards for the Sacramento-San Joaquin Delta and Suisun Marsh.

DEFICIENCIES. Reductions in deliveries of contracted firm water, made necessary by critically dry hydrologic conditions. The amount of these reductions is expressed as the percent of full annual supply delivered.

DEMAND. See Water Demand.

DEPENDABLE WATER. Dependable water is a generic term used to describe the total amount of water that is available for short- and long-term contracting CVP-wide. This water includes the total firm yield of the CVP and short- and long-term supplies of intermittent water.

ENDANGERED SPECIES. Generally taken to mean any species or subspecies whose survival is threatened with extinction and is included in the Federal list of endangered species.

FIRM YIELD. This is defined as that water supply available in all years from the operation of CVP facilities except in dry and critically dry years when shortages are taken. The amount of yield is premised on: 1) ultimate conditions (traditionally equated to year 2020 level of development), and 2) operations studies of the 1928-1934 critically dry period to establish deficiency criteria. The operations studies use historical hydrology modified to show the level of depletions, accretions, and demands appropriate for 2020 development and reflect coordinated operations with the State of California as set forth in the COA. Based on assumptions used in the COA EIS/EIR, the firm yield of the northern CVP was estimated at 8.3 million acre-feet (MAF), with 7.2 MAF committed under existing contracts.

GROUNDWATER OVERDRAFT. An unnatural increase in the depth to the groundwater table resulting from pumping groundwater for use at a rate greater than the rate of recharge.

INTERIM WATER. Interim water is defined as the difference between firm yield and the level of firm yield demand in any year. Prior to 2020, demands for firm yield supplies are assumed to be below their contractual maximum; thus, interim water can be contracted until the firm yield demand has built up to the contractual maximum.

INTERMITTENT WATER. Reclamation is proposing to use this term to denote a supply of water above firm yield which, when added to the supply, would constitute the total amount of water that could be contracted. This supply would be used in combination with groundwater through a conjunctive use program to expand the total supply of water which could be contracted by the Bureau. The water could be contracted on an annual, short-term (longer than 1 year but less than 20 years) or long-term (20 to 40 years) basis. The amount of water which could be delivered under this type of contract would not be as dependable as firm yield since the intermittent supply would depend on the type of water year (wet, normal, or dry), and the quantity of water delivered each year to firm yield contractors. The probability of delivering an intermittent supply would be calculated on the basis of past hydrology and the ability to meet firm yield demands based on the 1928-34 dry year period (e.g., 75 years out of 100, 80 years out of 100, 85 years out of 100, etc.).

<u>INTERRUPTIBLE WATER</u>. See Intermittent Water.

<u>PEAK FLOW</u>. The maximum discharge of a stream during a specified period of time.

<u>PERMEABILITY</u>. The property or capacity of a porous rock, sediment, or soil for transmitting a fluid.

<u>RECREATION DAY</u>. A standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period.

<u>RETURN FLOW</u>. Water which reaches surface drainage by overland flow or through groundwater discharge as a result of irrigation.

<u>RIPARIAN</u>. Living on or adjacent to a water supply such as riverbank, lake, or pond.

<u>SAFE YIELD</u>. The rate or amount at which an aquifer may be pumped without exceeding recharge and incurring overdraft.

<u>SHORTAGES</u>. Reductions in the amount of water being delivered under contract. The amount of the reduction is based on deficiency criteria established in each contract to moderate the effects of a dry and critically dry period.

<u>SPECIES</u>. The basic category of biological classification intended to designate a single kind of animal or plant.

<u>SURPLUS WATER</u>. Water which historically has been available. Generally, this water has been intermittent or interim water. See previous definitions.

<u>THREATENED SPECIES</u>. A species that is likely to become endangered in the foreseeable future and is included in the federal list of threatened species.

<u>WATER DEMAND</u>. The amount of water required to meet the needs of a contractor on a monthly basis. The demand is based upon the evapotranspirative needs of vegetation, seepage rates on the refuge, and conveyance losses.

<u>WATER NEED</u>. A monthly schedule of additional water deliveries (determined by review of farm delivery requirements, population

projections, and per capita historical consumption; and reduced by feasible conservation and conjunctive use yield) that would meet net demands for a water contractor through the contract period.

<u>WATER RIGHT</u>. A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes. California has a dual system of water rights: riparian and appropriative.

<u>WATER USE</u>. The quantity of water actually being diverted or assumed to be diverted in the future.

<u>WETLANDS</u>. Areas defined by the prevailing vegetation types and soil moisture content and contain vegetation typical of soils that are saturated for a major portion of the year.

<u>YIELD</u>. The volume of water available over a period of time from a storage facility.

ATTACHMENT B

ABBREVIATIONS

BVWSD	Buena Vista Water Storage District
BWGID	Biggs-West Gridley Irrigation District
CCID	Central California Irrigation District
CMP	Corrugated Metal Pipe
Contract 2948A	Contract 14-06-200-2498A
COTP	California-Oregon Transmission Project
CVP	Central Valley Project
DFG	California Department of Fish and Game
DMC	Delta-Mendota Canal
DWR	California Department of Water Resources
EQ	Environmental Quality
FKC	Friant-Kern Canal
GCID	Glenn-Colusa Irrigation District
GRCD	Grassland Resource Conservation District
GWD	Grassland Water District
KCWA	Kern County Water Agency
LHWSD	Lost Hills Water Storage District
MID	Merced Irrigation District
NED	National Economic Development
NWR	National Wildlife Refuge
PID	Pixley Irrigation District
PG&E	Pacific Gas & Electric Company
RCP	Reinforced Concrete Pipe
SLCC	San Luis Canal Company

STWSD	Semitropic Water Storage District
SWRCB	State Water Resources Control Board
TCC	Tehama-Colusa Canal
TDS	Total Dissolved Solids
RECLAMATION	U.S. Bureau of Reclamation
SERVICE or FWS	U.S. Fish and Wildlife Service
WCWUA	Western Canal Water User Association
Western	Western Area Power Administration
WMA	Wildlife Management Area

ATTACHMENT C

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APPENDIX D

RELATED LEGISLATION AND ACTS

This appendix represents only a partial listing of related legislation and programs. A more complete listing will be included in the Refuge Water Supply Planning Report.

LEGISLATION AND PROGRAMS AFFECTING CENTRAL VALLEY HABITAT

This discussion is organized into two major sections. It begins with the laws that affect Central Valley habitat and then looks at programs that present opportunities for improving that habitat.

LEGISLATION AFFECTING CENTRAL VALLEY HABITAT

The following discussion of laws affecting Central Valley waterfowl habitat is divided into Federal and State legislation.

Federal Legislation

The Federal government's authority to develop habitat is based largely on a body of existing Congressional acts that have been approved and amended over the past 55 years. Special acts of Congress and executive orders are other means of acquiring habitat. The following discussion identifies the scope and limitation of each Federal act for providing new and better Central Valley waterfowl habitat.

Federal acts related to developing more waterfowl habitat can be divided generally into funding, acquisition, and assistance authorities. Some acts address more than one authority. Table E-1 presents a summary of the applicable Federal acts and their authorities.

Most of the Congressional acts applicable to this study have been amended many times to accommodate changing priorities in the direction and funding of habitat acquisition. These modifications have changed the original emphasis of some acts. Because of these changes in emphasis, the following act summaries are not arranged in chronological order but begin with those that are most general in authority and set policy and funding structure that other acts depend on.

The Fish and Wildlife Act of 1956 established a comprehensive national fish and wildlife policy and the present USFWS. It directs the Secretary of the Interior to provide continuing research, to provide extension and information services, and to take any necessary steps to develop, manage, protect, and conserve fish and wildlife resources. These steps may include acquiring refuge lands and developing existing facilities.

The general authority established in this act could be used to develop the research necessary in the Central Valley to determine the need for additional habitat. It could also provide the authority to acquire more habitat with the use of Land and Water Conservation Funds or from special appropriations.

with duck stamp receipts in the fund and assigned to the Secretary of the Interior. These funds are used to acquire migratory bird refuges under provisions of the Migratory Bird Conservation Act and to acquire "Waterfowl Production Areas."

Unless the Wetlands Loan Act debt is forgiven,[1] 75 percent of the revenues from duck stamp sales will be used beginning in 1985 to repay the loan. This repayment could drastically reduce the funds available for Federal habitat acquisition under the MBCF.

Funds created by this act could be used to purchase areas of national significance to waterfowl in California. MBCF funds are now used to purchase conservation easements in the Central Valley that protect in perpetuity the wetlands acquired.

The Migratory Bird Conservation Act of 1929 established the Migratory Bird Conservation Commission. This commission approves areas and prices the Secretary of the Interior recommends for acquisition with MBCF funds. However, this act requires that the Secretary of the Interior consult with the appropriate State governments before recommending an area for purchase. Acquisition authority under this act includes rentals and purchase in fee or partial interests (easements). This act also authorizes the Secretary of the Interior to cooperate with local authorities in wildlife conservation as well as to conduct investigations, publish documents related to North American birds, and maintain and develop refuges.

This act also authorizes investigations that could be used in Californi, to assess the need for more habitat. The extent of this need is a key question that requires additional research. With approval from all the required Federal, State, and county governments, more waterfowl habitat could be acquired in the Central Valley under the authority of this act.

The Wetlands Loan Act of 1976 authorizes the appropriation of funds to accelerate the USFWS's land acquisition program for waterfowl. These funds are allocated to the MBCF and are subject for uses authorized under the Migratory Bird Hunting Stamp Act of 1934. This loan is to be repaid to the Treasury beginning in Fiscal Year 1985 with duck stamp revenues from the MBCF. Legislation is currently before Congress that would forgive this loan and extend funding for another 10 years. This legislation is further discussed below under "Federal Management and Improvement Programs."

These new funds could be used to acquire more waterfowl habitat in the Central Valley, but how these funds will be distributed among the States for the purposes authorized by the Migratory Bird Hunting Stamp Act is unknown.

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[1]The Department has submitted draft legislation to the Congress with the suggestion that it be introduced by a member of Congress. H.R. 30823 and S. 1329 would extend the Wetlands Loan Act for 10 years and forgive the repayment of advances made under it. For more information, see "Federal Management and Improvement Programs" below.

Funds authorized for acquisition by this act are not being used now for obtaining new habitat in California; they are being funneled primarily into management projects. Although there is some Federal control over the way States use these funds, the amount of habitat acquired under the authority of this act is largely the State's prerogative.

The Lea Act of 1948 authorizes the acquisition and development of up to 20,000 acres of land in California for the management and control of migratory waterfowl and other wildlife. These activities are carried out with funds appropriated from time to time by Congress. However, funding is contingent upon the State's acquiring equivalent acreage.

Approximately 5,400 acres of waterfowl habitat have been acquired in California under authority of the Lea Act. This authority, however, has not been used recently. Until there is additional need to control waterfowl depredation problems in California and the State agrees to have equivalent acreages, this authority will not be available for acquiring additional habitat.

The National Wildlife Refuge System Administration Act of 1966 expresses Congressional policy and provides guidelines and directives for the administration of all areas of the national wildlife refuge system, including areas for the conservation of fish and wildlife that are threatened with extinction. This act consolidates and expands authorities relating to management of the refuge system and provides sanctions and enforcement provisions to protect its resources. This act also provides the authority to exchange lands, negotiate concession contracts, and other similar activities.

A 1968 amendment provides that proceeds from disposal of lands in the system acquired with Duck Stamp funds or by donation are to be paid into the MBCF and that the Migratory Bird Conservation Commission must be consulted before any land from the refuge system is disposed of. It was amended in 1974 by PL 93-509 to require payment of the fair-market value of rights-of-way or other granted interests, with the proceeds being deposited in the MBCF and made available for land acquisition. It was amended by PL 94-215 to allow the disposal of interests in lands in the system by exchange. Finally, it was amended by PL 94-223 to establish administration and management of the system by the USFWS and to limit disposition of certain refuges except by an act of Congress.

Because this act addresses mainly the policy and administration of the national wildlife refuge system, it does not provide authority to acquire more waterfowl habitat in the Central Valley. It could be used as a funding source for the MBCF, but the amount of money generated from sale of rights-of-way or other interests is insignificant compared with other MBCF sources.

In addition to specific acts of Congress, refuges can be established by means of National Wildlife Refuges Acts in many ways, including withdrawal from public land, transfer from other agencies, cooperative agreement with other agencies, donation, and purchase. The purchases may be made under such authorities as the Fish and Wildlife Act of 1956, the Migratory Bird Conservation Act, the Fish and Wildlife

Coordination Act, and the Endangered Species Act of 1973. Three primary sources of funds for acquiring refuge lands are the MBCF, the Wetlands Loan Act, and the Land and Water Conservation Fund Act.

If the need for more waterfowl habitat can be demonstrated clearly, a special act of Congress establishing additional refuges in the Central Valley may be the most likely avenue for obtaining more habitat. This avenue may be necessary, because all funding sources under existing authorities are now being applied to various programs.

The Refuge Recreation Act of 1962 authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use when such uses do not interfere with the area's primary purpose. It also authorizes the acceptance of donations of funds and real and personal property for purposes of the act. As amended by the Endangered Species Act of 1973, it authorizes the acquisition of lands and interests suitable for either (1) fish and wildlife-oriented recreation, (2) protection of natural resources, (3) conservation of endangered or threatened species, or (4) carrying out two or more of the above. Such lands must be adjacent to or within the conservation area. Acquisition cannot be carried out with MBCF funds; however, funds for acquisition are available from the Land and Water Conservation Fund.

Central Valley National Wildlife Refuges could be expanded under this authority depending on the availability of Land and Water Conservation Funds.

The Land and Water Conservation Fund Act of 1965 created a special fund from various types of revenues such as surplus property sales, motorboat fuel tax, and Treasury appropriations. This act authorizes appropriations from the fund for matching grants to States for outdoor recreation projects and for financing various Federal programs, including the national wildlife refuge system. Acquisition of habitats funded through this act for the refuge system may be authorized by the Endangered Species Act, the Refuge Recreation Act, the Fish and Wildlife Act--except migratory waterfowl areas authorized by the Migratory Bird Conservation Act--and special acts of Congress.

This act will generate funds only through 1989 unless it is reauthorized. Legislation[2] is currently in Congress that will authorize the appropriation of $75 million per year for 10 years from the Land and Water Conservation Fund (LWCF) for habitat acquisition under the Migratory Bird Conservation Act. This transfer of LWCF funds was not previously authorized for this purpose.

If the use of LWCF funds for the Migratory Bird Conservation Act is approved, the authority of this act to acquire more waterfowl habitat will be greatly enhanced. If, however, the transfer of funding is not approved, the most likely way to apply these funds to acquire waterfowl habitat would be through a special act of Congress.

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[2]H.R. 30823 and S. 1329.

The Endangered Species Act of 1973 provides for the conservation of threatened and endangered species of fish, wildlife, and plants. It authorizes an expanded program of habitat acquisition using LWCF resources.

This acquisition authority could be used to acquire habitat for the Aleutian Canada goose[3] within the Central Valley but has not been used for that purpose. The State must be consulted before land can be acquired under the authorization of this act.

The purpose of the Small Reclamation Projects Act of 1956 is to encourage State and local participation in the development of reclamation projects and to provide Federal assistance. It states that the cost of means and measures to prevent loss of and damage to fish and wildlife resources shall be considered a project cost.

Projects under this authority are subject to the review requirements of the Fish and Wildlife Coordination Act, which authorizes habitat acquisition as a potential mitigation source. The acquisition of more habitat than is actually lost from project impacts is, however, unlikely.

The Federal Water Project Reclamation Act of 1965 declares the intent of Congress that recreation and fish and wildlife enhancement shall be fully considered purposes of Federal water-development projects, provided that non-Federal public bodies agree to three conditions. These bodies must (1) bear not more than one-half the separable costs of the project allocated to recreation and exactly three-quarters of such costs allocated to fish and wildlife enhancement, (2) administer project lands and water areas devoted to those purposes, and (3) bear all costs of operation, maintenance, and replacement. Where Federal lands or authorized Federal programs for fish and wildlife conservation are involved, the cost-sharing requirements are exempted.

This act provides for the expenditure of Federal water projects funds for land acquisition needed to establish refuges for migratory waterfowl when recommended by the Secretary of the Interior. It also authorizes the Secretary to provide facilities for outdoor recreation and fish and wildlife at all reservoirs under the Secretary's control, except those within national wildlife refuges.

The provisions of this act do not apply to projects constructed under authority of the Small Reclamation Projects Act or the Watershed Protection and Flood Prevention Act. Waterfowl refuges and habitat have never been purchased in California under the enhancement authority of this act, but they could be if Federal water agencies were directed to do so.

The Water Bank Act of 1970 authorizes the Secretary of Agriculture, in coordination with the Secretary of the Interior, to enter into 10-year contracts with landowners to preserve wetlands and retire adjoining agricultural lands. An

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[3]The Aleutian Canada goose is the only waterfowl species in the Central Valley currently listed as endangered.

annual payment may be made to participating owners, and the costs of conservation measures may be shared. State and county governments must agree to this program before it can be implemented locally.

In California, there is more demand for water bank agreements than can be met with current funds. Further development of waterfowl habitat in California is not possible under this act until additional funds are appropriated.

The Watershed Protection and Flood Prevention Act of 1954 declares a policy of assisting State and local organizations in preventing erosion, flood water, and sediment damages to watersheds and to further "the conservation, development, utilization and disposal of water, and the conservation and utilization of land."

This act authorizes the Secretary of Agriculture to assist local organizations in preparing and carrying out certain improvement works. It also requires that the Secretary of the Interior be notified of approval of assistance so that he "may make surveys and investigations" and recommend measures for "conservation and development of wildlife resources." However, inclusion of such measures in the project are discretionary for the local organization and the Secretary of Agriculture. The Secretary of the Interior must bear the cost of such conservation surveys and reports.

This act does not authorize Federal habitat acquisition but could provide Federal technical assistance to organizations interested in improving waterfowl habitat as part of their watershed protection plan.

The Soil Conservation and Domestic Allotment Act of 1935 provides programs for the prevention of soil erosion such as farm pond construction and establishes the Soil Conservation Service of the Department of Agriculture. As amended, it authorizes the Secretary of the Interior to review applications to the Department of Agriculture for assistance in draining farm wetlands in Minnesota, South Dakota, and North Dakota. Drainage assistance is prohibited if the Secretary finds that a wetland is important to wildlife preservation, if the Secretary or a State agency offers to lease or purchase such wetlands for waterfowl purposes within 1 year, or if a deal is closed within 5 years.

Although this act does not give the Secretary of the Interior any authority to review Department of Agriculture wetland drainage programs in California, it could be used to encourage waterfowl habitat improvements in the Central Valley if these improvements were part of a program to prevent soil erosion.

State Legislation and Policies

The following discussion of State laws and policies begins with the most general laws and policies that lay the groundwork for wildlife preservation and ends with those that more specifically aid in acquiring waterfowl habitat. The laws and policies discussed are:

Public Trust Doctrine

General Environmental and Land Use Laws

California Environmental Quality Act
California Endangered Species Act
Subdivision Map Act
California Land Conservation Act of 1965

Water Use and Water Development Laws

Water Code, Section 1243
Davis-Dolwig Act

Wildlife Habitat Conservation Laws

California Species Preservation Act
Conservation of Wildlife Resources Policy
Native Species Conservation and Enhancement Act
Fish and Wildlife Protection Conservation Policy

Wetland Management Laws

California Coastal Act
McAteer-Petris Act
Suisun Marsh Preservation Act
Keene-Nejedly California Wetlands Preservation Act
Senate Concurrent Resolution 28
California Park and Recreational Facilities Act
Fish and Wildlife Habitat Enhancement Act

Public Trust Doctrine. The Public Trust Doctrine has its roots in English Common Law. In England, the waterways were held in trust by the king for the public. Similarly, the California Constitution[4] provides that navigable waters are held in trust by the State for the people of California. This doctrine establishes generally that the State is legally and morally responsible for protecting, among other things, wetlands.

The State Lands Commission is given the authority by Public Resources Codes Section 6307 to settle land disputes between private and public entities. Both the California Supreme Court and the U.S. Supreme Court have used this doctrine to uphold the importance of preserving wetlands. A recent decision on Mono Lake by the California Supreme Court further strengthened and clarified the importance of the Public Trust Doctrine.

[4]Article X, Section 1 (1879); Article X, Section 3 (1879); Article X, Section 4 (1879); Article I, Section 25 (1910).

General Environmental and Land Use Laws. The following legislation, together wit the Public Trust Doctrine, provides general support for Central Valley fish and wildlife resources, including waterfowl and their habitat.

The purpose of the California Environmental Quality Act (CEQA)[5] is to provide timely information to the public and decision makers concerning the potential environmental impacts of proposed land and water use projects. This act is, in effect, the State's charter for environmental protection.

The effectiveness of CEQA in protecting wetlands varies according to how local communities enforce it and according to the nature of the proposed action. For example, no CEQA process is required when most private wetlands in the Central Valley are converted to agriculture. This act, nevertheless, has substantially benefited waterfowl and their management as well as most other State wildlife resources in two ways. (1) CEQA has made decision makers on land and water use more sensitive to environmental conditions, and (2) it has quickened the reform of planning and decision-making practices. In effect, it has helped to ensure that decision makers and the public take into account the value of fish and wildlife resources.

In 1984, the Legislature passed two amendments to the California Endangered Species Act: AB 3270 and AB 3309. AB 3270 requires that the State Fish and Game Commission establish a procedure for receiving and considering petitions to add or delete a species from the State lists of endangered, threatened, and rare plants and animals. This bill formalizes the petitioning process. It is expected to improve public awareness in this area and to provide consistent procedures throughout th State's endangered species program.

AB 3309 amended the California Endangered Species Act to require that certain State agencies adopt alternatives to a proposed project if the Department of Fish and Game determines that the project would jeopardize the existence of or adversely modify the habitat of an endangered or threatened species. This bill is designed to provide greater protection for endangered and threatened species by requiring more careful and deliberate consideration of the special needs of these species in the environmental review process. The text of the Endangered Species Act is included in Appendix F.

The Subdivision Map Act[6] requires that potential impacts to fish and wildlife habitat be identified before a parcel map can be approved. This legislation was strengthened by the State Attorney General's opinion on May 17, 1985. The opinion stated that if significant adverse environmental effects identified with respect to a tentative map of the subdivision related to the design or proposed improvements of the subdivision, then a local agency may not approve the tentative map.

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[5]Public Resources Code Section 2100 et seq.

[6]Government Code Section 66410 et seq.

The California Land Conservation Act of 1965 (Williamson Act) gives tax breaks to landowners who run commercial operations if they sign a 10-year renewable contract to maintain "agricultural preserves." These areas include open-space lands and wildlife habitat such as waterfowl hunting areas, salt ponds, and submerged areas.

This act encourages land use that favors wildlife, including waterfowl; however, because most wetlands are already taxed at a low rate, the effectiveness of this act is limited.

Water Use and Water Development Laws. The following legislation works primarily to enhance habitat through water resources development.

The Water Code, Section 1243, states that enhancement and protection of fish and wildlife is a beneficial use of water, and that the State Water Resources Control Board is to implement this policy. This policy supplies the foundation for the Davis-Dolwig Act of 1961.

The Davis-Dolwig Act of 1961[7] declares that recreation and fish and wildlife should be given equal consideration with other project purposes in the acquisition of lands for State water projects. This act authorizes the use of State General Funds to fish and wildlife resources as part of projects constructed by California alone or by California in cooperation with the U.S. Government. It supports the acquisition of waterfowl habitat by requiring that planning for fish and wildlife preservation and enhancement be done during the design phase of a project.

Wildlife Habitat Conservation Laws. The following legislation provides support for the conservation of wildlife and their habitat.

The California Species Preservation Act of 1970[8] established the Department of Fish and Game's role in listing rare and endangered species. It states that it is the intent of the Legislature to "preserve, protect, and enhance the birds, mammals, fish, amphibia, and reptiles of the State."

This act has required a report, published under the title At the Crossroads, to the Legislature every 2 years since 1972. To date, however, this act has not been used as a vehicle for habitat acquisition, though habitat loss is identified as a key factor in the decline of wildlife.

The Conservation of Wildlife Resources Policy[9] stems from the Public Trust Doctrine that wildlife are the property of all the people of the State. This policy can be used to preserve wildlife habitat, but it does not outline a specific process for doing so.

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[7] Water Code, Sections 11900-11925.
[8] Fish and Game Code, Sections 900-903, 3511, and 4700, Chapter 1030; AB 2395.
[9] Fish and Game Code, Sections 1800-1801.

The Native Species Conservation and Enhancement Act of 1974[10] declares that it is State policy to maintain habitat needed for the continued existence of wildlife, regardless of the level of economic value of that wildlife. It creates the Native Species Conservation and Enhancement Account to receive donations for the conservation and enhancement of nongame wildlife species and native plant species. No such account, however, was set up for game species such as waterfowl, although an account for game species may be possible.

The Fish and Wildlife Protection and Conservation Policy[11] is a general mandate to protect and conserve fish and wildlife resources. It states:

> The protection and conservation of the fish and wildlife resources of this state are hereby declared to be of utmost public interest. Fish and wildlife are the property of the people and provide a major contribution to the economy of the State as well as providing a significant part of the people's food supply and therefore their conservation is a proper responsibility of the state. . . .

This policy lends general support to any legislation that could call for habitat acquisition for the conservation of fish and wildlife resources.

Wetlands Management Laws. Several acts directly protect California wetlands: the California Coastal Act of 1976, the McAteer-Petris Act of 1969,[12] and the Suisun Marsh Preservation Act. However, they only protect small geographic areas. Nearest to the interests of this report are the declarations of the Suisun Marsh Preservation Act, namely, that the marsh be preserved and protected, that it include nearly 10 percent of the State's remaining natural wetlands, and that it provide habitat for wintering waterfowl and other fish and wildlife.

The Keene-Nejedly California Wetlands Preservation Act of 1976[13] calls for recognition of general marsh resource values. It states that there is a need for an "affirmative and sustained public policy and program directed at their [wetlands] preservation, restoration, and enhancement, in order that such wetlands shall continue in perpetuity." This act was designed to lay the foundation for a statewide wetlands plan and for the purchase of 10 wetlands; however, no funds were allocated. Senate Concurrent Resolution 28 (1978) was intended to regain the momentum this act failed to establish.

Senate Concurrent Resolution No. 28 (SCR 28), Relative to Wetlands, (1979), requested the Department of Fish and Game to prepare a plan that would identify means to protect existing wetlands, to restore former wetlands, and to create new wetlands. Among other items, SCR 28 directed the Department of Fish and Game to identify potential wetland habitat and the means to acquire it with the goal of increasing California's wetlands by 50 percent. The plan was submitted in

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[10]Fish and Game Code, Sections 1750-1763.

[11]Fish and Game Code, Section 1600.

[12]San Francisco Bay Conservation and Development Commission Enabling Act.

[13]Public Resources Code, Sections 5810-5818.

PROGRAMS AFFECTING CENTRAL VALLEY HABITAT

A number of Federal, State, and private programs affect Central Valley waterfowl habitat. Most of these programs have several areas of interest; for example, a program may involve habitat acquisition, management, and research. Table E-2 lists the major programs, together with their areas of interest, that affect Central Valley habitat. Appendix I contains a list of contacts for these programs. Appendix J lists the publications related to the programs.

This discussion categorizes these programs according to their major interest or activity, taking habitat acquisition to be the most important for the purposes of this report. Categories, in order of discussion, include:

Acquisition
Water resource development
Management and improvement
Research
Lobbying

Each of these activities is in turn divided into Federal, State, and, if applicable, private programs.

Habitat Acquisition Programs

The decline in the value of Central Valley lands has created an excellent opportunity to acquire these lands for development back into waterfowl habitat. The following paragraphs describe those Federal, State, and private programs that work primarily to acquire new waterfowl habitat.

Federal Acquisition Programs. Many Federal authorities can be used to acquire more waterfowl habitat in the Central Valley. The majority of these authorities are designed for use by the USFWS in its habitat acquisition programs. The degree to which these authorities can be used for habitat acquisition, however, is determined by the policies of each Federal bureau or department and by the limitations and policies specified in each authority. Authority limitations were pointed out earlier under the discussion of Federal legislation.

USFWS Land Acquisition Policy. The aim of the USFWS land acquisition policy as of August 1982 is to protect lands and waters consistent with legislation, congressional guidelines, and executive orders, for the conservation of fish, wildlife, and plants and their related habitat. This policy includes providing wildlife-oriented public use of these lands and waters as well as educational and recreational uses.

The basic USFWS policy is to acquire interest in land only when other means of achieving program goals and objectives, such as zoning or regulation, are not appropriate, available, or effective. When lands are to be acquired, the minimum

Table E-2. Programs and their areas of interest affecting central valley waterfowl habitat

Program	Interests[a]
FEDERAL PROGRAMS	
Bureau of Reclamation	
Central Valley Project	D
Mid-Valley Canal Project/San Joaquin Conveyance Project	D
San Luis Drain Project	D
West Sacramento Canal Unit	D
Corps of Engineers	
Cache Creek Basin	D
Merced Stream Group	D
Morrison Creek Stream Group	D
Sacramento Riverbank Protection Projects	D
Sacramento-San Joaquin Delta	D
San Francisco-Stockton Ship Channel	D
Department of Agriculture	
Resource Conservation and Development Programs	I
Small Watershed Programs (PL-566)	D,I
Water Bank Program	A,I,T
Department of the Interior	
Preserve Our Wetlands and Duck Resources (POWDR)	I,[b] P,S
Fish and Wildlife Service	
Conservation Easement Program	A
Migratory Bird Wetland Preservation Program	I,P
National Wildlife Refuge Program	C,E,I,M
Use of Agricultural Tile Drain Water for Marsh Management	R
Research Programs	R
Wastewater Availability Study for Wetlands	R
STATE OF CALIFORNIA PROGRAMS	
Bay Conservation and Development Commission	I,M
California Coastal Commission	I,M
Department of Fish and Game	
1981 Duck Club Survey	R
Duck Stamp Program	I,S
Ecological Reserve Program	A,E,I,M
Sacramento-San Joaquin Delta Study[c]	C,R
Region IV Research Programs	R
Senate Concurrent Resolution No. 28	A,P
Waterfowl Group Research Programs	E,R,T
Wildlife Management Area Program	C,E,I,M
Department of Water Resources	
Suisun Marsh Preservation Plan	D,I
Grasslands Water District	
Water Appropriation Program	C,D,L,M
Humboldt State University	
Wildlife Department	R
Resource Conservation Districts	
Suisun and Grasslands Districts Wetland Programs	D,M
Tulare Lake Drainage District	
Drain Water Impoundments	D,I
University of California	
Natural Land and Water Reserves System	A,E,M
Pertinent Studies/Research	R
Wildlife Extension Service	E,I,T
Wildlife Conservation Board	
Acquisition Programs	A,I

November 1983. This plan, entitled A Plan for Protecting, Enhancing, and Increasing California's Wetlands for Waterfowl, is further discussed below under State acquisition programs. SCR 28 and the Department of Fish and Game's plan carry no legal authority; they must be implemented by the Legislature to take effect.

The California Park and Recreational Facilities Act of 1984 (AB 2099), a bond issue, was passed in June 1984. It added a chapter to the Public Resources Code for financing a program of acquiring, developing, or restoring real property for State and local park, beach, recreational, or historical resources preservation. The total bond is for $370 million, of which $5 million is earmarked for acquiring, developing, rehabilitating, or restoring real property for wildlife-oriented public use projects. It may be possible to acquire waterfowl habitat with these funds. A copy of this act is contained in Appendix G.

Along with AB 2099, the Fish and Wildlife Habitat Enhancement Act of 1984 (SB 512) was passed in June 1984. It added sections to the Fish and Game Code that authorize the issuance of bonds totaling $85 million. The funds obtained from the sale of these bonds will be appropriated by the Wildlife Conservation Board and the State Coastal Conservancy to "correct the most severe deficiencies in fish and wildlife habitat currently found in California through a program of acquisition, enhancement, and development of habitat areas that are most in need of proper conservation and management."

Of the $85 million, $30 million is earmarked to acquire and enhance habitat for "wildfowl and other wildlife benefited by a marsh or aquatic environment." In addition, $5 million is earmarked to acquire and enhance lands "for habitat for rare, endangered, and fully protected species."

This total of $35 million is being administered by the Wildlife Conservation Board and holds the greatest potential for acquiring waterfowl habitat. The remaining $50 million will go to restore waterways for the management of fisheries, to manage other wildlife habitat, to acquire coastal zones, to enhance and develop habitat, and to fund local agencies.

As of September 1985, the Wildlife Conservation Board had spent $2.5 million to acquire or develop waterfowl habitat. A copy of the Fish and Wildlife Habitat Enhancement Act is contained in Appendix H.

In addition to the laws and policies discussed above, the California Waterfowl Association has introduced State legislation (SB 493) that would essentially create the State equivalent of the Department of Agriculture's Water Bank Program. One major difference is that the proposed State program would, in addition to requiring an initial 10-year sign-up period, require a 10-year notice before cancellation by the landowner. This legislation, supported by the Department of Fish and Game, is before the Legislature and, if enacted, could become a powerful additional tool to help preserve and enhance Central Valley waterfowl habitat.

Table E-2. Programs and their areas of interest affecting central valley waterfowl habitat, continued

	Interests[a]
OTHER PROGRAMS	
Audubon Society	
Reserve Programs	A,E,I,L,M
California Waterfowl Association	
California Marsh Program	I,L,M,S
Ducks Unlimited	
Waterfowl Habitat Leasing Program	A
John Schulte	
Private Research Projects	R
Nature Conservancy	
California Critical Areas Program	A,E,I,M
Oregon State University	
Department of Fisheries and Wildlife	R
Sacramento Valley Waterfowl Habitat Management Committee	L
Waterfowl Habitat Owners Alliance	L

Key: A--Acquisition, easement, leasing
C--Consumption of waterfowl
D--Water development
E--Education, information
I--Improvement
L--Lobbyist group on wetland/waterfowl issues
M--Management, maintenance
P--Planning
R--Research
S--Cost sharing for improvement
T--Technical assistance in management

[a]For those programs that have two or more areas of interest, the area of interest under which the program is discussed in the text is indicated with an underscore.
[b]In the text, habitat improvement programs have been combined with habitat management programs in a single discussion.
[c]With the USFWS.

interest necessary to reach management objectives is acquired or retained. If fee title is required, full consideration is given to extended-use reservations, exchanges, or other alternatives that will lessen the impact on the owner and the community. Donations of desired lands or interests are encouraged.

To carry out this policy, a Land Protection Plan is developed whenever a land-based solution to a resource protection problem is identified for action by the USFWS. The plans are prepared with public participation and consider the sociocultural impacts of implementation.

To implement the various authorizing acts and congressional mandates, USFWS acquisition units are divided into two land acquisition authorization categories:

1. Specifically Authorized Areas. In those areas specifically authorized by an act of Congress, acquisition is carried out in accordance with the policies prescribed by Congress in the authorizing legislation.

2. Generally Authorized Areas. Acquisitions in areas under general authorities such as the Migratory Bird Conservation Act, Fish and Wildlife Act of 1956, Endangered Species Act, Migratory Bird Hunting and Conservation Stamp Act, and Refuge Recreation Act of 1962 are carried out on a willing-seller basis. However, the USFWS may acquire land through litigation to manage and develop the unit effectively or to prevent uses that would cause irreparable damage to the resources the unit was established to protect. Requests to the solicitor to initiate condemnation will be made only after receiving previous approval from the director and notifying the landowner.

Two major ongoing Federal programs in the Central Valley deal with acquisition by fee, rental, or easement of waterfowl habitat. They are the USFWS Conservation Easement Program and the Department of Agriculture Water Bank Program. These programs are funded by and administered under authority granted by the Migratory Bird Conservation Act and the Water Bank Act.

USFWS Conservation Easement Program. The purpose of the USFWS Conservation Easement Program is to preserve waterfowl habitat by obtaining perpetual easements in key areas identified in the USFWS's Land Protection Plans. Landowners in this program must maintain existing land use conditions and cannot alter their land in any way that is detrimental to waterfowl. Easement payments are based on assessed value of the land.

The USFWS has targeted three major Central Valley areas for its Conservation Easement Program: the Grasslands Area of the San Joaquin Valley (Kauffeld and Loth, 1985), the Butte Sink (USFWS, 1984), and the Colusa Basin (Strong and Helvie, 1985) of the Sacramento Valley. Since 1979, about 26,000 acres have been placed under conservation easements in the western part of the Grasslands Area. Within Butte Sink, about 2,400 acres are now protected, and about 637 acres of existing wetlands are protected in the Colusa Basin.

In August 1985, the USFWS released a plan to acquire about 36,550 acres of waterfowl habitat in the eastern part of the Grasslands Area of Merced County (Kauffeld and Loth, 1985). This plan proposes conservation easements on 30,260 acres of grassland and marshland, and fee title acquisitions on 6,290 acres of grassland, marshland, and cropland. Funding for these acquisitions would come under provisions of the Migratory Bird Conservation Act and the Endangered Species Act. The two areas proposed for fee title acquisition would be managed by the USFWS to complement the Merced and San Luis national wildlife refuges. Easement lands, on the other hand, would continue to be managed by the landowner under terms of the easement documents.

Over the years, much of the East Grasslands has been converted to farmland. The most recent conversions occurred during the late 1970s, when nearly 15,500 acres of waterfowl habitat were lost. Unless the area receives protection, such as the kind provided by implementation of the USFWS's plan, additional acres may be converted to farmland.

Landowners have been expressing a high degree of interest in the USFWS's Conservation Easement Program. For example, from the Colusa Basin alone, about 60 landowners with a total of about 6,000 acres have requested a USFWS easement appraisal. Particularly encouraging is the fact that much of the current landowner interest in easements involves converting agricultural land back to marshland.

Additional easements are being pursued aggressively with available funds. However, current funding levels are inadequate to rapidly meet the easement needs projected for the Central Valley (Kauffeld and Loth, 1985; USFWS, 1984; Strong and Helvie, 1985).

Department of Agriculture Water Bank Program. The objectives of the Department of Agriculture Water Bank Program are to provide wetland and upland habitat for nesting waterfowl, to provide food for waterfowl, and to provide technical assistance in preparing and applying a conservation plan for the landowners in important waterfowl areas. The Agricultural Stabilization and Conservation Service administers funds for cost-sharing in the above activities. Under this program, landowners enter 10-year agreements to maintain their property in a condition determined by the Soil Conservation Service.

State Acquisition Programs. The California Department of Fish and Game is charged with carrying out certain legislatively mandated programs, some of which directly affect wetlands. The California Fish and Wildlife Plan (draft) describes wetlands as a habitat of concern and includes strategies for protecting, maintaining, and acquiring waterfowl habitat.

As described above under the discussion of State legislation, the Department of Fish and Game developed a plan for protecting, enhancing, and increasing California's wetlands for wildlife. This plan, required by SCR 28, was submitted in November 1983.

The plan identifies a formidable array of threats to wetlands and waterfowl and presents a program requiring many legislative actions. The proposed plan calls for acquiring conservation easements, finding new sources of water, using wastewater for waterfowl and wetlands improvement, protecting waste grain for waterfowl, and accelerating wetland and waterfowl research. In addition, the plan suggests new sources of funding, sample proposed legislation, and a list, arranged according to priority, of potential new wetlands for acquisition or development. To take effect, the Legislature must provide funding and implementation. The passage of the Fish and Wildlife Habitat Enhancement Act of 1984 will aid the habitat acquisition portion of this plan.

The Fish and Wildlife Habitat Enhancement Act (see Appendix H) is a major vehicle for acquiring and improving Central Valley waterfowl habitat. This act authorized bonds totaling $85 million, $35 million of which is earmarked for acquiring and improving waterfowl and other wildlife habitat. Under provisions of this act, two significant acquisitions have been approved for funding: (1) about 150 acres adjoining the west side of the Mendota Wildlife Management Area in Fresno County and (2) about 949 acres adjoining the eastern edge of the Mendota Wildlife Management Area. Within the same area, another two acquisitions involving 2,477 acres are also being considered for funding. Because of the relative importance of these acquisitions, they have been described in greater detail in Part IV under "State Resources for Improving Habitat."

The Wildlife Conservation Board, working with the Department of Fish and Game, administers acquisition programs that include acquiring wetlands by purchasing fee titles, by purchasing easements, and by arranging leasing. The goals of these programs are to preserve natural habitat, improve existing lands for wildlife, and develop access to and facilities for hunting and fishing. Funding is obtained from pari-mutuel racing funds, license plate fees, and bond issues, including bonds issued under the Fish and Wildlife Habitat Enhancement Act.

<u>Private Acquisition Programs</u>. Private duck clubs have also acquired, preserved, and managed wetlands for waterfowl in the Central Valley. Of all areas managed for waterfowl, about two-thirds are duck clubs. In 1981, about 137,000 acres of waterfowl habitat were in private ownership (California Department of Fish and Game, 1983).

In addition, local parks and private foundations have acquired habitat for waterfowl. The Nature Conservancy, the Audubon Society, and Ducks Unlimited have purchased land directly, obtained partial interest in land, or leased land to protect wetlands. (See also the discussion of the California Waterfowl Association below under "Private Management and Improvement Programs.")

<u>Nature Conservancy</u>. The Nature Conservancy manages the California Critical Areas Program. The purpose of this program is to identify and protect ecologically endangered lands through acquisition and easements. To date, the Nature Conservancy has acquired wetland, riparian, and upland preserves throughout California that are important to waterfowl and plans to acquire additional areas.

The Nature Conservancy is considering funding a proposal by Farm and Wet Lands Incorporated for the Mokelumne Sink area. The Mokelumne Sink comprises about 11,000 acres of native wetlands, riparian woodlands and forests, and developed farmlands about 20 miles south of Sacramento at the confluence of the Cosumnes and Mokelumne rivers. Although the area already provides habitat of considerable value to waterfowl, particularly during the winter season when some flooding occurs, waterfowl habitat would be significantly improved under the Farm and Wet Lands proposal. The proposal involves both the acquisition of conservation easements and the creation of new waterfowl habitat, including fall-flooded agricultural fields that do not now exist.

Audubon Society. Through its Reserve Programs, the Audubon Society protects the natural diversity and abundance of wildlife and their habitats. The Audubon Society accomplishes its goals through land acquisition, management, lobbying, and litigation. Its preserves in California contain wetland habitat. The society also informs and educates the public about wildlife and environmental issues.

Ducks Unlimited. A private organization established in 1937, Ducks Unlimited has contributed tremendously to improving breeding conditions for waterfowl through its Waterfowl Habitat Leasing Program.

This organization has developed and purchased breeding habitat in Canada and, recently, the United States. California has recently been included in this program, and projects totaling about $0.5 million are scheduled for 1986.

Water Resources Development Programs

The availability of water resources has a profound effect on waterfowl habitat. The following Federal and State programs hold opportunities for enhancing waterfowl habitat through water development projects.

Federal Water Programs. Several Federal agencies are carrying out water development programs in the Central Valley that affect waterfowl habitat: the Bureau of Reclamation, the Army Corps of Engineers, and the Department of Agriculture. Of the various Federal water projects outlined below, only the Cache Creek Basin Project and the Morrison Creek Stream Group Project by the Corps of Engineers appear to have the potential to enhance the Central Valley waterfowl habitat base significantly (rather than merely mitigate for project-caused losses).

Acquisition of Unappropriated Water. During fall, winter, and spring, a significant amount of Sacramento River water remains unappropriated.[14] Various entities have recommended that the USFWS and the California Department of Fish and Game file applications with the State Water Resources Control Board for rights to use portions of this unallocated water to manage public refuges. Such applications have already been initiated by some private entities. For example, near Lambertville, which is adjacent to the Sacramento National Wildlife Refuge, a group of duck-hunting clubs, working through their local irrigation district, recently applied for a firm supply of the surplus water. The application, which was opposed by the Department of Fish and Game because it lacked a fish screen, has not yet been approved. Its approval would establish an important precedent and act as encouragement for future applications.

[14] For additional discussion, refer to the Central Valley Fish and Wildlife Management Study report for Problem B-1.

Bureau of Reclamation. The Bureau of Reclamation is responsible for several Central Valley water projects:

San Luis Drain Project
Mid-Valley Canal Project/San Joaquin Conveyance Project
West Sacramento Canal Unit
Central Valley Project

The purpose of the San Luis Drain Project is to provide an agricultural drainage system as a solution to high water-table and salinity problems in the San Joaquin Valley. Associated with the drain are proposed holding reservoirs that could benefit waterfowl. This project is in the feasibility stage.[15]

The Mid-Valley Canal Project/San Joaquin Conveyance Project is intended to provide agricultural water from the proposed Auburn Dam to service areas between Merced and Pixley. The original plan called for some water appropriations to national wildlife refuges as well as wetland management. This project is in the feasibility stage.

The West Sacramento Canal Unit is intended to provide Sacramento River water to western Sacramento Valley areas, mainly in Yolo and Solano counties. The original plan called for the creation of a 5,900-acre refuge at the mouth of Putah Creek in the Yolo Causeway in Yolo County. The feasibility study for this project has been completed, and the project is currently inactive.

In December 1978, the Secretary of the Interior directed the Bureau of Reclamation to prepare legislation regarding the Central Valley Project that would accomplish the following:

1. Authorize the Federal Central Valley Project to meet State water quality standards.

2. Authorize the relocation of the intake to the Contra Costa Canal.

3. Amend the Central Valley Project's authorization by making fish and wildlife protection specific project purposes and by allowing Central Valley Project water to be provided for fish and wildlife as appropriate on a nonreimbursable basis.

4. Authorize a guaranteed water supply for Central Valley refuges.

5. Establish a Coordinated Operating Agreement for the Central Valley Project and California's State Water Project.

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[15]The San Luis Drain terminates in the Kesterson National Wildlife Refuge reservoir, where high selenium concentrations were discovered to be causing serious reproductive problems in waterfowl. The Kesterson problem has cast the future of the San Luis Drain Project into uncertainty.

Furthermore, the Secretary of the Interior indicated that long-term commitments of interim or intermittent water should not be made until the water needs of the areas of origin and various refuges have been met.

The Bureau of Reclamation did prepare a draft environmental statement in 1980, but no legislation along these lines was ever enacted by Congress.

During mid-1985, the Bureau of Reclamation and Department of Water Resources completed a proposed Coordinated Operating Agreement for the Central Valley Project and State Water Project. The agreement would require negotiations for the exchange and sale of Central Valley Project water to the State Water Project. Congress is acting on this agreement now (Summer 1986). To date, draft legislation meeting the other four of the Secretary of the Interior's 1978 directives has not been prepared.

The Bureau of Reclamation's pursuance of reauthorization of the Central Valley Project (1) to make fish and wildlife protection specific project purposes and (2) to guarantee water supplies for refuges could significantly aid efforts to expand Central Valley waterfowl habitat. However, many roadblocks, problems, and questions still exist in developing necessary legislation. Moreover, the need for new legislation, particularly the reauthorization making fish and wildlife protection specific project purposes, has not yet been agreed to by the entities involved.

The reauthorization of the Central Valley Project according to the Secretary's 1978 directives would certainly benefit Central Valley waterfowl. Nevertheless, because the necessary legislation has still not been prepared, and because there is a debate over the need for such legislation, these important issues may not be resolved for some time.

Corps of Engineers. The Corps of Engineers is carrying out a number of water reclamation projects in the Central Valley. These projects involve the following waterways:

Cache Creek Basin
Merced Stream Group
Morrison Creek Stream Group
Sacramento-San Joaquin Delta
Sacramento Riverbank
San Francisco-Stockton Ship Channel

The purpose of the Cache Creek Basin Project is to provide flood control improvements at Clear Lake and sediment control improvements at the Cache Creek settling basin. In conjunction with the proposed settling basin, the Corps of Engineers and the USFWS are planning a new 3,600-acre wildlife refuge. The Cache Creek Basin Project has been authorized, and construction funding could be available as early as Fiscal Year 1986. The USFWS is evaluating whether this refuge, if created, would be added to the national wildlife refuge system, perhaps for management through the Sacramento National Wildlife Refuge.

The Merced Stream Group Project is intended to provide local flood protection by channelizing streams and creating reservoirs. This project has been authorized, and a USFWS easement is proposed as mitigation for project effects. The easement could perpetuate critical wetlands in the area.

The purpose of the Morrison Creek Stream Group Project is to provide local flood protection by channelizing streams and creating a holding basin. One feature of this project would result in a new wildlife refuge for possible management by the USFWS. The size of this refuge could range from about 2,500 to 7,800 acres, depending on which of the developmental alternatives, if any, is adopted. The Morrison Creek Stream Group Project has been authorized for construction; however, the Corps of Engineers is considering substantial project changes, which may delay the start of construction.

The purpose of the Sacramento-San Joaquin Delta Project is to select a plan for rehabilitating Delta levees to reduce the threat of flooding. A number of fish and wildlife enhancement alternatives have been discussed, including flooding some Delta island areas. The feasibility study for this project has been completed, and the project is currently inactive.

The purpose of the Sacramento River Bank Protection projects is to stabilize the riverbanks. These projects are ongoing, and there has been some discussion of establishing riparian wetland refuges along the river as mitigation for project impacts.

The San Francisco-Stockton Ship Channel Project is intended to remove dredge material from the channel. The dredge material from this ongoing project will be placed on adjacent lands to create upland and wetland habitat.

Department of Agriculture. The Department of Agriculture conducts the Small Watershed Programs (PL-566). These programs, which apply to areas less than 250,000 acres, have a number of purposes. They are intended to:

1. Promote soil and water conservation on public and private lands with the goal of controlling erosion, siltation, and flooding.

2. Supply water for growing domestic and industrial needs.

3. Attract new industries.

4. Provide agricultural water management.

5. Improve fish and wildlife resources.

6. Provide recreation.

7. Recharge groundwater reservoirs.

8. Provide water quality management.

The Soil Conservation Service participates in these programs by providing technical and financial assistance.

State Water Programs. In addition to the State Water Project, which consists of water storage and conveyance facilities being managed or operated by the State, a Federal and State interagency group and various districts are conducting wetland conservation programs.

Suisun Marsh Protection Plan. An interagency group that includes the Department of Water Resources, the Department of Fish and Game, and the Bureau of Reclamation is carrying out the Suisun Marsh Protection Plan. The purpose of this plan is to restore and protect water quality in the Suisun Marsh to levels that are conducive to waterfowl food-plant production.

Resource Conservation Districts. California has many resource conservation districts; however, only the Suisun and Grasslands districts are primarily oriented toward wetlands and waterfowl. Both have a Wetland Program. The purpose of these ongoing programs is to protect and manage wetlands. The programs are carried out with the involvement of private landowners, water districts, the Soil Conservation Service, and other government agencies.

Grasslands Water District. The Grasslands Water District is managing an ongoing Water Appropriation Program. The purpose of this program is to distribute water among the users within the district. Litigation and legislative decisions have allocated cheap Central Valley Project water to the Grasslands Water District that can only be used on duck clubs maintained in native wetland or pasture habitats.

Tax advantages are also available to duck club owners within the Grasslands Water District. The Carpenter Act of 1973 stabilized tax assessments on duck clubs within the Grasslands Water District. This act provides for the assessment of lands as open space when such lands are subject to a "wildlife habitat contract" that restricts use of the lands to wildlife habitat and native pasture. Such lands must be eligible to receive Federal water and must be 150 acres or larger.

Tulare Lake Drainage District. The Tulare Lake Drainage District is developing drain water impoundments in the Tulare Lake Basin. The purpose of these impoundments is to provide agricultural drain water holding reservoirs and evaporation ponds. The district operates approximately 3,200 acres of evaporation ponds, which receive tile drain water and contain water throughout the year. In addition, the district manages flood-water holding facilities, which receive water intermittently during winter. Both areas are used heavily by waterfowl. Future plans of the district include constructing 5,300 additional acres of evaporation ponds.

Habitat Management and Improvement Programs

In addition to acquisition programs and water development programs that create or contribute to new waterfowl habitat, many programs involve managing or improving existing habitat. As Table E-2 shows, most of the programs have various areas of interest. Although some of the following programs may also be involved in habitat acquisition, their primary interest is in habitat management and improvement.

Federal Management and Improvement Programs. The Department of the Interior, the USFWS, and the Department of Agriculture are conducting Federal programs that affect Central Valley waterfowl habitat.

Department of the Interior. The Department has submitted draft legislation to the Congress with the suggestion that it be inroduced by a member of Congress under the name of the POWDR Program (Preserve Our Wetlands and Duck Resources). This program is intended to serve as a focal point for the Administration, Congress, State and local governments, and the private sector to cooperate in developing a comprehensive program to encourage the conservation of wetland and duck resources. The POWDR Program could enhance funding in a number of ways. The legislation introduced before Congress is intended to:

1. Increase revenues in the Migratory Bird Conservation Fund by increasing the cost of the Federal duck stamp to $15 dollars and requiring users of certain national wildlife refuges to purchase entrance permits.

2. Amend the Land and Water Conservation Fund to authorize grants to states for wetlands conservation. The proposed grants would be in an amount equal to three times the amount of a given state's annual duck stamp revenues dedicated to wetlands conservation.

3. Extend the Wetlands Loan Act for 10 years and forgive repayment of advances made under this act, permitting the USFWS to continue using revenues from sales of duck stamps for acquisition of migratory bird habitat.

4. Prohibit the use of Federal tax dollars for subsidizing the drainage and development of wetlands.

Fish and Wildlife Service. The USFWS is administering two ongoing programs that affect Central Valley habitat: the National Wildlife Refuge Program and the Migratory Bird Wetland Preservation Program.

The purpose of the National Wildlife Refuge Program is to provide food and resting areas for migratory birds during the fall and winter. These goals are obtained partly through working to preserve existing waterfowl habitat and controlling the depredation of local croplands. Protecting threatened and endangered species is also a special concern of this program. Another of its objectives is to provide opportunities to the public for bird watching, studying, and hunting.

The purpose of the Migratory Bird Wetland Preservation Program is threefold:

1. To identify, evaluate, and determine the priorities of wintering waterfowl habitat.

2. To determine which areas require Federal involvement for preservation and, if required, the nature of the involvement.

3. To determine what efforts other than acquisition are required for preserving wetlands.

Department of Agriculture. The Department of Agriculture is responsible for the Resource Conservation and Development Programs. These are locally initiated, sponsored, and directed programs that usually include several counties. Their purpose is to conserve and develop natural resources within the project area. Fish and wildlife habitat improvement is commonly carried out under this program. The Soil Conservation Service provides technical and financial help to the projects.

State Management and Improvement Programs. The Department of Fish and Game is the principal State organization responsible for maintaining Central Valley habitat. However, the University of California, the Bay Conservation and Development Commission, and the California Coastal Commission also have programs that affect waterfowl habitat.

Department of Fish and Game. The Department of Fish and Game administers the State's Duck Stamp Program, the Wildlife Management Area Program, and the Ecological Reserve Program.

The purpose of the Duck Stamp Program is to provide a source of funds through the sale of State duck stamps to finance the enhancement of waterfowl breeding and wintering habitat in California and Canada. At least 33 percent of the funds go to Canada, with the balance going to administrative costs and California wetland enhancement. The funds are not being used currently for acquiring wetlands because of the high cost of obtaining lands in fee. However, there are no restrictions on the use of these funds for acquiring wetlands.

The purpose of the Wildlife Management Area Program is to provide food, cover, water, and other habitat requirements to resident and migratory wildlife. This goal includes preserving critical habitat types such as wetlands and uplands. By providing food during fall, the Department of Fish and Game hopes to reduce preharvest crop depredations. This program also provides hunting and other recreational opportunities to the public. Moreover, the areas managed by this program are designed to act as flood control basins during wet years.

The Ecological Reserves Program was developed to protect rare and endangered wildlife, aquatic organisms, and specialized habitat types. This program gives the Department of Fish and Game the authority to acquire land and water and set them aside as ecological reserves. The land may be acquired in any number of ways, including purchasing, leasing, or receiving as a gift.

University of California. The University of California administers the Natural Land and Water Reserves System Program. The purpose of this program is to preserve and manage a cross section of the State's diverse natural habitats to meet the university's teaching and research needs in those disciplines that require field work. As yet, no wetland reserve has been acquired under this program, but such an acquisition is a top priority of the Davis campus.

The University of California also has a Wildlife Extension Service. As part of this service, the university offers training courses in waterfowl and wetland management and advises landowners on how to improve the wildlife value of their property. The Wildlife Extension Service also sponsors research related to waterfowl and their habitat needs.[16]

Bay Conservation and Development Commission. The Bay Conservation and Development Commission was the nation's first coastal management agency. As mentioned above under the discussion of State wetlands management laws, the programs administered by this commission do protect wetlands, but they are limited geographically. Nevertheless, the commission's programs serve as examples of ways to preserve waterfowl habitat.

California Coastal Commission. Like the Bay Conservation and Development Commission, the jurisdiction of the California Coastal Commission lies outside the Central Valley. However, this commission implements the Coastal Act of 1976, which contains some of the best wetland protection policies in existence. Moreover, its Interpretive Guidelines for Wetlands and Other Wet Environmentally Sensitive Habitat Areas has caused these areas to be better managed locally, and its success supports efforts to restore wetlands in the Central Valley.

Private Management and Improvement Programs. The California Waterfowl Association is administering the California Marsh Program, which acts to increase California breeding and wintering habitat by creating new marshes. It accomplishes this goal through agreements with various government agencies. The agencies provide wetland sites, design and engineering work, and operation and maintenance funds; the California Waterfowl Association provides the construction money.

In addition to the Marsh Program, the California Waterfowl Association lobbies to preserve and improve California's marshes by influencing legislation and government agency programs that affect wetlands.

Habitat Research Programs

A number of research projects concerning Central Valley waterfowl and their habitat are being carried out by Federal, State, and private organizations or individuals. Some of these projects are specifically directed toward waterfowl in the Central Valley, while others merely have implications for them. The more important research projects are discussed generally below. Appendix K contains a compilation of particular research project titles and the names of the scientists carrying them out.

Federal Research Programs. The USFWS is the Federal agency most involved in research on waterfowl and their needs. In addition to those research programs listed in Appendix K, the USFWS studied the use of agricultural tile drain water for

[16] These research programs are listed in Appendix K.

marsh management in the San Joaquin Valley and the use of municipal wastewater for developing wetlands. The study of tile drain water involved reviewing the available literature, determining the sufficiency of available data, and recommending specific studies concerning management techniques.

The study of wastewater availability for wetlands was broader in scope: it involved 11 national wildlife refuges, the Butte Sink Area, and the Grasslands Area. Study participants analyzed all existing and available data relating to wastewater supply and use on these 13 Central Valley wetlands.

Several excellent examples showing the utility of municipal wastewater effluent to develop wetland habitat have been completed. For example, near Show Low, Arizona, a 46.9-acre marsh that provides excellent waterfowl habitat was recently created with effluent from a municipal secondary treatment plant. The high value of this newly created habitat was demonstrated by the unusually high density of breeding pairs (4.0 per acre of water surface), the density of nests on islands (121.5 per acre), and the production of ducklings (60.1 per acre of water surface) (Piest and Sowls, 1985).

One of the most recent examples in California of using wastewater to create wetlands is along the San Francisco Bay shoreline near the city of Hayward. Here, the Hayward Marsh Development Plan provides for restoring about 1,800 acres of fresh- and brackish-water marshland, with effluent from secondary treatment plants and seasonal urban storm runoff water as the primary freshwater sources. Although the project has experienced substantial delays because of engineering problems, it is expected to become fully operational soon.

<u>State Research Programs</u>. In 1981, the Department of Fish and Game conducted a duck club survey to identify problems that duck club owners were having with maintaining their wetland habitat. The results of the survey were published and are available through the Wildlife Management Branch of the Department of Fish and Game.

The Department of Fish and Game is carrying out various research programs within its Region IV, which has its headquarters in Fresno and encompasses the surrounding counties. The purpose of these programs is to assess the benefits of current wetland management practices to waterfowl. The study covers the State wildlife management areas within this region. Based upon its assessment, the Department of Fish and Game will identify and implement management practices that will increase the value of wildlife areas to waterfowl.

The Department of Fish and Game's Waterfowl Group conducts surveying, banding, and research assistance programs. The surveying programs document the population trends of waterfowl wintering in California. These surveys reveal the short- and long-term changes in waterfowl distribution. The data are used to develop final annual harvest regulations.

The banding program documents the mortality, movements, distribution, immigration, and emigration of waterfowl in California. The research assistance programs provide financial and logistical support to students and other individuals who are conducting waterfowl research in California.

The Department of Fish and Game also worked with the USFWS on studies of the Sacramento-San Joaquin Delta. These studies documented the wildlife resources of the Delta. Based upon the results of the study, the research group recommended ways to conserve, enhance, and restore these resources.[17]

In addition to the above Department of Fish and Game programs, the Wildlife Department at California State University at Humboldt is conducting basic research on wildlife projects of interest to individual department members.[18]

Private Research Programs. Mr. John Schulte, a veterinarian, and Oregon State University are conducting private research programs related to Central Valley waterfowl.

Mr. Schulte's study, limited to the Sacramento Valley, will determine the effects of weather-related stress on mallards using different types of wetlands. His results will attempt to identify those habitat types that are most valuable to the mallard and thus could be useful in determining Central Valley habitat needs.

Oregon State University's Department of Fisheries and Wildlife is studying the Tulare Lake Basin to determine the use of its wetlands by wintering waterfowl and to correlate this use with invertebrate populations and salinity. Oregon State University is also working with the USFWS to assess drainwater evaporation ponds as waterfowl habitat in the San Joaquin Valley.

Recent Waterfowl Research Developments. Two recent developments involving waterfowl research have implications for the alternative plans outlined in Part III.

Relationships Between Habitat and Waterfowl Populations. the relationships between Central Valley wintering habitat and waterfowl breeding success and survival are not yet well documented. However, it appears probable that strong correlations will be found between each of these population variables and the Central Valley's winter habitat conditions. Recent data for pintails show that their body weights and conditions decline dramatically during dry winters in the Central Valley. During wet winters, however, when wetland habitat is more abundant, the changes are much less significant (Miller, 1985).

[17] These recommendations were outlined in the Department of Fish and Game report entitled Sacramento/San Joaquin Delta Wildlife Habitat Protection and Restoration Plan.

[18] Dr. R. Botzler: "Avian Cholera and Lead Interaction in Waterfowl Using the Sacramento Valley"; Dr. S. W. Harris: "Food Habits of Waterfowl in the San Joaquin Valley."

In addition, parallels to the Central Valley can be drawn from an ecologically similar situation in Mississippi Flyway wintering areas. In the Mississippi Flyway, a strong correlation between wintering-ground conditions and mallard repoductive rates has been known for some time (Heitmeyer and Fredrickson, 1981). Moreover, biologists have just recently reported for this species a probable link between wintering grounds and survival rate (Nichols et al., 1985). The senior author of the report dealing with mallards in the Mississippi Flyway is conducting similar research on Central Valley waterfowl species.

Small, Intensively Managed Wetland Units. The California Waterfowl Association and the Department of Fish and Game have recently begun a research study, with funding from State Duck Stamp revenues, of waterfowl nesting productivity on California's Grizzly Island Wildlife Management Area.

The objective of the study is to test the hypothesis that small but very intensively managed wetland units can substantially increase waterfowl nesting productivity in California. The theory includes three basic principles: (1) use relatively small areas to provide high-quality nesting cover, (2) exclude predators, and (3) provide high-quality brood ponds. The application of this concept elsewhere has increased densities of nesting mallards from about 15 to 500 per square mile. Similar results in the Central Valley might enable managers to increase fall and winter populations of certain species substantially, especially mallards.

The initial test in 1985 of the high-density breeding concept at Grizzly Island produced extremely encouraging results, recording nest densities of about 1.0 per acre. The experience will be expanded into the Sacramento Valley during 1986, probably at the State's Gray Lodge Wildlife Management Area.

If the high-density breeding concept gains widespread acceptance and use, future conflicts could arise between managing Central Valley wetlands for production versus wintering habitat. Care will be needed to maintain a balanced program.

Lobbying Organizations

Many of the private organizations discussed above include lobbying as one of their interests, although not a primary one. At least three organizations, however, are primarily interested in lobbying: the Waterfowl Habitat Owners Alliance, the Sacramento Valley Waterfowl Habitat Management Committee, and the California Waterfowl Association.

The Waterfowl Habitat Owners Alliance is a nationwide lobbying group interested in the preservation and management of waterfowl habitat. The Sacramento Valley Waterfowl Habitat Management Committee is interested in providing guidance and recommendations to the USFWS, the Department of Fish and Game, legislators, and other committees concerning the management and needs of Sacramento Valley wetlands. The California Waterfowl Association lobbies to preserve and protect key wetlands by influencing legislation and government agency programs.

SECTION 1. Article 1 (commencing with Section 900) of Chapter 3 of Division 2 of the Fish and Game Code is repealed.

SEC. 2. The heading of Article 1.5 (commencing with Section 1000) of Chapter 3 of Division 2 of the Fish and Game Code is amended and renumbered to read:

Article 1. Generally

SEC. 3. Section 1902 of the Fish and Game Code is repealed.

SEC. 4. Section 1903 of the Fish and Game Code is repealed.

SEC. 5. Chapter 1.5 (commencing with Section 2050) of Division 3 of the Fish and Game Code, as added by Chapter 1510 of the Statutes of 1970, is repealed.

SEC. 6. Chapter 1.5 (commencing with Section 2060) is added to Division 3 of the Fish and Game Code, to read:

CHAPTER 1.5. ENDANGERED SPECIES

Article 1. General Provisions

2050. This chapter shall be known and may be cited as the California Endangered Species Act.

2051. The Legislature hereby finds and declares all of the following:

(a) Certain species of fish, wildlife, and plants have been rendered extinct as a consequence of man's activities, untempered by adequate concern and conservation.

(b) Other species of fish, wildlife, and plants are in danger of, or threatened with, extinction because their habitats are threatened with destruction, adverse modification, or severe curtailment, or because of overexploitation, disease, predation, or other factors.

(c) These species of fish, wildlife, and plants are of ecological, educational, historical, recreational, esthetic, economic, and scientific value to the people of this state, and the conservation, protection, and enhancement of these species and their habitat is of statewide concern.

2052. The Legislature further finds and declares that it is the policy of the state to conserve, protect, restore, and enhance any endangered species or any threatened species and its habitat and that it is the intent of the Legislature, consistent with conserving the species, to acquire lands for habitat for these species.

2053. The Legislature further finds and declares that it is the policy of the state that state agencies should not approve projects as proposed which would jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat essential to the continued existence of those species, if there are reasonable and prudent alternatives available consistent with conserving the species or its habitat which would prevent jeopardy.

Furthermore, it is the policy of this state and the intent of the Legislature that reasonable and prudent alternatives shall be developed by the department, together with the project proponent and the state lead agency, consistent with conserving the species, while at the same time maintaining the project purpose to the greatest extent possible.

2054. The Legislature further finds and declares that, in the event specific economic, social, or other conditions make infeasible such alternatives, individual projects may be approved if appropriate mitigation and enhancement measures are provided.

2055. The Legislature further finds and declares that it is the policy of this state that all state agencies, boards, and commissions shall seek to conserve endangered species and threatened species and shall utilize their authority in furtherance of the purposes of this chapter.

2056. The Legislature further finds and declares that the cooperation of the owners of land which is identified as habitat for endangered species and threatened species is essential for the conservation of those species and that it is the policy of this state to foster and encourage such cooperation in furtherance of the purposes of this chapter.

2060. The definitions in this article govern the construction of this chapter.

2061. "Conserve," "conserving," and "conservation" mean to use, and the use of, all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary. These methods and procedures include, but are not limited to, all activities associated with scientific resources management, such as research, census, law enforcement, habitat acquisition, restoration and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

2062. "Endangered species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease. Any species determined by the commission as "endangered" on or before January 1, 1985, is an "endangered species."

2063. "Feasible" means feasible as defined in Section 21061.1 of the Public Resources Code.

2064. "Project" means project as defined in Section 21065 of the Public Resources Code.

2065. "State lead agency" means the state agency, board, or commission which is a lead agency under the California Environmental Quality Act (Division 13 (commencing with Sec. 21000) of the Public Resources Code).

2067. "Threatened species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by this chapter. Any animal determined by the commission as "rare" on or before January 1, 1985, is a "threatened species."

2068. "Candidate species" means a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that the commission has formally noticed as being under review by the department for addition to either the list of endangered species or the list of threatened species, or a species for which the commission has published a notice of proposed regulation to add the species to either list.

Article 2. Listing of Endangered Species

2070. The commission shall establish a list of endangered species and a list of threatened species. The commission shall add or remove species from either list if it finds, upon the receipt of sufficient scientific information pursuant to this article, that the action is warranted.

2071. The commission shall adopt guidelines by which an interested person may petition the commission to add a species to, or to remove a species from either the list of endangered or the list of threatened species.

2071.5. The department shall recommend, and the commission shall adopt, criteria for determining if a species is endangered or threatened.

2072. The petition shall be written, shall be clearly identified as a petition, and shall clearly indicate the administrative measure recommended.

2072.3. To be accepted, a petition shall, at a minimum, include sufficient scientific information that a petitioned action may be warranted. Petitions shall include information regarding the population trend, range, distribution, abundance, and life history of a species, the factors affecting the ability of the population to survive and reproduce, the degree and immediacy of the threat, the impact of existing management efforts, suggestions for future management, and the availability and sources of information. The petition shall also include information regarding the kind of habitat necessary for species survival, a detailed distribution map, and any other factors that the petitioner deems relevant.

2072.7. The department may, in the absence of a petition from an interested party, recommend to the commission that it add a species to, or remove a species from, either the list of endangered species or the list of threatened species. If it makes a recommendation under this section, the department shall include the information specified in Section 2072.3. A department recommendation under this section shall be considered by the commission as a petition with a departmental recommendation to accept and consider as described in subdivision (b) of Section 2073.5, and is subject to Sections 2074 to 2079, inclusive.

2073. Within 10 days of the receipt of a petition from an interested person under Section 2072.3, the commission shall refer the petition to the department.

[2073.5 Within 90 days, the department shall evaluate]
the petition, and report one of the following recommendations to the commission:

(a) Based upon the information contained in the petition, there is not sufficient information to indicate that the petitioned action may be warranted, and the petition should be rejected.

(b) Based upon the information contained in the petition, there is sufficient information to indicate that the petitioned action may be warranted, and the petition should be accepted and considered.

2074. The commission shall schedule the petition for consideration at its next available meeting and distribute its pending agenda to interested persons pursuant to Section 2078. The commission shall also make the petition available for review upon request.

2074.2. (a) At the scheduled meeting, the commission shall consider the petition, the department's written report, and comments received, and the commission shall make and enter in its public record one of the following findings:

(1) If the commission finds that the petition does not provide sufficient information to indicate that the petitioned action may be warranted, the commission shall publish a notice of finding that the petition is rejected, including the reasons why the petition is not sufficient.

(2) If the commission finds that the petition provides sufficient information to indicate that the petitioned action may be warranted, the commission shall publish a notice of finding that the petition is accepted for consideration. If the accepted petition recommends the addition of a species to either the list of endangered species or the list of threatened species, the commission shall include in the notice that the petitioned species is a candidate species. The commission shall maintain a list of species which are candidate species.

(b) The commission shall distribute the findings relating to the petition pursuant to Section 2078.

2074.4. If a petition is accepted by the commission for consideration, all reasonable attempts shall be made to notify affected and interested parties and to solicit data and comments on the petitioned action from as many persons as is practicable. In addition to commission efforts to provide notification through distribution of the commission agenda and minutes pursuant to Section 2078, the department shall immediately undertake efforts to notify affected and interested parties. Methods of notification may include, but are not limited to, correspondence, newspaper notices, and press releases, and notification shall include notice to owners of that land which may provide habitat essential to the continued existence of the species, unless the director determines that ownership is so widespread, fragmented, or complex as to make individual notice impractical.

2074.6. The department shall promptly commence a review of the status of the species concerned in the petition. Within 12 months of the date of publication of a notice of acceptance of a petition for consideration by the commission pursuant to paragraph (2) of subdivision (a) of Section 2074.2, the department shall provide a written report to the commission, based upon the best scientific information available to the department, which indicates whether the petitioned action is warranted, which includes a preliminary identification of the habitat that may be essential to the continued existence of the species, and which recommends management activities and other recommendations for recovery of the species.

2074.8. Nothing in this article imposes any duty or obligation for, or otherwise requires, the commission or the department to undertake independent studies or other assessments of any species when reviewing a petition and its attendant documents and comments.

2075. The commission shall schedule the petition for final consideration at its next available meeting after receipt of the departmental report provided pursuant to Section 2074.6 and shall distribute the pending agenda for that meeting pursuant to Section 2078. The commission shall make the department's report, or copies thereof, which was provided, pursuant to Section 2074.6, available for review upon request.

2075.5. At the meeting scheduled pursuant to Section 2075, the commission shall make one of the following findings:

(1) The petitioned action is not warranted, in which case the finding shall be entered in the public records of the commission and the petitioned species shall be removed from the list of candidate species maintained pursuant to Section 2074.2.

(2) The petitioned action is warranted, in which case the commission shall publish a notice of that finding and a notice of proposed rulemaking pursuant to Section 11346.4 of the Government Code to add the species to, or remove the species from, the list of endangered species or the list of threatened species. Further proceedings of the commission on the petitioned action shall be made in accordance with Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code.

2076. Any finding pursuant to this section is subject to judicial review under Section 1094.5 of the Code of Civil Procedure.

2076.5. Notwithstanding Sections 2071 to 2075.5, inclusive, the commission may adopt a regulation which adds a species to the list of endangered species or to the list of threatened species as an emergency regulation pursuant to Article 1.5 (commencing with Section 240) to Chapter 2 of Division 1 if the commission finds that there is any emergency posing a significant threat to the continued existence of the species. The commission shall notify affected or interested persons of the adoption of such an emergency regulation pursuant to the methods described in Section 2074.4.

2077. (a) The department shall review species listed as an endangered species or as a threatened species every five years to determine if the conditions that led to the original listing are still present. The review shall be conducted based on information which is consistent with the information specified in Section 2072.3 and which is the best scientific information available to the department. The review shall include a review of the identification of the habitat that may be essential to the continued existence of the species and the department's recommendations for management activities and other recommendations for recovery of the species. The department shall notify any person who has notified the commission, in writing with their address, of their interest, and the department may notify any other person.

(b) Review of species that are listed by both the commission and the United States Department of Interior will be conducted in conjunction with the five-year review process of the United States Department of Interior.

(c) Initial review of those species listed by the commission before January 1, 1982, that are not listed by the federal government shall be undertaken and completed by July 1, 1987. Initial review of those species listed by the commission after January 1, 1982, that are not listed by the federal government shall be undertaken and completed within five years of the date the species was originally listed by the commission.

(d) Notwithstanding any other provision of this section, the commission or the department may review a species at any time based upon a petition or upon other data available to the department and the commission.

(e) The department shall report in writing to the commission the results of its five-year review for each listed species. The commission shall treat any report of the department under this subdivision which contains a recommendation to add a species to, or remove a species from, the list of endangered species or the list of threatened species as a department recommendation submitted pursuant to Section 2072.7.

2078. To provide all interested persons access to information and notification of pending listing or delisting actions, the commission shall distribute the related agenda of pending actions and those portions of its minutes of actions taken under this article to any individuals who have notified the commission, in writing with their address, of their interest. This notification shall meet the requirements of public notice as required for commission action under Section 2074, 2074.2, 2075, or 2077.

2079. The department shall, by January 30 of each year, beginning January 30, 1986, prepare a report summarizing the status of all state listed endangered, threatened, and candidate species, and shall submit the report to the commission, the Legislature, the Governor, and all individuals who have notified the commission, in writing with their address, of their interest. This report shall include, but not be limited to, a listing of those species designated as endangered, threatened, and candidate species, a discussion of the current status of endangered, threatened, or candidate species, and the time frames for the review of listed species pursuant to this article.

2084. The commission may authorize, subject to terms and conditions it prescribes, the taking of any candidate species, or the taking of any fish by hook and line for sport that is listed as an endangered, threatened, or candidate species.

2085. The provisions of this article shall apply to any species designated as a candidate species under Section 2074.2 if notice has been given pursuant to Section 2074.4.

Article 3. Taking, Importation, or Sale

2080. No person shall import into this state, export out of this state, or take, possess, purchase, or sell within this state, any species, or any part or product thereof, that the commission determines to be an endangered species or a threatened species, or attempt any of those acts, except as otherwise provided in this chapter, the Native Plant Protection Act (Chapter 10 (commencing with Section 1900) of this code), or in the California Desert Native Plants Act (Division 23 (commencing with Section 70500) of the Food and Agricultural Code).

2081. Through permits or memorandums of understanding, the department may authorize individuals, public agencies, universities, zoological gardens, and scientific or educational institutions, to import, export, take, or possess any endangered species, threatened species, or candidate species for scientific, educational, or management purposes.

2082. This chapter does not prohibit the sale of any endangered species or threatened species, or any part or product thereof, when the owner can demonstrate that the species, or part or product thereof, was in the person's possession before the date upon which the commission listed the species as an endangered species or threatened species or as an endangered animal or rare animal prior to January 1, 1985, and shall not prohibit the sale of that part or product by an individual not normally engaged in that sale if it was originally possessed by the seller for the seller's own use and so used by that seller. However, it shall be unlawful to sell any species, or part or product thereof, if that sale would have been unlawful prior to the date upon which the commission added the species to the listing of endangered species or threatened species or to the listing of endangered animals or rare animals prior to January 1, 1985.

2083. This chapter does not apply to the taking of fish otherwise authorized pursuant to Part 3 (commencing with Section 7600) of Division 6 or to the possession of individual animals which were lawfully possessed before the commission listed the species as an endangered species or as a threatened species or as an endangered animal or rare animal prior to January 1, 1985.

2092. (a) Notwithstanding Section 21081 of the Public Resources Code, if, after consulting with the department pursuant to Section 2090, jeopardy is found, the state lead agency shall require reasonable and prudent alternatives consistent with conserving the species which would prevent jeopardy.

(b) If specific economic, social, or other conditions make infeasible the alternatives prescribed in subdivision (a), except as provided in subdivision (c), the state lead agency may approve a project when jeopardy is found, if both of the following conditions are met:

(1) The state lead agency requires reasonable mitigation and enhancement measures as are necessary and appropriate to minimize the adverse impacts of the project upon the endangered species or threatened species, or habitat essential to the continued existence of the species, including, but not limited to, live propagation, transplantation, and habitat acquisition, restoration, and improvement.

(2) The state lead agency finds all of the following:

(A) The benefits of the project as proposed clearly outweigh the benefits of the project were it to be carried out with the reasonable and prudent alternatives consistent with conserving the species which would prevent jeopardy.

(B) An irreversible or irretrievable commitment made after initiation of consultation required pursuant to Section 2090, of resources to the project, which has the effect of foreclosing the opportunity for formulating and implementing reasonable and prudent alternatives consistent with conserving the species which prevent jeopardy, has not been made.

(c) A state lead agency shall not approve a project which would likely result in the extinction of any endangered species or threatened species. The state lead agency shall base its determination on the best existing scientific information.

2093. In order to encourage resolution of potential conflicts as early as possible, the department shall, through guidelines, provide a mechanism for informal consultation prior to a determination pursuant to Section 21080.1 of the Public Resources Code.

2094. At the request of a project applicant, the applicant shall be afforded the opportunity to participate fully in the consultation under this article.

2095. If a project may affect species that are listed as threatened or endangered under both this chapter and the federal Endangered Species Act (16 U.S.C. Sec. 1531 et seq.), and if the project is subject to state lead agency actions pursuant to the provisions of the California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) and actions of a federal agency action pursuant to the federal Endangered Species Act (16 U.S.C. Sec. 1531 et seq.), the department shall participate to the greatest extent practicable in the federal consultation.

The Legislature encourages cooperative and simultaneous consultation by every state lead agency in order to develop a coordinated federal Biological Opinion that reflects consistent and compatible findings between state and federal agencies. Whenever possible, the department, consistent with this act, shall adopt a federal Biological Opinion as the written findings required pursuant to Section 2090.

Whenever the department has reason to believe that a project may affect species that are listed as threatened and endangered under both this chapter and the federal Endangered Species Act (16 U.S.C. Sec. 1531 et seq.), and if the project is subject to state lead agency actions pursuant to the provisions of the California Environmental Quality Act (Division 13 (commencing with Section 21000 of the Public Resources Code) and actions of a federal agency action pursuant to the federal Endangered Species Act (16 U.S.C. Sec. 1531, et seq.), the department shall request the United States Department of the Interior, Fish and Wildlife Service or the National Marine Fisheries Service, whichever is appropriate, to initiate consultation pursuant to the federal Endangered Species Act (16 U.S.C. Sec. 1531 et seq.).

2096. The provisions of this article do not apply to any species designated as a candidate species under Section 2074.2. However, upon a request from a lead agency or a project proponent, the department shall grant an informal consultation on any proposed project which may affect a candidate species. It is the intent of the Legislature to facilitate the resolution of potential conflicts between candidate species and proposed projects on the basis of information available at the time, and not to require the alteration of project processing schedules pending final determination of the status of any candidate species.

2097. This article shall remain in effect only until July 1, 1987, and as of that date is repealed, unless a later enacted statute, which is chaptered before July 1, 1987, deletes or extends that date.

Article 5. Funding

2098. The department shall pay the costs of administration of this chapter from the Endangered and Rare Fish, Wildlife, and Plant Species Conservation and Enhancement Account in the Fish and Game Preservation Fund.

SEC. 3. Section 21104.2 is added to the Public Resources Code, to read:

21104.2. The state lead agency shall consult with, and obtain written findings from, the Department of Fish and Game in preparing an environmental impact report on a project, as to the impact of the project on the continued existence of any endangered species or threatened species pursuant to Article 4 (commencing with Section 2090) of Chapter 1.5 of Division 3 of the Fish and Game Code.

SEC. 4. No appropriation is made and no reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution or Section 2231 or 2234 of the Revenue and Taxation Code because the only costs which may be incurred by a local agency or school district will be incurred because this act creates a new crime or infraction, changes the definition of a crime or infraction, changes the penalty for a crime or infraction, or eliminates a crime or infraction.

SEC. 5. It is the intent of the Legislature, if this bill and AB 3270 are both chaptered and become effective January 1, 1985, and this bill is chaptered after AB 3270, that the provisions of Chapter 1.5 (commencing with Section 2050), as added to Division 3 of the Fish and Game Code by this bill and Chapter 1.5 (commencing with Section 2060), as added to Division 3 of the Fish and Game Code by AB 3270, form a single, unified California Endangered Species Act (Chapter 1.5 (commencing with Section 2050), Division 3, Fish and Game Code).

Therefore, if both this bill and AB 3270 are chaptered and this bill is chaptered last, this bill does not prevail over AB 3270 and the provisions of both bills shall become operative in a single, unified Chapter 1.5 (commencing with Section 2050) of Division 3 of the Fish and Game Code.

CHAPTER ______

An act to add Chapter 7 (commencing with Section 2600) to Division 3 of the Fish and Game Code, relating to financing of a fish and wildlife habitat enhancement program by providing the funds necessary therefor through the issuance and sale of bonds of the state, by providing for the handling and disposition of the funds, and by providing for the submission of the measure to a vote of the people, and declaring the urgency thereof, to take effect immediately.

LEGISLATIVE COUNSEL'S DIGEST

SB 512, Hart. Fish and wildlife habitat enhancement: bond issue.

Existing law states that it is the policy of the state to encourage the conservation and maintenance of wildlife resources under the jurisdiction and influence of the state. The policy also includes specified objectives.

This bill would enact the Fish and Wildlife Habitat Enhancement Act of 1984, which, if adopted, would authorize the issuance, pursuant to the State General Obligation Bond Law, of bonds in the amount of $85,000,000. The funds generated from the bond sale would be available for appropriation to the Wildlife Conservation Board and the State Coastal Conservancy for specified purposes according to specified schedules. The bill would provide for submission of the bond act to the voters at the June 5, 1984, Direct Primary Election.

The bill would take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. Chapter 7 (commencing with Section 2600) is added to Division 3 of the Fish and Game Code, to read:

CHAPTER 7. FISH AND WILDLIFE HABITAT ENHANCEMENT ACT OF 1984

Article 1. General Provisions

2600. This chapter shall be known and may be cited as the Fish and Wildlife Habitat Enhancement Act of 1984.

2601. (a) The fundamental requirement for healthy, vigorous populations of fish and wildlife is habitat. Without adequate habitat, efforts to conserve and manage fish and wildlife resources will have limited success.

(b) Assuring adequate habitat, with the resulting increase in the abundance of fish and wildlife, confers substantial benefits on the people of California through the opportunities afforded for the use, enjoyment, and appreciation of fish and wildlife resources, the perpetuation of species of fish and wildlife for their intrinsic and ecological values, and the enhancement of economic activities based on these resources.

(c) Accordingly, the purpose of this chapter is to provide the financial means to correct the most severe deficiencies in fish and wildlife habitat currently found in California through a program of acquisition, enhancement, and development of habitat areas that are most in need of proper conservation and management.

2602. As used in this chapter, the following terms have the following meanings:

(a) "Acquisition" means the acquisition of any interest in real property.

(b) "Coastal zone" means the coastal zone as defined and mapped pursuant to Section 30103 of the Public Resources Code.

(c) "Local public agency" means a city, county, city and county, regional park or open-space district, recreation and park district, resource conservation district, association of governments, or joint powers agency whose jurisdiction is wholly or partially within the coastal zone or in the San Francisco Bay region.

Article 2. Habitat Enhancement Program

2620. All money deposited in the Fish and Wildlife Habitat Enhancement Fund shall be available for appropriation by the Legislature for the following purposes:

(a) Forty million dollars ($40,000,000) for expenditure by the Wildlife Conservation Board pursuant to the Wildlife Conservation Law of 1947 for the acquisition, enhancement, or development, or any combination thereof, of lands located outside the coastal zone for the preservation of resources and the management of wildlife and fisheries, in accordance with the following schedule:

(1) Thirty million dollars ($30,000,000) for the acquisition, enhancement, or development, or any combination thereof, of lands for habitat for wildfowl and other wildlife benefitted by a marsh or aquatic environment.

(2) Ten million dollars ($10,000,000) for the restoration of waterways for the management of fisheries and the enhancement or development, or both, of habitat for other wildlife.

(b) Five million dollars ($5,000,000) for expenditure by the Wildlife Conservation Board pursuant to the Wildlife Conservation Law of 1947 for the acquisition, enhancement, or development, or any combination thereof, of lands for habitat for rare, endangered, and fully protected species.

(c) Thirty million dollars ($30,000,000) for expenditure by the State Coastal Conservancy for the acquisition, enhancement, or development, or any combination thereof, of marshlands and associated and adjacent lands and the development of associated facilities and for grants to local public agencies for those purposes, in accordance with the following schedule:

(1) Twenty million dollars ($20,000,000) for grants by the conservancy to local public agencies in the coastal zone and in the San Francisco Bay region for the acquisition, enhancement, or development, or any combination thereof of marshlands and adjacent lands for habitat for wildlife benefitted by a marsh or aquatic environment and the improvement of drainage into wetlands to control or retard erosion and sedimentation, and biologically and hydrologically associated upland habitat areas. Of the amount made available pursuant to this paragraph, not less than five million dollars ($5,000,000) shall be available for grants for projects in the San Francisco Bay region.

(2) Ten million dollars ($10,000,000) for expenditure by the conservancy for the purposes authorized in this subdivision.

(d) Ten million dollars ($10,000,000) for expenditure by the Wildlife Conservation Board pursuant to the Wildlife Conservation Law of 1947 for the acquisition, enhancement, or development, or any combination thereof, inside the coastal zone of marshlands and adjacent lands for habitat for wildlife benefitted by a marsh or aquatic environment.

2621. An annual amount, not to exceed one hundred thousand dollars ($100,000), may be appropriated from the funds available pursuant to subdivisions (a) and (d) of Section 2620 in the 1984–85 through 1989–90 fiscal years, in a particular amount to be determined in each annual appropriation, to the Wildlife Conservation Board for expenditure for costs incurred by the board in administering this chapter, as provided in this section. The board shall augment, as needed, any amount appropriated pursuant to this section with an appropriation from any other funds available to it. This chapter is not intended, nor shall it be construed, to authorize the Wildlife Conservation Board or the department to establish any additional personnel positions.

2622. An annual amount, not to exceed two hundred fifty thousand dollars ($250,000), may be appropriated from the funds available pursuant to subdivision (c) of Section 2620 in the 1984–85 through 1989–90 fiscal years, in a particular amount to be determined in each annual appropriation, to the State Coastal Conservancy for expenditure for costs incurred by the conservancy in administering this chapter.

CENTRAL VALLEY WATERFOWL BIOLOGY

This discussion of Central Valley waterfowl biology is organized into two parts. The first part identifies the major waterfowl species found in the valley, including several that are considered unique because of their declining populations. The second part discusses the factors known to be limiting Central Valley waterfowl populations.

MAJOR CENTRAL VALLEY WATERFOWL SPECIES

Table C-1 lists the waterfowl most common in the California Central Valley. The most important[1] species are gadwalls, mallards, pintails, shovelers, green-winged teal, American wigeon, several species of Canada geese, Pacific greater white-fronted geese, Ross' geese, lesser snow geese, and tundra swans. Ring-necked ducks and wood ducks are also present in significant numbers. Buffleheads, common goldeneyes, mergansers, lesser scaup, redheads, and cinnamon teal are also present and recorded in population surveys in the Central Valley. However, valley population levels of these species are relatively low, making up only small fractions of the Continental Flyway and Pacific Flyway populations. No trends in numbers have been determined.

Most wintering waterfowl flocks in the Central Valley are not confined to any specific area throughout the fall and winter. They move among the wetlands of the Sacramento and San Joaquin valleys, the Delta, and the Suisun Marsh in response to weather changes, water conditions, food availability, and season. Although some distinct patterns have been recorded, these movements are largely unpredictable. Distribution and movement often change significantly during very wet years when the amount of habitat increases significantly because of flooding and ponding on agricultural lands and in flood bypasses.

Population data for Central Valley waterfowl are compiled from mid-September prehunting season surveys, biweekly surveys during the hunting season, and a January midwinter survey. Data are compiled separately for some organized duck clubs and agricultural areas. Counts are made of waterfowl on each Federal national wildlife refuge and State wildlife management area. Counts are also made of concentrations on several reservoirs in the Sierra Nevada foothills and the Coast Ranges.

[1] Importance measured in terms of numbers, impact on the environment, contribution to annual hunting harvests, and interest to nonconsumptive users such as bird watchers.

Table C-1. Major Central Valley waterfowl species

Coot

American (*Fulica americana*)

Ducks

Bufflehead (*Bucephala albeola*)
Canvasback (*Aythya valisineria*)
Gadwall (*Anas strepera*)
Goldeneye, Common (*Bucephala clangula*)
Mallard (*Anas platyrhynchos*)
Merganser
  Common (*Mergus merganser*)
  Hooded (*Lophodytes cucullatus*)
  Red-breasted (*Mergus serrator*)
Pintail, Northern (*Anas acuta*)
Redhead (*Aythya americana*)
Ring-necked Duck (*Aythya collaris*)
Ruddy Duck (*Oxyura jamaicensis*)
Scaup:
  Greater (*Aythya marila*)
  Lesser (*Aythya affinis*)
Shoveler, Northern (*Anas clypeata*)
Teal:
  Cinnamon (*Anas cyanoptera*)
  Green-winged (*Anas crecca*)
Wigeon, American (*Anas americana*)
Wood Duck (*Aix sponsa*)

Geese

Canada (*Branta canadensis*)[a]
Greater white-fronted (*Anser albifrons*)
Ross' (*Chen rossii*)
Snow, Lesser (*Chen caerulescens*)

Swan

Tundra (*Cygnus columbianus*)

[a]The Aleutian Canada goose is classified as an endangered species. Almost the entire population of this species is believed to winter in the Central Valley. The cackling Canada goose is another unique subspecies whose populations have declined to relatively low levels and are now possibly imperiled.

Unique Central Valley Waterfowl

Three subspecies of geese that winter in the Central Valley--the Aleutian Canada, tule greater white-fronted, and cackling Canada--are unique because of their present population status.

The Federal Government has designated the Aleutian Canada goose as an endangered species because of its restricted breeding range and low numbers. Currently nesting only on a few of the Aleutian Islands--including Buldir, Amukta, Aaitak, and Aggatu--the Aleutian Canada goose's breeding range was more extensive until Russian and, later, American trappers introduced arctic foxes to the nesting islands. Extensive recovery efforts are under way to increase population levels by removing foxes from former nesting islands, protecting known staging and migration areas, and implementing hunting closures. Parts of the Colusa, Butte, and San Joaquin basins have been closed to hunting of all Canada geese at varying times to protect the Aleutians. If and when breeding populations are reestablished on several more islands in the Aleutian chain and a sustaining population is achieved, this subspecies will be transferred to the threatened category and eventually taken off the list.

The existence of the tule greater white-fronted goose, a subspecies of the greater white-fronted goose, has been a subject of controversy for many years. Breeding grounds have recently been located in the Cook Inlet of Alaska, and all major wintering areas have now been identified. Research is under way to better delineate the number of birds in the breeding and wintering populations. Winter population numbers are currently estimated at about 2,000 (USFWS, 1978). The entire Pacific Flyway population of tule greater white-fronted geese is believed to winter in the Central Valley.

The cackling Canada goose is another unique subspecies whose populations have been substantially reduced. A continued reduction could place it on the list of threatened or endangered species.

Current and Desired Waterfowl Populations

The Pacific Flyway Technical Committees[2] have drafted management plans for all Pacific Flyway geese and swans. These plans include population objectives. The USFWS has also developed population objectives for important species of waterfowl in the Central Valley based on these flyway goals and on historic population levels as measured by midwinter aerial surveys. Table C-2 shows both the population objectives and current status for Central Valley waterfowl that are easily surveyed from the air. These species are also those of primary interest for hunting.

[2]These committees are composed of Federal, State, and university representatives from California, Oregon, Washington, Idaho, Nevada, New Mexico, Wyoming, Utah, and Montana.

Table C-2. Estimated Central Valley waterfowl populations and USFWS population objectives

	Estimated population[a]	USFWS population objective	Percentage of objective
Swans			
Tundra	46,207	38,000	122
Geese			
Aleutian Canada[b]	2,357	1,200	196
Cackling Canada	70,979	275,000–325,000[c]	23
Great Basin Canada	12,982	20,000	65
Greater white-fronted	97,557	300,000–350,000[c]	30
Arctic snow	439,753[d]	300,000	66
Wrangel Island snow	18,840	95,000[e]	20
Ross'	--[f]	80,000	--
Ducks			
Canvasback	25,309	20,000	127
Mallard	404,097	500,000	81
Northern shoveler	405,928	500,000	81
Northern pintail	2,120,719	2,750,000	77
Green-winged teal	233,132	200,000	117
American wigeon	484,633	600,000	81

[a] Five-year average (1979-1983).
[b] Endangered.
[c] Fall count.
[d] The 439,753 is a total midwinter white goose average and includes Wrangel Island birds as well as Ross' geese. The population objective for all white geese was estimated at 670,000 birds.
[e] Breeding pairs.
[f] Because Ross' geese are indistinguishable from other white geese during aerial surveys, their current population is unknown. The Ross' goose population in California is thought to be from 80,000 to 100,000 birds.

The current status of Central Valley waterfowl populations was determined by averaging midwinter (or fall) counts between 1979 and 1983. All waterfowl species are below population objectives except canvasback ducks, green-winged teal, Aleutian Canada geese, and tundra swans. As a group, Central Valley geese are furthest below population objectives, reflecting what appears to have been a steady decline over the last 25 years. Cackling Canada geese in particular have recently undergone a dramatic population decline that triggered emergency hunting closures during the 1983-84 hunting season. These closures will probably continue until the population recovers.

During the past several years, population levels of pintails wintering in the Central Valley have been moderately to severly depressed. Reduced recruitment caused by a prolonged drought over much of the pintail's major breeding range in Canada has caused this reduction in winter populations. When this drought ends--there are signs of an easing now--and the condition of the breeding habitat improves, both pintail recruitment and winter population levels should rise. With larger wintering populations, the major limiting effects, if any, of the existing Central Valley habitat base should be easier to detect and quantify, particularly if a population increase of pintails should happen to coincide with another drought in the valley like the one in 1976-77.

Data Problems. Although midwinter or fall aerial surveys are the best waterfowl population indexes available, some problems are inherent in these counts. The accuracy of surveys is always debatable. Population levels are occasionally generated from several surveys flown at different times. This method produces errors in population indexes if any waterfowl move between survey areas. Also, visual counts are subject to large error due partly to observer bias, flock size, and bird size. Some species of waterfowl are less conspicuous than others and are probably underestimated, especially in mixed flocks, or else not counted at all. For example, counting green-winged teal among larger ducks usually produces an underestimate of teal numbers.

The distribution of waterfowl during winter surveys provides another problem in determining waterfowl population levels in the Central Valley. All waterfowl are highly mobile, and some move great distances in response to temperature, water conditions, and population size (Nichols et al., 1983). Severe northern weather can push birds into California that would otherwise winter at higher latitudes, thus inflating Central Valley counts. This movement is probably more of a problem with ducks, since geese are highly traditional in their winter habitat use, and most cackling, greater white-fronted, and snow geese winter in California regardless of climatic conditions.

Habitat type can also influence the accuracy of waterfowl surveys. Wood ducks prefer riparian habitat and are not amenable to aerial counts; consequently, their population status is unknown.

Because of the many potential errors in waterfowl population indexes, annual surveys are probably best used for tracking long-term population trends rather than for determining absolute annual numbers. However, for management purposes and for determining the need for waterfowl habitat in California, it would be beneficial to understand how annual population indexes compare with actual population size.

Data Needs. To obtain more accurate information regarding waterfowl populations, improved survey methods are needed to produce more accurate population indexes. Methods are also needed to translate these indexes into absolute numbers.

FACTORS LIMITING CENTRAL VALLEY WATERFOWL POPULATIONS

The following discussion of limiting factors takes as its starting point responses to a questionnaire sent to individuals, mostly wildlife biologists, in various Federal, State, and private organizations. The questionnaire requested those surveyed to identify the factors that limit California Central Valley waterfowl populations. Sixteen respondents identified a number of limiting factors. Table C-3 summarizes these factors.

Table C-3. Factors questionnaire respondents identified as limiting Central Valley waterfowl

	Agricultural Practices	Contaminants	Cost of Management	Disease	Food	Habitat Distribution	Habitat Mismanagement	Habitat Quality	Habitat Quantity	Hunting	Marsh Habitat	Predation	Riparian Habitat	Sanctuary	Water	Water Development
U.S. Fish and Wildlife Service																
David Gilmer		●		●	●	●		●						●		
Michael Miller					●						●			●		
Patrick O'Halloran						●	●		●						●	
Harry Ohlendorf		●						●	●							
Felix Smith																●
Paul Springer	●											●	●			
Douglas Weinrich					●				●							
Gary Zahm	●	●		●	●		●			●					●	●
U.S. Dept. of Agriculture																
Wendell Miller							●		●							
Randall Gray									●		●					
Daniel Patterson							●		●							
Calif. Waterfowl Assoc.																
Daniel Chapin			●			●	●								●	
John Schulte	●			●	●							●			●	
Calif. Dept. of Fish and Game																
Robert LeDonne	●															
Calif. Dept. of Water Resources																
George Reiner	●				●											
U.C. Davis																
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In strict theoretical terms, a limiting factor is one that independently prevents a population from increasing. However, because most of the factors identified by the 16 questionnaire respondents are not independent but are interrelated to some degree, this theoretical definition is too strict for the purposes of this discussion. For example, food, water, and disease were all suggested as limiting factors. However, food availability is to a degree related to water. Flooded rice fields, for example, appear to be used more than dry fields by some duck species. Diseases such as botulism are also related to the quantity, quality, and distribution of water. Thus, understanding what factors limit waterfowl populations requires an appreciation of the interaction of many variables.

Annual Fluctuation in Population Levels. Another important element in evaluating limiting factors is the large annual fluctuation in population levels of most waterfowl species. Breeding-ground conditions that affect the quantity and quality of habitat outside of California change dramatically each year, affecting reproduction. Consequently, the number of waterfowl returning each year to winter in California is extremely variable.

In years of poor breeding-ground conditions, the quantity and quality of nesting habitat may be the most important factor limiting waterfowl populations. However, in years of good breeding-ground conditions, the most important factor may be the number and condition of waterfowl returning to the breeding grounds. Conditions in California would play a major role in the latter situation. The limiting factors identified by the 16 respondents should therefore be considered potential, not necessarily acting in all years or on all species.

Grouping Waterfowl by Habitat Needs. Grouping waterfowl by similar habitat needs is also helpful in evaluating potential limiting factors. Because many species of waterfowl share similar habitat needs, limiting factors affecting one species probably act on other ecologically similar species. The following list categorizes waterfowl commonly found in California into groups of species that have similar habitat requirements. In addition to those shown, wood ducks and tundra swans have unique habitat needs.

Dabbling ducks	Diving ducks	Geese
American wigeon	Bufflehead	Canada
Cinnamon teal	Canvasback	Pacific greater white-fronted
Gadwall	Goldeneye	Ross'
Green-winged teal	Merganser	Snow
Mallard	Redhead	Tule greater white-fronted
Northern pintail	Ring-necked duck	
Northern shoveler	Ruddy duck	
	Scaup	

Factors that Control the Number and Condition of Waterfowl

Waterfowl populations are regulated through mortality and natality. These factors act in density-dependent ways to limit populations to levels that can be supported by their habitat. As populations increase beyond the carrying capacity of the habitat, mortality increases or natality decreases, holding populations in check.

Hunting, disease, food stress, predation, and contamination are the major mortality factors acting on waterfowl populations in the Central Valley. In addition to affecting waterfowl mortality, the availability of food in California may also influence the reproductive success of both resident and migratory fractions of California waterfowl populations. The following sections discuss how habitat quantity and quality affect mortality and reproductive success.

Hunting. Hunting is the largest single mortality factor affecting most waterfowl populations. It accounts for approximately 50 percent of all annual waterfowl losses (Bellrose, 1976). In California, the estimated annual retrieved duck and goose harvests from 1961 to 1981 averaged 1,679,633 and 187,477, respectively. Table C-4 shows the species composition of the harvest.

Hunting mortality is regulated with the objective of removing only the harvestable excess in any population. The excess is estimated by annual surveys that determine breeding bird numbers, habitat conditions, and reproductive success of each species. Bag limits, season duration, and methods of hunting are then adjusted to control the allowable kill.

Each species' reproductive capacity and vulnerability to hunting and nonhunting mortality determines the impact hunting will have. Species with large clutches, early sexual maturity, and the ability to renest or produce multiple clutches can theoretically withstand more hunting. Dabbling ducks generally have these traits, and hence their bag limits are relatively high. Swans, geese, and diving ducks have relatively small clutches, deferred sexual maturity, and usually an inability to renest. These characteristics account for the reduced bag limits on geese and some species of diving ducks and for the total protection of swans in California.

Although all species of waterfowl can withstand some degree of hunting mortality, inadequate information for predicting the allowable kill can lead to over harvest. The Aleutian Canada goose in California and races of Canada geese in the Midwest are examples of populations that were at one time limited by hunting. Reductions in harvest of these species produced subsequent increases in population levels.

Disease. Disease directly or indirectly accounts for the largest proportion of nonhunting mortality of waterfowl (Bellrose, 1976). In California, several diseases affect waterfowl populations. Major epizootics[3] of botulism and fowl cholera have killed thousands of water birds in California in a short period.

[3]Epizootic: A disease that affects many animals of one kind at the same time.

Table C-4. Relative importance of various ducks and geese in the California waterfowl harvest

Species	Percentage of harvest
Ducks[a]	
Pintail	36.1
Green-winged teal	15.9
Mallard	15.9
American wigeon	11.3
Northern shoveler	8.5
Blue-winged teal/cinnamon teal	2.8
Gadwall	2.6
Scaup	1.5
Ruddy	1.1
Canvasback	1.1
Wood	1.0
Ring-necked	0.6
Bufflehead	0.6
Redhead	0.4
Goldeneye	0.2
Merganser	0.1
Scoter	0.1
Others	Trace
Geese[b]	
Canada	75
Snow	14
Greater white-fronted	8
Others	3

[a]Average harvest of each duck species during the 1966-75 hunting season. Duck data from Carney et al., 1978.

[b]Harvest of each goose species during the 1980 hunting season.

Botulism. Botulism is probably the most devastating waterfowl disease in California. Massive outbreaks in 1968 and 1969 killed an estimated 250,000 waterfowl. Botulism is caused by a bacterium-produced toxin. Warm anaerobic conditions and a protein source are necessary for an outbreak to occur. Pre-irrigation of agricultural fields, receding water levels that expose mud flats, and changes in water quality all kill organisms that provide the protein medium necessary to trigger an outbreak. Decaying waterfowl from an epizootic then produce toxic maggots that are eaten by other waterfowl, thus creating a deadly cycle.

Type C botulism is toxic to all species of waterfowl. However, species that concentrate in large numbers in the Central Valley during late summer or fall, when ambient temperatures are high, are particularly vulnerable to the disease. Botulism hits hardest the early arriving dabbling ducks such as pintail and locally abundant resident breeders such as mallard, gadwall, and cinnamon teal. Geese generally arrive after ambient temperatures have decreased and are not exposed to botulism. Diving ducks and wood ducks are also less affected by botulism because of the diving ducks' preference for deep water and the wood ducks' preference for riparian vegetation.

Fowl Cholera. Fowl cholera is another disease that can cause a massive loss of waterfowl. Over 70,000 waterfowl died of fowl cholera in California during the winter of 1965-66. Poultry and waterfowl can carry this disease in an intermediate, nonvirulent stage. In infectious stages, cholera spreads rapidly through dense flocks of wintering birds.

Similar to botulism, cholera in a virulent stage is infectious to all species of waterfowl. Swans, geese, dabbling ducks, and diving ducks have died in California from cholera. Snow and Ross' geese in the Sacramento Valley and swans in the Delta seem to be affected the most.

The impacts of avian diseases are amplified by the concentration of birds in the affected area. Waterfowl are gregarious during winter and often congregate in flocks of several hundred thousand. Although this natural gregariousness is partly responsible for the bird's vulnerability to disease, the limited amount of habitat available to waterfowl may also contribute to this vulnerability by causing the birds to concentrate in unnaturally high numbers.

Food. Many of the questionnaire respondents cited food as a potential limiting factor of Central Valley waterfowl populations. All waterfowl require food to fulfill individual nutritional needs and to meet energy demands for migration and reproduction. Each waterfowl species has evolved unique feeding strategies to fulfill its nutritional requirements. Geese and swans are mainly adapted to vegetarian diets, whereas diving ducks primarily consume animal matter. Dabbling ducks generally eat a wide variety of animal and plant material, although a species such as the wigeon is largely vegetarian. Agriculture, water, and human disturbance affect the abundance and availability of natural and agricultural foods to waterfowl.

The stress of inadequate food during winter can affect waterfowl in many ways. The birds can starve to death, but this rarely happens in California. Much more likely is their loss to predation or disease as a result of their weakened condition. However, the precise role of food stress in causing losses from predation and disease is unknown.

Effects of Food Quality. Food quality can also affect waterfowl populations. Abundant and readily available foods are not always nutritionally balanced. For example, rice provides an adequate energy source but is low in protein. As a result, a strict diet of rice would cause malnutrition if supplemental protein and other essential elements were not available. Foods high in protein are especially important during molt and egg formation. Some agricultural crops such as grains and cereals provide an ample source of energy to waterfowl, but invertebrates and native vegetation are probably the source of protein and other essential nutrients. The relationship between the availability of essential nutrients and the needs of waterfowl in the Central Valley is only now beginning to be understood.

Effects of Food on Reproductive Success. Food can dramatically affect reproductive success. Ducks and geese generally arrive at their northern breeding grounds with nearly all of the body reserves necessary to lay and incubate a clutch of eggs (Raveling, 1979; Krapu, 1981). Inadequate reserves result in smaller clutches or delayed breeding while reserves are built up. In either case, reduced production can occur. However, it is not known just how important body reserves acquired on the wintering ground are to reproductive success in northern nesting areas. Migrant waterfowl may be able to acquire all the body reserves they need to reproduce successfully from staging areas between California and their respective breeding areas, although this acquisition seems unlikely.

Adaptation of Feeding Habits to Agriculture. Some species of waterfowl have been able to take advantage of food resources created by the conversion of native habitat to agriculture. Geese commonly feed on the shoots of germinating grain and cereal crops as well as on the seeds. Tundra swans often feed on waste corn in both dry and flooded fields and have been known to take advantage of unharvested potatoes. Of the dabbling ducks, mallard and pintail commonly feed in harvested grain fields.

Other species of waterfowl have not adapted their feeding habits to agricultural practices. The smaller dabbling ducks such as green-winged teal, cinnamon teal, northern shoveler, and gadwall use shallow-water marshes and mud flats for the most part. Diving ducks feed mainly on invertebrate food sources that are primarily produced in deepwater marshes. Thus, food is probably more limiting for these species in the Central Valley than for waterfowl that have adapted to agricultural foods.

Effects of Water on Food Availability. Water probably affects the abundance of food available to waterfowl more than any other factor. California experiences tremendous variation in annual precipitation, often leading to drought or flood conditions. In years of abundant rainfall, rivers and streams overflow into bypasses and basins, and surface water accumulates in agricultural fields, greatly increasing the acreage of flooded habitat in the Central Valley. The bypass areas alone contribute over 150 square miles of water during floods. The importance of these temporary wetlands is shown by their ability to attract hundreds of thousands of waterfowl from neighboring areas. Part of the attraction of these areas is undoubtedly the abundant food resources such as grain and invertebrates that become available when they are inundated. However, in most years (three out of four), only a limited amount of occasional water is available, and then usually only for relatively short periods. Thus, the dependable habitat base is the managed wetlands that have dependable water supplies.

Effects of Human Disturbance on Food Availability. Human disturbance can reduce the availability of food to waterfowl. Hunting in particular can prevent waterfowl from using preferred feeding areas during the day. The demand for hunting areas is great enough that few sanctuaries exist where waterfowl can feed undisturbed. Waterfowl have adapted to disturbance to some degree by feeding at night and resting during the day in public wetlands or other water impoundments such as the San Luis Reservoir.

Predation. Predators affect waterfowl populations by killing the birds or eating their eggs. The ability of predators to catch healthy adult birds, however, is thought to be low and of little consequence to wintering waterfowl populations. Predators are generally more successful at catching sick or weakened adults, incubating females, and broods.

The impact of predators in California is probably greatest on the nests of resident breeding waterfowl. Skunks, opossums, rats, and raccoons are the most common Central Valley predators, with gulls, snakes, foxes, and coyotes occasionally destroying nests. Predation was responsible for the majority of nest failures in a study of nesting success in the Grasslands Area (Anderson, 1956). In that 2-year study, predators destroyed 62 and 82 percent of the duck nests in the study area.

Introduced predators appear to be a major cause of low nesting success. Predators new to the valley include the Norway rat, which arrived with the early sailing ships. House cats and dogs probably came with Spanish mission settlements. The valley red fox became established in Glenn County sometime in the 1870s or 1880s, apparently introduced from the eastern United States as a settler's pet. Only during the last 25 to 30 years have these foxes extended their range throughout most of the upper valley. In extending their range, they displaced the native gray fox, which is known to be less predaceous than the red fox. The opossum became established in California around 1912. Its range into the upper Sacramento Valley, however, did not occur until the late 1940s and 1950s (Sacramento Valley Waterfowl Habitat Management Committee, undated).

The high nest predation rates in California have been blamed on the destruction of quality nesting habitat by agriculture. Clean farming techniques and grazing are responsible for removing much of the native cover nesting waterfowl prefer. Many times, the only remaining nesting cover is along dikes, ditches, and fence rows. Because these areas often serve as predator trails, the likelihood of a predator encountering a nest, and thus predator efficiency, is increased.

Predation is probably heaviest on dabbling ducks because of their upland nesting habits. Mallard, gadwall, cinnamon teal, and pintail are the most common dabbling ducks nesting in the Central Valley. The significance of nest predation on population levels of these resident breeders, however, is unknown. Dabbling ducks have the ability to renest if their first nest is destroyed; this ability compensates to some degree for high predation losses.

Predation on nesting females also contributes to resident waterfowl mortality. The disproportionate loss of females to predators is thought to be one of the major causes of the unbalanced sex ratios common in continental waterfowl populations. The magnitude of the problem in California, however, is unknown.

Contamination. Contaminants that affect waterfowl populations come in many forms. Pesticide use for agriculture, accidental and intentional chemical dumping, and industrial and municipal waste have all contributed to an overall reduction in environmental quality. Lead poisoning from ingested lead shot is also responsible for a percentage of waterfowl mortality, although mass die-offs are unusual.

The impacts of contaminants on waterfowl are many and complex. The most toxic pesticides can kill waterfowl rapidly through dermal and respiratory contact as well as through contamination of the food they eat. Repeated exposure to less than lethal doses of pesticides can ultimately cause death if the chemicals are persistent and accumulate in the body.

Contaminants have been shown to affect reproduction in many species of wildlife. Exposure to relatively low levels of some pesticides can change nesting behavior. Organochlorines are probably the most well known for their effects on avian reproduction. Exposure to DDT can cause egg shells to thin, causing decreased egg hatchability. DDT was implicated in the decline of brown pelicans and other birds in California. Other organochlorines have similar reproductive effects. Recent studies in California have shown that, while in the state, waterfowl are accumulating contaminants that could be affecting reproduction. This accumulation is occurring even though many of these chemicals have been banned (Harry Ohlendorf, undated).

Some contaminants such as mercury and selenium can cause teratogenesis.[4] As discussed in Part II, an unusually high incidence of embryo deformity was recently observed at the Kesterson National Wildlife Refuge in the eggs of a number of nesting waterfowl, including two species of ducks. High selenium concentrations were found in the reservoir cells and are suspected of causing the problem.

Contaminants that are not directly toxic to waterfowl can still have adverse effects. For example, organic herbicides are generally considered nontoxic to waterfowl, but they have devastating effects on their habitat. Along with the elimination of cover, herbicides can destroy the vegetative food base of some species. Invertebrate populations that depend on vegetation and serve as food sources to other species of waterfowl can also be eliminated through habitat destruction. Moreover, some contaminants are water soluble and thus readily transported through water channels. As a result, these water-soluble contaminants can affect vegetation and food chains in areas remote from the original areas of application.

[4]Teratogenesis: The production of malformed fetuses.

Lead poisoning from ingesting lead shot kills an estimated 2 to 3 percent of the continental fall and winter waterfowl populations annually (Bellrose, 1976). Research suggests, however, that many factors contribute to the severity of the problem. The sex, age, size, and diet of a bird influence the effects lead has on it. Lead poisoning affects females more than males, adults more than immatures, and smaller birds more than larger birds (Jordan and Bellrose, 1951; Jordan, 1968). A diet of hard grains such as corn also increases the toxicity of lead, mainly because of increased mechanical breakdown of lead in the gizzard.

The availability of lead shot is another factor that influences the severity of the problem. In ponds with hard bottoms, lead pellets accumulate at the soil surface, making them readily accessible to foraging waterfowl. In ponds with soft bottoms and in those that are plowed annually, lead pellets are often dispersed, thereby decreasing their accessibility.

Although contaminant problems are known to exist in California, the species of waterfowl that are most affected and the magnitude of the problem are unknown.

Data Needs

Some of the research necessary to determine what habitat components are limiting each species in the Central Valley is under way, but a broader effort and much more information are needed. The importance of California to wintering waterfowl, however, cannot be overstated. More waterfowl winter in California than in all other Pacific Flyway states combined, and the Central Valley receives the majority of California's waterfowl use. All the cackling and Aleutian Canada geese and nearly all of the Pacific Flyway's greater white-fronted geese depend on wintering areas in the Central Valley.

The relative importance of winter habitat in California versus breeding-ground conditions in Canada and Alaska is not clear. Traditionally, biologists thought that breeding habitat was limiting waterfowl populations, but a recent study in the Mississippi Flyway suggests that improved conditions at the wintering ground can increase the numbers of young mallards in fall populations. In that study, the authors used precipitation as an index of winter wetland quality. The study showed increased numbers with above-normal rainfall (Heitmeyer and Fredrickson, 1981). The authors suggested improved body condition of breeding waterfowl during wet years as the mechanism for increased population.

Annual variation in habitat conditions in California probably affects Pacific Flyway waterfowl populations in a similar way. California has lost most of its wetlands and experiences tremendous annual variations in precipitation. Federal agricultural subsidies such as Payment-in-Kind programs greatly affect the amount of land in grain production. The combination of these factors can produce huge annual variations in habitat and food supply. These conditions probably affect the acquisition of body reserves by waterfowl in winter and thus influence their reproductive success during the following nesting season. The reduced body weight of pintails in California during dry winters supports this hypothesis (Michael Miller, undated).

Events occurring on wintering and breeding grounds are probably not independent. Wintering conditions seem to affect survival and reproduction on the breeding grounds, and habitat conditions in nesting areas can influence mortality of young returning to wintering areas. Although the relationships between survival, reproduction, and habitat conditions are beginning to be understood for some species, particularly mallards, species-specific research is still needed in the Pacific Flyway before the effects of limiting factors in California can be better understood.