UNDELIVERED WATER:
FULFILLING THE CVPIA PROMISE TO CENTRAL VALLEY REFUGES

CENTRAL VALLEY PROJECT IMPROVEMENT ACT
REFUGE WATER SUPPLY PROGRAM

REPORT OF THE INDEPENDENT REVIEW PANEL

NOVEMBER 3, 2009

ACKNOWLEDGMENTS

The Panel extends its appreciation to the staff of the U.S. Bureau of Reclamation and the U.S. Fish and Wildlife Service for supporting this investigation and to maintaining the lifeblood of the remaining Central Valley wetlands: a secure, reliable, clean water supply that endures for future generations. The Panel thanks our intrepid facilitator and editor, Mark Horne, of PBS&J. Thanks are also due to John Spranza of PBS&J for his support of our deliberation sessions and to Mary Bean of Circlepoint for assembling this Panel.

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EXECUTIVE SUMMARY

The 1992 Central Valley Project Improvement Act transformed California's federal water management system by providing fish and wildlife a co-equal priority with other uses. In so doing, the Act mandated that the federal government establish a program, now known as the Refuge Water Supply Program (RWSP), to manage, secure, and deliver a reliable, clean water supply to serve the wetland habitat needs of nineteen federal, state, and private wildlife refuges in California's Central Valley. The refuges protect a significant portion of the last remaining 5 percent of the historic Central Valley wetlands and provide birds of the Pacific Flyway habitat during critical periods when no other wetlands habitat may be available. In response to a request from OMB, the Bureau of Reclamation and the Fish and Wildlife Service established an Independent Panel to evaluate the performance of the RWSP component of the Central Valley Project Improvement Act.

The Act's Mandate: Bureau of Reclamation was to deliver 555,515 acre-feet/year (AFY) of firm water supplies to nineteen wildlife refuges in California's Central Valley. Approximately 80 percent of the water was to be provided from Central Valley Project supplies with the remainder obtained via water conservation, conjunctive use, purchase, lease, donations, or similar activities, and provided in cumulative increments over a 10-year period (with the total amount provided by 2002).

Panel Charge: During its 17-year operation, the RWSP has expended considerable funds on water and conveyance, managed deliveries of historical levels of water (Level 2) and additional water supplies (Incremental Level 4), and constructed numerous facilities to deliver water to the refuges. The Panel was asked to consider the program's performance and recommend improvements to all aspects of program effectiveness and efficiency based on the information provided by the agencies and the public record.

Panel Findings and Recommendations: The Panel evaluated, made findings, and provided specific recommendations based on five major elements of the program: Program Management, Water Supply, Water Conveyance, Program Metrics, and Refuge Management. In each element, the Panel strived to develop specific recommendations that provide a roadmap for the implementing agencies to follow.

- **Program Management:** The Act mandated that the CVP be managed equally for the environment as well as for other uses. Implementing agencies have been negligent in interpreting and implementing the co-equal environmental mandates of the Act through uneven application of its authorized administrative powers. The Panel found misallocation of Level 2 conveyance funding obligations at the expense of the Restoration Fund, non-use of available authorities, a lack of strategic planning and implementation, and a disconnection between ecological priorities and water supply decision-making. The Panel recommends a re-design of the Program that: emphasizes systemwide strategic planning and management, treating water as fungible between Refuges and Levels 2 and 4, incorporating systemwide, ecological monitoring and performance; elevates biological needs for decision-making; maximizes transparency and public reporting in its decision-making relative to administrative powers; requests supplemental federal funding for the Restoration Fund; and integrates the Refuge and Fisheries Programs.

- **Water Supply:** The Act mandated that the RWSP provide firm and reliable deliveries of water to the Refuges' boundaries equal to the historical levels of water supplies to the Refuges (essentially the average but highly variable levels received by the refuges in the years preceding the Act, referred to as Level 2), as well as to secure additional, long-term supplies needed to provide optimum habitat management (referred to as Incremental Level 4). The Panel found that: the quantity of Level 2 deliveries were close but did not meet the levels specified by the Act; and the reliability of firm water deliveries to meet Level 2 water needs improved compared to firm water deliveries prior to the Act. Prior to the Act, the Refuges only had legal entitlement to a collective total of 121,700 acre-feet of firm supply (referred to as Level 1), with average historic water supply levels of 422,251 acre-feet (referred to as Level 2) being highly variable and inconsistent. Since passage of the Act, the Refuges receive a firm, dependable water supply recently averaging 386,000 acre-feet of firm water supply, which allows refuge managers to meet refuge needs on a more consistent basis and with less variability. However, the Panel also found that the provision of Incremental Level 4 water was decidedly much poorer: the Program increased supply in years when water was readily available leading to temporarily improved conditions, but the Program clearly and convincingly failed in its efforts to secure the mandated amount of additional firm and dependable water supplies, with lower prospects for success now than when the Act was passed. Very limited amounts of long-term water have been acquired, while funding and water supplies are diminishing and water costs are escalating. Therefore the Panel recommends that all water supplies should be managed as one fungible pool to increase flexibility, use, and ecological responsiveness and benefits; and that the funding and responsibility for securing Incremental Level 4 water be delegated to an independent entity.

- **Water Conveyance (Delivery):** The Act mandated that conveyance be provided to the borders of all nineteen refuges by 2002. Seven years after external conveyance was to be completed, five refuges remain without the needed external conveyance improvements and water wheeling costs have been quickly rising. Because time and money are diminishing, the Panel recommends that RWSP prioritize the remaining efforts based on biological need and that the federal government's General Accounting Office audit the efficacy and efficiency, costs, and decision-making processes of the conveyance program.

- **Program Metrics:** Monitoring, analysis and reporting of refuge-specific and systemwide water deliveries, water quality, and ecological benefits have been inadequate and information doesn't exist to measure systemwide performance and productivity of the Refuge Water Supply Program. To assure that the timing of water deliveries meets ecological needs, the Panel recommends a series of new and revised monitoring and reporting protocols that cover water, fiscal, administrative, and ecological parameters.

- **Refuge Management:** The Panel found that the Refuge system's ecological performance has optimized use of water by upgrading the infrastructure within refuge lands and by following guidelines established by the Central Valley Joint Venture Implementation Plan. To better use the disproportionate availability of water north of the Delta and to optimize the timing of deliveries, the Panel recommends that annual water schedules be centrally processed and administered to optimize systemwide habitat benefits; that systemwide communication and coordination be improved; and that a long-term systemwide monitoring program be implemented to enable adaptive management of water deliveries and optimize ecological benefits among the nineteen Refuges.

I. INTRODUCTION

A. What the Act Requires

In 1992, Congress enacted the Central Valley Project Improvement Act (CVPIA or Act) in P.L. 102-575 with the objectives to:

- Protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;
- Address impacts of the Central Valley Project (CVP) on fish, wildlife and associated habitats;
- Improve the operational flexibility of the Central Valley Project;
- Increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation;
- Contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento–San Joaquin Delta Estuary; and
- Achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal, and industrial and power contractors.

In support of the objectives of the Central Valley Joint Venture[1] (CVJV) and the purposes noted above, the Act mandated the Bureau of Reclamation (Reclamation) deliver 555,515 acre-feet/year (AFY) of firm water supplies on specified delivery schedules to nineteen federal, state and private wildlife Refuges (Refuges) (shown on Figure 1) in the Central Valley (Valley). Approximately 80 percent of the water was to be provided from CVP supplies with the remainder obtained via water conservation, conjunctive use, purchase, lease, donations, or similar activities, and provided in cumulating increments over a 10-year period (with the total annual amount to be provided by 2002).

To facilitate the delivery of the water, new conveyance facilities were to be constructed and/or Reclamation would enter into contracts with individual water and irrigation districts to wheel water through existing non-CVP conveyance facilities.

B. What the Panel Was Asked to Do

In response to a request from the federal Office of Management and Budget (OMB) to develop performance goals and complete improvement actions per the Program Assessment Rating Tool (PART) Review, Reclamation and the Fish and Wildlife Service (Service) conducted an independent review of the Refuge Water Supply Program (RWSP). Reclamation retained a consultant to convene an independent panel (Panel, whose member biographies are included in Appendix A) and

[1] The Central Valley Joint Venture is one of 17 Joint Venture partnerships in the United States, established under the North American Waterfowl Management Plan, which brings together conservation organizations, public agencies, private landowners and other partners interested in the conservation of bird habitat within California's Central Valley.

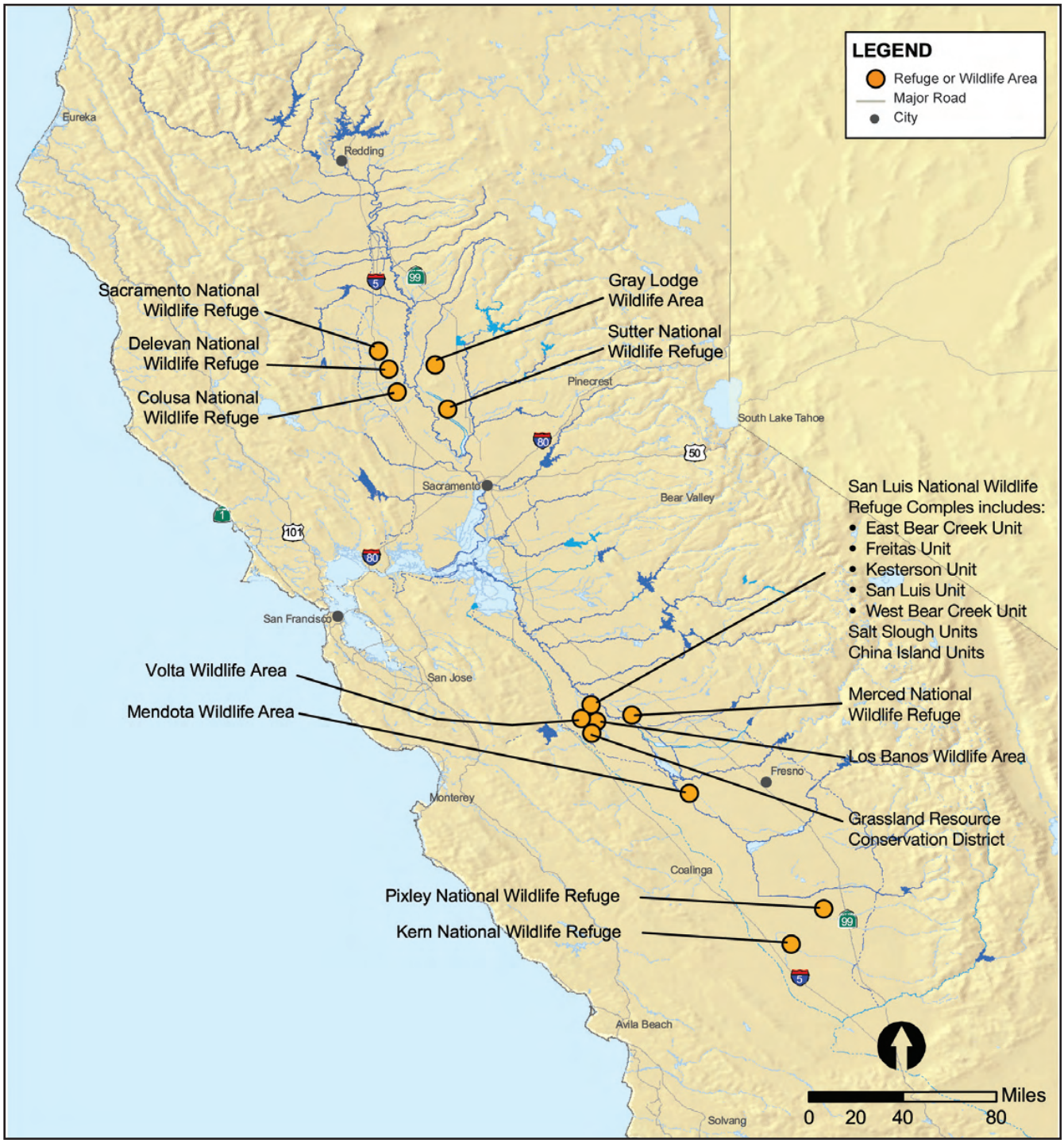

Figure 1 Central Valley Refuges Receiving CVPIA Water Supplies
SOURCE: Reclamation, 2003-2005; Service, 2004; DFC, 2007

Reclamation and the Service developed seven critical questions for the Panel to address (which are also included in Appendix A). This report documents the findings of the RWSP Independent Review, whose purpose was to provide programmatic recommendations and guidance to improve effectiveness and efficiency of the program. The recommendations of the RWSP Panel (and a separate panel on the anadromous fisheries program) are planned to inform a long-term management plan for implementation of the CVPIA that is being developed under a separate process.

The Panel met a total of nine days, including two days of Preparatory Sessions (on February 5 and 6, 2009) and seven days of deliberations (March 1 to 3, April 13 and 14, and May 7 and 8), which also included two Public Information Sessions. The first (on March 2) concentrated on a discussion with agency staff and the second (on April 13) focused on a discussion with stakeholders. Panel members submitted more than 200 questions to the agencies, reviewed dozens of documents and agency responses to the questions (submitted by the Panel), analyzed data on water supply and delivery, and participated in several conference calls to develop and refine their findings and recommendations.

C. What the Panel Found

Based on the information made available, the Panel concluded that 16 years after passage of the Act, none of the key mandates established by Congress have been fully achieved. This conclusion is based on the following facts relative to the Act's mandates:

- In no year have Full Level 4 water supplies ever been delivered to the Refuges;
- Since 2002, the quantity of firm CVP water supplied to the Refuge boundaries in accordance with their water orders has been 386,000 acre-feet on average, which is still approximately 8 percent short of the Act's Level 2 mandate of 422,251 acre-feet;
- Delivery of firm water supplies increased from 121,700 acre-feet (Level 1) to a recent average of 386,000 acre-feet (Level 2);
- Less than half of mandated Incremental Level 4 Water supplies have been delivered, mostly through short-term, spot market leases and a few medium-term contracts;
- No good faith effort was made to develop or implement a strategic program that would produce additional firm, dependable, long-term water supplies from diverse sources by 2002, as mandated in the Act;
- RWSP has failed to use all available tools authorized in the Act and did not sufficiently pursue all market opportunities to acquire water; and
- Although construction of external conveyance facilities (to the Refuges) was to be completed by 2002, conveyance projects still remain to be completed at five Refuges, which has limited their ability to receive their complete allocation of CVP water.

The progress of the RWSP in meeting the total water supply mandate is illustrated in Figure 2, which shows that total water deliveries since passage of the Act have averaged 80% of the Full Level 4 mandate. .

Even though the reliability of Level 2 water deliveries improved, the failure to provide the mandated Full Level 4 water supplies prevented optimal performance of the Refuges, especially in the spring and

summer, resulting in substantial lost opportunity to meet the Act's goals to protect, restore, and enhance fish and wildlife when water was not delivered. The inability to consistently deliver firm and dependable Incremental Level 4 Water has, on occasion, pre-empted spring and summer irrigations and maintenance of pond water, which has compromised the potential to stimulate germination of some plants, to maximize seed production, or to maintain summer pond water, which is required for successful breeding and survival of some of the sensitive and at-risk species that depend on the wetland habitats in refuges.

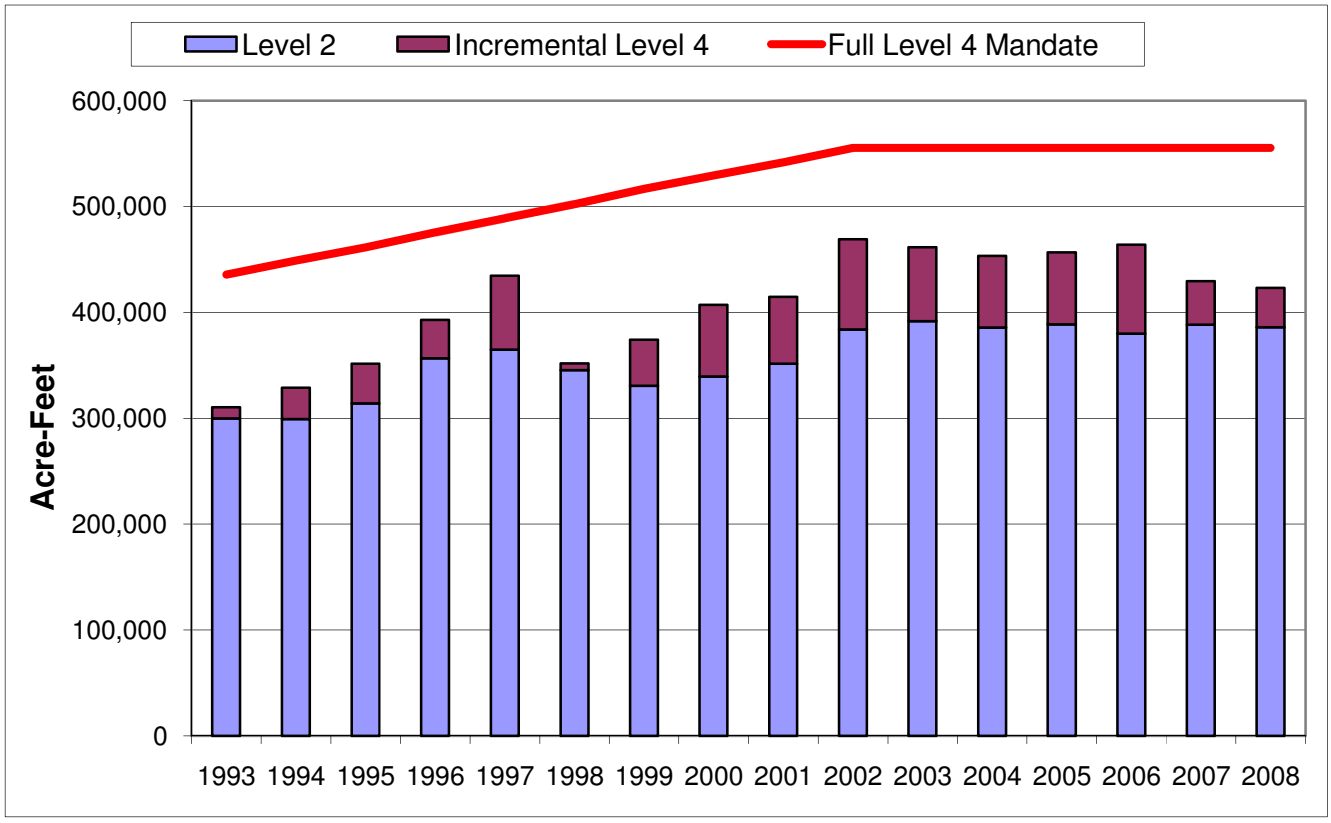

Figure 2 Total CVPIA Water Deliveries to Central Valley Refuges

Despite the over-arching failure to secure the total mandated water supplies, the CVPIA has improved water conveyance facilities, water quality and the reliability of Level 2 water supplies to the 14 Refuges where construction is completed. In some locations this has enabled refuge managers to expand wetland habitats, enhance species protection, and improve migratory bird conservation efforts. By adding new conveyance facilities, CVPIA also greatly expanded the (mostly unrealized) potential for year-round water at most Refuges, which would further improve species and habitat management options if water was reliably delivered in the spring and summer.

D. What the Panel Recommends

To achieve the aims of the Act, the Full Level 4 water supply must be delivered to the Refuges. To accomplish this, the Panel recommends actions in five topical areas: (1) water supply, (2) water conveyance (delivery), (3) program and benefit measurement, (4) management of the RWSP, and

(5) management of the CVPIA Refuges, as listed below (and repeated in the Rationale section, which provides a more detailed basis for these recommendations).

1. Water Supply

a) Within 18 months of the public release of this report, Reclamation should, in consultation with the Inter-agency Refuge Water Management Team, contract with an independent, third-party entity for the purpose of acquiring all Incremental Level 4 water. All Restoration Fund monies available for acquiring Incremental Level 4 Water should be made available to this independent entity, and the entity will be responsible for all Level 4 Water transactions undertaken using these monies. This independent entity would select and fund proposals from other qualified public and private entities to acquire Incremental Level 4 Water and, if cost-effective, wheel the acquired water. This program should be modeled after other successful programs such as the Columbia River Basin Water Transaction Program and the Deschutes River Conservancy.

The attributes of the independent entity should include:

- Authority to receive and disperse funds (from the CVPIA Restoration Fund and other public and private sources), including disbursements to partner entities for transaction and operational costs related to the development of diverse water sources;
- Representative decision-making board which shall establish criteria to assess the merits of proposals, which shall include the full suite of measures identified in the Act, including water conservation, transfers, conjunctive use, purchase, lease, donations, fallowing, land acquisition, or similar activities;
- Public process for the solicitation, review, and approval of grant proposals for water acquisition projects with clear conflict-of-interest guidelines;
- Administrative and technical competence and capacity to originate, review, and execute water acquisition, development, and wheeling proposals;
- Process to qualify entities that can develop water supply sources; and
- Ability to establish a close working relationship with the funding agency.

This third-party entity and its program should adopt a portfolio approach to develop alternative water supplies to provide leverage against increasing spot market prices, especially in dry and critically dry years, in order to assemble a diversity of sources, in different water year types and in all geographic locations, which could include:

- Acquisition of senior water rights;
- Acquisition of long-term leases (e.g. 25-50 year);
- Leasing of mid-term contracts of five to 10 years (similar to the current contract for the San Joaquin River Exchange Contractors Water Authority) with potential suppliers;
- Spot market purchases of short-term water supplies to supplement firm and reliable supplies (medium and long-term supplies) as needed;

- Further development of local water resources, especially for use in dry years, such as groundwater and conjunctive use capacity and water treatment capability to accept brackish groundwater or irrigation return water with degraded water quality; and
- Development of partnerships with others to develop regional groundwater banking operations, conservation, or purchase of shares in existing groundwater banking operations if total costs are below projected critical-dry year water costs.

Proposals to the third-party entity to acquire water should include analysis of wheeling options and costs, and if deemed cost-effective, could result in negotiations and agreements to wheel, exchange, or otherwise deliver the water. Reclamation would be responsible for constructing conveyance to ensure that Full Level 4 water could be delivered per the CVPIA.

The third-party entity should include water quality specifications in all future water supply and conveyance contracts to assure that acquired and conveyed water supplies are of suitable quality.

Given the unmet deadline to reach the mandate for the provision of Full Level 4 Water by 2002, Reclamation should place the highest priority on the funding and implementation of this recommendation and proceed as expeditiously as possible.

2. Water Conveyance (Delivery)

a) The Service should prioritize the funding and completion of remaining external conveyance construction projects at Gray Lodge Wildlife Area (WA), East Bear Creek Unit of the San Luis National Wildlife Refuge (NWR), Mendota WA, Pixley NWR and Sutter NWR, based on balancing the potential biological improvements with the length of time required to complete the projects, extent of work completed to date, and the status of environmental permitting.

b) The Department of Interior (DOI) should request that the General Accounting Office (GAO) immediately conduct an independent audit of the RWSP's water conveyance costs and efficiencies to determine if the Restoration Fund is paying a disproportionate share of wheeling costs and conveyance losses. If GAO determines that the program's costs are disproportionate to other users in a system or district, Reclamation should then renegotiate the corresponding delivery contracts to adjust conveyance rates and assure that future cost increases are reasonable.

   The GAO analysis should also include a systemwide cost-benefit assessment of conveyance options and operations and maintenance practices to determine the most efficient and cost-effective strategies for delivering timely water supplies to each refuge. Reclamation should immediately incorporate the results of the GAO analysis in all subsequent operational conveyance decisions to assure that water is delivered to the Refuges in the most cost-effective method feasible, thereby reducing conveyance costs and losses.

c) Reclamation should maintain rate structures with those conveyance contractors that have had no annual cost increases, and where feasible negotiate permanent rate structures with other conveyance contractors that limit future cost increases.

d) Reclamation should include specifications in all future water conveyance contracts to assure the quality of water delivered to the boundary of the Refuges is consistent with the quality of the incoming source water.

3. Program and Benefit Measurement

a) Reclamation should expand and enhance monitoring and public reporting, at the end of each water year, the following water-related metrics:
   - Accurate, weekly volumes of water delivery at refuge boundaries;
   - Total cost (including acquisition and conveyance) of all Incremental Level 4 Water delivered to the boundary of each individual refuge (both in total and on a per-AF basis), by refuge;
   - Quality of water delivered to each refuge with specific emphasis on constituents of concern, including boron, mercury, selenium, and salts, and identify when the samples were acquired and compare these parameters to the maximum contaminant levels recommended by the Service.

b) Reclamation should publicly report on a monthly basis, the actual monthly water deliveries to each refuge (for the prior month) versus the planned deliveries identified in each refuge manager's annual water delivery schedules. In addition, Reclamation should publicly report at the end of each water year, a summary of the previous year's performance in meeting each refuge's monthly water delivery schedules.

c) At the end of each water year, the Service should report on actual versus planned acres of the following habitat-types (identified in the Water Management Plans) for each refuge: (1) seasonal wetland (this may be subdivided further by type seasonal habitat on a refuge-specific basis, e.g., swamp timothy, smartweed, and watergrass), (2) permanent wetland, (3) semi-permanent/brood pond, (4) riparian, and (5) other refuge-specific types (e.g., vernal pool)

d) Within 18 months of the release of this report, the Service should implement a systemwide ecological monitoring and evaluation program for all CVPIA Refuges, which integrates existing and newly collected information (identified herein) and produce an annual report at the end of each water year.

   The annual report should include an evaluation of the systemwide ecological benefits of all Central Valley refuges that receive CVPIA water, based on the following:
   - The result of ongoing monitoring, including (1) the Service's Animal Health Lab disease reports; (2) mid-winter waterfowl inventories, (3) nesting and brood surveys; and (4) any additional data collected regularly by the Refuges, such as herptile distribution and abundance.
   - New coordinated systemwide monitoring effort for at least 1 key migrant species and 2 resident Threatened and Endangered (T&E) species (including one warm-blooded and one

cold-blooded), which is included (in the Annual report) every five years and identifies population numbers and survival rates for the 3 previous years.

- An estimate of the bioenergetic food production benefits to migrant waterfowl, consistent with the methodology used by the Central Valley Joint Venture, to compliment and inform the CVJV implementation plan.

4. Refuge Water Supply Program Management

a) Reclamation should redesign the RWSP to emphasize systemwide strategic planning and management; elevate the optimization of biological productivity into decision-making; maximize transparency and public reporting in its decision-making relative to administrative powers; and better integrate the RWSP and Anadromous Fisheries Restoration Program.

b) Reclamation should realign and optimize management structure of the RWSP to optimize flexibility and fungibility of Level 2 Water and any Incremental Level 4 Water to optimize ecological productivity of the Refuges as determined by Refuge managers.

c) Concurrent with the establishment of an independent third-party to acquire Incremental Level 4 water supplies, Reclamation should make funding available to that entity in an amount equal to or greater than the previous 5-year historical average of funding for acquisitions and wheeling of Incremental Level 4 water, plus any supplemental appropriations made available by Congress or any other sources.

d) To support expansion of long-term ecological monitoring and evaluation on the Refuges, Reclamation should allocate 3 percent of the Restoration Fund (available to the Refuges) to the CVJV to supervise this new effort, including the hiring of a new staff biologist (in coordination with the Service) with significant experience in ecological monitoring and evaluation to supervise the compilation, synthesis and reporting of data, and to coordinate similar data collection efforts on private Refuges that receive CVPIA water. As needed and appropriate, these newly allocated funds can be expended to compile and/or collect new data as described below.

e) Reclamation and the Service should increase the effectiveness of the Inter-agency Refuge Water Management Team (IRWMT) as a forum to collaborate and reach consensus on the availability and timely allocation of water to and among Refuges with appropriate representation of CVPIA program managers, federal, state, and private refuge managers, CVJV partners, and other interested parties. The IRWMT should meet regularly to address water needs, at the beginning of the water year and seasonally to deal with changes in water availability or unanticipated needs or demands.

f) Prior to the start of each water year, the Service should compile all individual refuge water orders for the coming water year into a cumulative water order for the entire system, which identifies the quantity and timing of water from the Level 2 pool, plus any available Incremental Level 4 Water. The Service will subsequently communicate that schedule to

Reclamation for planning its annual water deliveries and concurrently make the cumulative refuge water schedule publicly available.

g) Reclamation should immediately modify policies and practices that are inconsistent with the intent of the Act to improve CVP operations and deliver 100 percent of all Level 2 water to the refuge system (regardless of any external conveyance constraints) and assure that all refuge water (both Level 2 and Incremental Level 4):
   - Is fungible in time and space across the entire CVPIA refuge system;
   - Has highest priority at the pumps, equivalent with the exchange contractors;
   - Is eligible for, prioritized and provided carry-over storage; and
   - Is no longer subject to the current practice, where water that cannot be conveyed to a refuge is returned to the CVP pool. Reclamation should annually report to the Inter-agency Refuge Water Management Team on the operational decisions that affected Reclamation's ability to make timely water deliveries to the Refuges, including all decisions related to Delta pumping, carry-over storage, or allocations of Level 2 and Incremental Level 4 Water to non-refuge users.

h) Reclamation should immediately cease using the Restoration Fund to pay Level 2 wheeling costs and shift those costs to other CVP operational fund sources, consistent with §3406d(3) of the Act.

i) Within 18 months of the public release of this report, Reclamation shall complete an investigation of barriers to providing subsidized CVP power to meet refuge electrical needs and report to the Inter-agency Refuge Water Management Team. Where feasible, within three years, Reclamation should provide CVP power to reduce energy costs associated with all potential refuge water sources and conveyances that require power, including surface and groundwater pumping and water treatment.

j) Reclamation should request annual federal appropriations to augment the Restoration Fund to completely fund Full Level 4 water supply acquisition, completion of conveyance systems and operation of the third-party entity that will manage water acquisitions. Funding for conveyance systems should be requested immediately and water acquisition funding should be requested on an annual basis until sufficient water supplies are secured to reach the Full Level 4 mandate. Reclamation should provide information on budget requests to the CVJV and other potential supporters to who can help secure the necessary funding from Congress and other potential sources as appropriate.

k) Reclamation should use all appropriate and legal means to assure that the State of California annually reimburses the CVPIA Restoration Fund for the State's share of program costs, as established by the Act and required by the Central Valley Project Improvement Act Sharing of Costs Agreement for Mitigation Projects and Improvements (SCAMPI) between Reclamation and the State of California.

l) The Service should immediately retain and/or hire a CVP operations expert to represent the interests of the refuge program to advise the Service on optimal delivery strategies related to in-year CVP water operations delivery decisions.

5. Central Valley Refuge Management

a) The Service should immediately implement a coordinated systemwide effort among all Refuges to enhance the availability of early- and late-season habitat sufficient to meet refuge management needs and identify any other gaps in habitat availability that can be addressed by providing sufficient quantities of properly timed water to those Refuges that can best support Valley-wide species and habitat goals, especially in dry- and critically dry years.

b) The Service should use the results of ecological monitoring to identify and promote adaptive management techniques and procedures to continually enhance the means and methods to manage water within Refuges and enhance habitat productivity.

II. CONTEXT

A. Historical Setting

Over several million years of tectonic and geomorphic activity, California's Central Valley evolved into a long trough, roughly 400 miles long by 40 miles wide, with three distinct divisions, the Sacramento; San Joaquin; and Tulare basins. Surrounded by Sierra Nevada range on the east and the Coast Ranges on the west, the Valley was drained by an extensive system of riverine, lacustrine, and riparian features that emptied to the Pacific Ocean via a vast delta. Deposition of sediments from the adjacent mountains and changes in sea level created a relatively flat valley floor, resulting in permanent water bodies in the Tulare Basin and the potential for a vast inland sea east of the Sacramento-San Joaquin Delta (Delta) during wet years.

The landscape of the Valley floor reflected diverse ecological conditions in an extensive and interconnected mosaic of aquatic, wetland, and terrestrial system of great diversity. The dynamic nature of this system in combination with a Mediterranean climate supported diverse plant communities that provided the resources for sizable populations of resident and migratory wildlife species, and various groups of indigenous peoples. Animals migrating into and through the valley grew to depend on this unique setting for their success in exploiting environments for different life cycle events across many scales ranging from local to global. (Refer to Figure 3 which illustrates historical extent of wetlands in the Sacramento and San Joaquin valleys and the Tulare Basin and their current limited distribution.)

When settlement began in earnest with the gold rush in 1850, wetlands occupied approximately 4 million acres of the Valley and the presence of the rivers and streams facilitated the movement of people into the Sierra foothills. The need to feed a growing human population and the presence of rich soils in proximity to rivers and streams provided the impetus for the "reclamation" of low-lying lands that historically were seasonally flooded. The damming of rivers, availability and use of mechanized equipment, intensive agricultural practices, and widespread flood control efforts, much of which was facilitated by legislated incentives, quickly altered the historical flooding regimes that formed and maintained the Central Valley wetlands, accelerating the loss of these wetland communities. By the 1930s, vast areas of the Valley floor had been transformed from a rich mosaic of interconnected wetland, riparian, and floodplain habitats, into wide expanses of farm and ranch land, reducing the amount of wetlands to approximately 600,000 acres, about 15 percent of their historical extent.

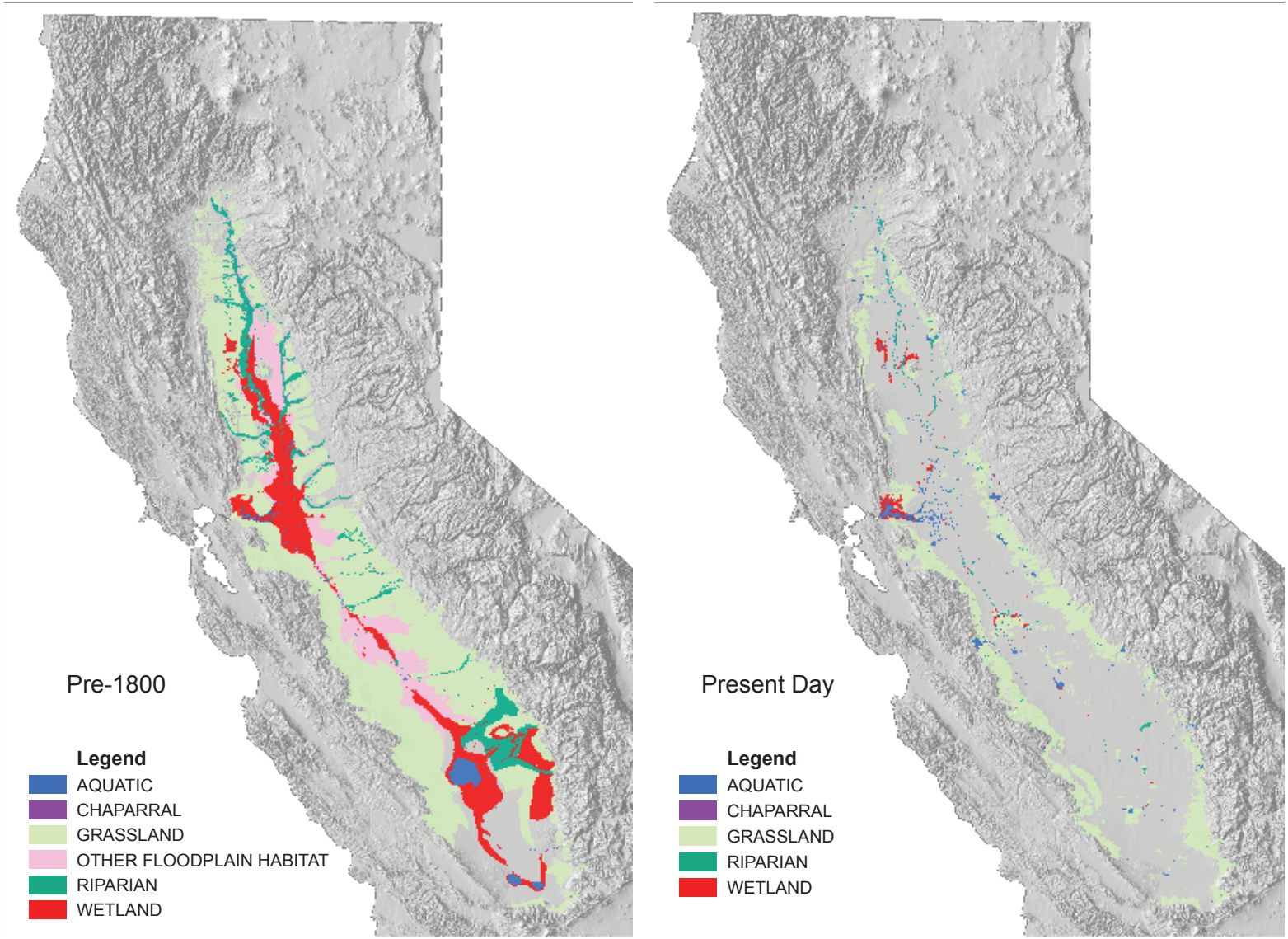

Figure 3 Historic and Current Loss of Central Valley Wetland Habitats

DATA SOURCES: Central Valley Historic Mapping Project, GIC, Chico State; Modern Wetlands, Ducks Unlimited & Central Valley Joint Venture
MAP DESIGN: Ducks Unlimited, Western Regional Office; adapted from Central Valley Joint Venture, Central Valley Joint Venture Implementation Plan—Conserving Bird Habitat, U.S. Fish and Wildlife Service, Sacramento, CA, 2006

B. Effects of the Central Valley Project

By the 1930s, the extensive hydrologic changes in the Valley compromised and limited the amounts of water available for agriculture and urban needs, creating a need for a valley-wide solution for water supply and distribution. To meet this need, a project for the entire Central Valley was envisioned by the state of California, but as this was during the Depression, the state had insufficient funds to develop the system. After considerable effort, Congress enacted legislation to authorize and fund the CVP in 1937. Over the next two decades the CVP was developed with dams, pumps, and canals (generally shown on Figure 4), which further modified the volume and timing of water in rivers and greatly expanded the land area that could be irrigated for agriculture,[2] further reducing wetland acreage. The once vast network of aquatic and wetland habitats shrunk even more, with remaining wetlands becoming fragmented and isolated. Today, only about 200,000 acres of wetland habitats exist in the Central Valley, approximately 5 percent of their historic extent prior to colonization and settlement.

C. Identification of Refuge Water Needs

In 1985, Reclamation and the Service, assisted by the California State Departments of Fish and Game (DFG) and Water Resources (DWR), initiated a study of the water supply needs of fourteen federal and state and private wildlife refuges in the Central Valley. The objectives of this report included the following: (1) Confirm and update monthly water quantity requirements (for the refuges); (2) Determine groundwater quantity and quality and identify conjunctive use potential; (3) Determine contractual and physical capabilities of water and irrigation districts to deliver water on a monthly basis; (4) Provide preliminary designated and associated costs of (water) delivery systems; and (5) Evaluate power requirements for delivery systems and wells.

The Refuge Water Supply Investigation report[3] completed in 1989 identified and described four different levels of water supply (based on information provided by refuge managers):

- **Level 1:** The sum of the refuges' firm water supply to be provided through surface water rights or long-term water contracts prior to the Act;
- **Level 2:** The sum of the average historical water deliveries to the refuges prior to the Act;
- **Level 3:** The sum of water deliveries that would be needed to fully utilize existing wetland habitats; and
- **Level 4:** Total water deliveries required for optimum refuge management.

(Note that Level 1 and Level 3 are generally only useful for reference purposes. Although the Refuge Water Supply Investigation report did not clearly define "optimum" habitat management, it did note that the difference between historical water deliveries and the amounts needed for optimum management could be described in terms of habitat diversity, duration of late-winter flooding, brood water and pond water.)

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[2] Reclamation (http://www.usbr.gov/dataweb/html/cvp.html) estimates current water supply deliveries are sufficient to irrigate 3 million acres of land.

[3] *Report on Refuge Water Supply Investigations: Central Valley Hydrologic Basin, California*. U.S. Department of Interior, Bureau of Reclamation, Mid-Pacific Region. March 1989.

Figure 4 Central Valley Project System
SOURCE: Reclamation, 2003-2005

In 1989, Reclamation, the Service, and DFG also prepared the San Joaquin Action Plan/Kesterson Mitigation Plan report,[4] which proposed the creation of new refuges and specified the optimum annual water needed for each refuge area, which eventually became five federal and state refuges, and an assemblage of numerous private refuges (which are collectively known as the Grasslands complex, and referred to herein as a single private refuge).

By combining the water supply needs identified in the Refuge Water Supply Investigation report and the San Joaquin Action Plan report (collectively, the 1989 Water Supply Reports), the amount of water needed to support "basic" (or historic) management of wetland habitats in the nineteen Refuges was identified as 422,251 AFY of Level 2 Water and the total Level 4 Water need established at 555,515 AFY. The difference of 133,264 AFY, the amount needed to implement "optimum" habitat management, is identified as Incremental Level 4 Water.

As described in the Refuge Water Supply Investigation, Level 2 Water reflected average historical water deliveries to the Refuges, which were often variable and limited. These supplies were usually managed to provide seasonal wetland habitats that could support migratory and wintering waterfowl, the highest refuge management priority given limited water supplies. Since Incremental Level 4 Water was essentially "new" water for the Refuges, it could provide opportunities to expand flooded wetland habitats and provide year-round pond and irrigation water for waterfowl breeding, improved food production, and habitat for resident species. Figure 5 shows the pattern of the proposed monthly utilization of Full Level 4 Water (for all nineteen Refuges, based on the 1989 Water Supply Reports), as well as those portions of the total that are Level 2 and Incremental Level 4 Water.

This figure shows that the intended monthly utilization of water was to support the "fall flood-up" (to assure adequate habitat for wintering waterfowl) with a secondary spike in the spring (to enhance food production, provide waterfowl brood water, and support riparian habitat). The pattern for the proposed monthly utilization of Incremental Level 4 Water is markedly different than the overall pattern, which likely illustrates an intention to utilize this new water supply principally to support spring and summer irrigations for food production, seasonal brood water for breeding waterfowl, and year-round pond water for resident wetlands-dependent species.

In addition to the pattern of monthly deliveries, the relative proportion of Incremental Level 4 Water at individual refuges is also worth noting,[5] as it varies considerably among the nineteen Refuges (from zero to almost 79 percent), with a higher proportion of Incremental Level 4 Water for the refuges located south of the Sacramento–San Joaquin Delta, as shown in Table 1.

[4] *San Joaquin Action Plan /Kesterson Mitigation Plan: Merced County, California.* State of California: The Resource Agency; and Department of Fish and Game. United States Department of Interior: Bureau of Reclamation; and Fish and Wildlife Service. December 1989.

[5] For the fourteen federal and state Refuges (considered in the Refuge Water Supply Investigation), refuge managers estimated the amounts of water needed for all four levels. For the refuges created as a result of the San Joaquin Action Plan, the report determined that Level 2 Water should be established as ⅔ of Full Level 4 Water.

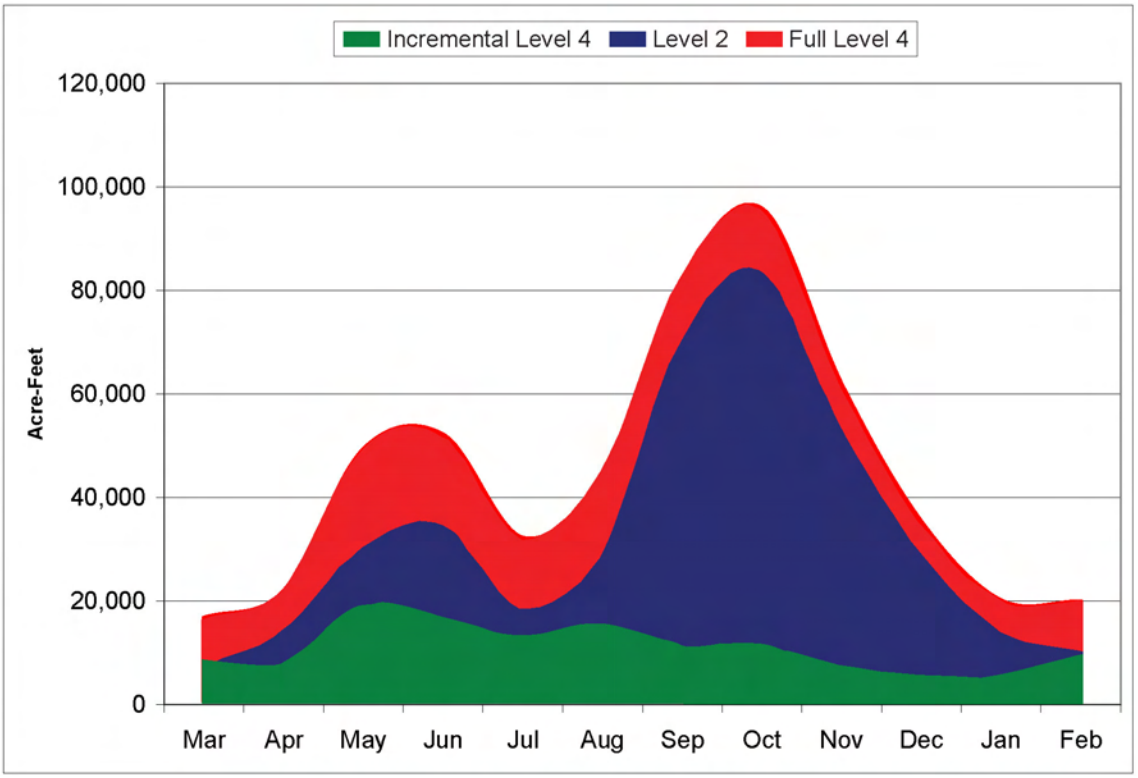

Figure 5 Proposed Monthly Deliveries of Water to Central Valley Refuges

In addition, the schedule of monthly deliveries included in the 1989 Water Supply Reports shows a marked variation in the proposed utilization of Full Level 4 Water between those Refuges located north and south of the Delta, as shown in Figure 6. Although the rationale for the varied pattern of proposed water utilization is not clear, it may be driven by differences in water availability at the time of the 1989 Reports, where refuges north of the Delta then had access to additional water supplies in spring and summer, primarily in the form of agricultural return waters, while refuges south of the Delta had little access to such water. Plus, the refuges south of the Delta have a greater proportion of wetlands relative to uplands, generating a greater dependency on spring and summer (or year-round) water for refuges south of the Delta. Figure 6 also illustrates how much more demand exists during the spring and summer for refuges located south of the delta. Much of this demand is supposed to be met by Incremental Level 4 supplies, which underscores the reliance on Incremental Level 4 supplies by refuges located south of the Delta.

Table 1 Relative Proportion of Incremental Level 4 Water to Full Level 4 Amounts

Refuge	Refuge Area (acres)	Water Supply (AFY)			Inc. Level 4 as Percent of Level 4
		Full Level 4	Level 2	Incremental Level 4	
Sacramento Valley					
Sacramento National Wildlife Refuge	10,783	50,000	46,400	3,600	7.2%
Delevan National Wildlife Refuge	5,797	30,000	20,950	9,050	30.2%
Colusa National Wildlife Refuge	4,626	25,000	25,000	0	0.0%
Sutter National Wildlife Refuge	2,591	30,000	23,500	6,500	21.7%
Gray Lodge Wildlife Area	9,100	44,000	35,400	8,600	19.5%
Subtotals and Average	*32,897*	*179,000*	*151,250*	*27,750*	*15.5%*
San Joaquin Valley					
San Luis Unit	26,609	19,000	19,000	0	0.0%
West Bear Creek Unit	3,892	10,810	7,207	3,603	33.3%
East Bear Creek Unit	4,000	13,295	8,863	4,432	33.3%
Kesterson Unit	10,621	10,000	10,000	0	0.0%
Freitas Unit	5,500	5,290	5,290	0	0.0%
Merced National Wildlife Refuge	8,234	16,000	13,500	2,500	15.6%
Kern National Wildlife Refuge	11,492	25,000	9,950	15,050	60.2%
Pixley National Wildlife Refuge	6,833	6,000	1,280	4,720	78.7%
Volta Wildlife Area	2,891	16,000	13,000	3,000	18.8%
Los Banos Wildlife Area	6,217	25,000	16,670	8,330	33.3%
China Island Unit	3,875	10,450	6,967	3,483	33.3%
Salt Slough Unit	2,240	10,020	6,680	3,340	33.3%
Mendota Wildlife Area	11,802	29,650	27,594	2,056	6.9%
Grassland RCD	75,863	180,000	125,000	55,000	30.6%
Subtotals and Average	*180,069*	*376,515*	*271,001*	*105,514*	*28.0%*
Totals and Averages	***212,966***	***555,515***	***422,251***	***133,264***	***24.0%***

SOURCE: Bureau of Reclamation 1989

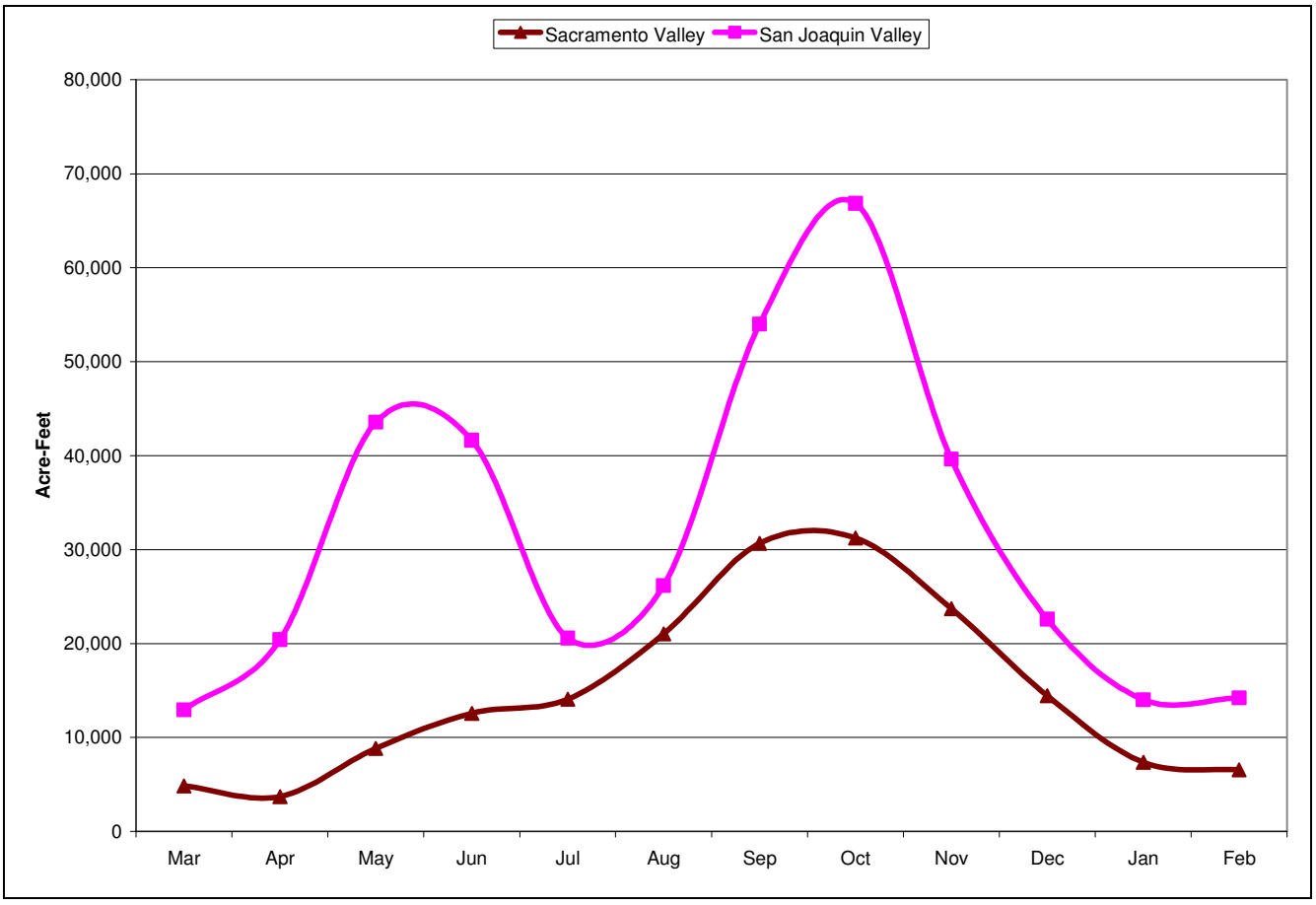

Figure 6 North (Sacramento Valley) and South (San Joaquin Valley) Variation in Proposed Monthly Deliveries of Full Level 4 Water to Refuges

D. CVPIA Intent

In 1992, based on the information in the 1989 Water Supply Reports and other information, Congress enacted the Central Valley Project Improvement Act and mandated the delivery of 555,515 AFY water on specified delivery schedules to the nineteen Refuges in the Central Valley, comprised of:

- 422,251 AFY of Level 2 Water, which was to be provided from the Central Valley Project (and other diverse sources); and
- 133,264 AFY of additional water needed to provide Full Level 4 supplies, with the full level attained through cumulating increments over a 10-year ramp-up period "… through long-term contractual agreements with appropriate parties …" via water conservation, conjunctive use, purchase, lease, donations, or similar activities.

The provision of Incremental Level 4 Water was to be funded via levies on the water and electrical power provided by the Central Valley Project to agricultural and municipal/industrial contractors. These levies are collected in the CVPIA Restoration Fund and subsequently allocated to CVPIA fish and wildlife programs and projects.

Specific requirements in the Act relevant to the Refuges were to:

- Establish a CVPIA Restoration Fund (Fund), of which not more than 33 percent may be used for actions related to water deliveries to Refuges. Use the Fund to meet the fish and wildlife mitigation and restoration needs resulting from construction and operation of the CVP.
- Establish annual mitigation and restoration payments for CVP water and power contractors and water transfers for deposit into the Fund;
- Make mitigation and restoration of fish and wildlife an authorized purpose of CVP water and operations;
- Provide firm water supplies of suitable quality to maintain and improve wetland habitat areas on units of the National Wildlife Refuge System in the Central Valley of California; on the Gray Lodge, Los Banos, Volta, North Grasslands, and Mendota state wildlife management areas; and on the Grasslands Resources Conservation District in the Central Valley of California;
- Establish quantity and delivery schedules of water, measured at the refuge boundary, for the areas listed in the bullet above in accordance with Level 2 of the "Dependable Water Supply Needs" table in the 1989 report, and two-thirds of the water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin Action Plan;
- Provide refuge water through long-term contractual agreements with appropriate parties, supplemented by the increment of water provided. Provide such water whether or not such long-term contractual agreements are in place;
- By 2002, provide water to the boundaries of each refuge listed above at the quantity and delivery schedule in accordance with Level 4 of the "Dependable Water Supply Needs" table in the 1989 Report, and provide the water supply needed for full habitat development for those habitat areas identified in the San Joaquin Basin Action Plan/Kesterson Mitigation Action Plan Report;
- Acquire quantities of Incremental Level 4 water (to supplement Level 2 Water) in cumulating increments of not less than 10 percent per annum through voluntary measures which include water conservation, conjunctive use, purchase, lease, donations, or similar activities, or a combination of such activities which do not require involuntary reallocations of project yield;
- Reimburse all costs associated with acquiring, delivering, conveying and wheeling Level 2 Water from existing federal/Reclamation budgets;
- Share the costs associated of acquiring, delivering, conveying and wheeling Level 4 Water on a 75/25 percent basis between Reclamation and the State of California;
- Temporarily reduce deliveries of Level 2 Water up to 25 percent whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water and similar or greater reductions are imposed on agricultural contractors;
- Construct or acquire from non-federal entities water conveyance facilities, conveyance capacity, and wells necessary to deliver Level 2 and Incremental Level 4 Water, except for areas in or around the Sacramento–San Joaquin Delta Estuary.
- Allow for water banking of Level 2 and Incremental Level 4 Water as a strategy to meet refuge water deliveries;

- Authorize funding for non-federal entities to assist in water acquisition, conveyance, delivery and habitat restoration activities;
- Authorize land acquisition and associated water rights as a strategy to meet refuge water deliveries.

Based on the language of the Act, Congress' intent with respect to the Refuge Water Supply Program can be summarized as follows:

- Provide 555,515 AFY of dependable, firm water of suitable quality to the nineteen Central Valley Refuges by 2002;
- Provide 75 percent of the Level 2 Water supply (or approximately 333,188 AFY) to the Refuges in dry years;[6]
- To complete construction of new water conveyance facilities to the boundary of the individual Refuges by 2002;
- Develop and implement a program for the acquisition of a Incremental Level 4 water supply that should identify how the Secretary (of Interior) intends to utilize, in particular the following options: improvements in or modifications of the operations of the project; water banking; conservation; transfers; conjunctive use; and temporary and permanent land fallowing, including purchase, lease, and option of water, water rights, and associated agricultural land; and
- Achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal, and industrial and power contractors.

The provision of additional water to the Refuges was intended to:

- Protect, restore, and enhance fish and wildlife and associated habitats in the Central Valley;
- Address impacts of the Central Valley Project on fish, wildlife and associated habitats;
- Contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento–San Joaquin Delta Estuary; and
- Support the objectives of the Central Valley Joint Venture.[7]

E. Biological Effects of CVPIA Implementation

Development of the Central Valley Refuges generally involved grading or leveling former agriculture lands, some of which may have contained wetland depressions, into small parcels known as management units, some of which were surrounded by levees to facilitate the application and manipulation of water. Those units, collectively known as wetland units, create the potential for several wetland habitat types via (1) occasional irrigation to foster annual plant growth; (2) seasonal

[6] In California, based on precipitation and runoff, water years are identified by one of four categories: wet, average, dry, and critically-dry. Water years that are characterized as "dry" are sometimes identified as being a "non-critical" dry year. The dry year delivery mandate of Level 2 Water to the Refuges does not distinguish between a dry or critically-dry year.
[7] The primary objectives of Central Valley Joint Venture are to"…protect, maintain and restore habitat to increase waterfowl populations to desired levels in the Central Valley of California consistent with other objectives of the North American Waterfowl Management Plan."

inundation to stimulate invertebrate production and provide brood water, and (3) year-round inundation (if sufficient water was available) to provide pond water for both resident and migratory species.

Prior to CVPIA secure water supplies for the Refuges in the Central Valley were very limited and some Refuges had no access to any secure water. Refuges had varying levels of water rights, from some to none, and few options were available to convey purchased water from distant sources. Access to on-site water sources, including groundwater or surface flows was inconsistent, and water reuse opportunities, such as agricultural return flows with degraded water quality, were limited to a few locations. The internal water distribution systems of the Refuges were typically poorly designed, relied on inefficient application methods, and employed aging equipment. Water could not easily be moved between the units within the Refuges, individual units could not be hydrologically isolated, and filling or draining units was a slow process. Some units could only be filled or drained by moving water from one unit to the next.

In dry years, some Refuges could not provide any wetland habitat and in others, wetland habitats went dry at times critical to wildlife needs, sometimes resulting in the loss of broods or reduced survival of resident wildlife. Coordinated planning and action by managers among Refuges was limited, if not impossible.

The enactment of CVPIA increased the amount and quality of water available to the Refuges, enhanced the reliability of water supplies, improved the ability to deliver water on-demand, and greatly improved the potential to convey water to the Refuges (via the construction of external conveyance facilities). These improvements reduced waterfowl mortality from disease, improved body condition of some species, and improved habitat for several threatened and endangered (T&E) species. In response to the improved availability of water and the promise of water for optimum habitat management, the internal water distribution systems within the Refuges were substantially upgraded. As a result, many of the Refuges now have a relatively secure water supply for fall and winter irrigations, which has enabled the refuge managers to achieve many habitat management goals, including wetlands restoration, migratory bird conservation, and protection of some resident species. CVPIA also expanded the potential for year-round water at most Refuges, providing important forage foods for resident and some migrant wildlife and improving the range of options for migratory and resident species and habitat management.

While the water provided by CVPIA is important every year, the provision of relatively secure Level 2 Water supplies for Refuges in years of moderate to severe drought has improved the protection of the Central Valley's biodiversity, resulting in some progress toward the goals to protect, restore, and enhance fish, wildlife, and associated habitats.

For example, by 1990, the white-faced ibis had been designated as a species of special concern, typically a prelude to state and/or federal listing as threatened or endangered. Secure water from CVPIA and improvements in refuge management led to a significant turn-around in a relative short period. At the Sutter National Wildlife Refuge (NWR), the population increased from approximately 100 birds in 1991 to approximately 15,000 by 2005, while at Kern NWR, the population grew from 50 in 1991 to over 6,500 by 2005. (It appears that a subsequent decline in Incremental Level 4 Water

deliveries resulted in population declines, which underscores the critical relationship between the availability and timing of water deliveries and the biological productivity of wetland habitats.)

Wintering populations of wigeon, green-winged teal, northern shoveler, and gadwall all have increased and are stable due to improvements in water supplies and refuge management. The Refuges now provide for one of the highest densities of wintering wetlands-dependent raptors in the world, harboring species such as peregrine falcon, merlin, and bald eagle. Another species that greatly benefited from CVPIA is the white-fronted goose. The Refuges currently provide virtually all of this species' required roosting and foraging habitats where moist-soil and other wetland foods result from habitat types that can be provided in optimum measure only with Full Level 4 Water deliveries. In addition, the availability of year-round water has increased the population of non-bird resident species at many Refuges.

It should be noted that the positive aspects of CVPIA implementation were not achieved in isolation. In concert with the prospect of additional and more secure water, the Central Valley Joint Venture has brought many parties together to focus energy, planning resources, and funding on wetland restoration projects. These efforts have been guided by the goals of the North American Waterfowl Management Plan, and funding provided by the North American Wetlands Conservation Act, various California bond measures, foundations, the participating entities, and other sources.

F. Biological Significance of Central Valley Refuges

About the same time that the Central Valley Project was authorized, there was increasing interest in protecting and managing wetland habitats, largely because of decreasing populations of waterfowl during the drought of the 1930s. Over time, twelve federal National Wildlife Refuges were established (Colusa, Delevan, Kern, Merced, Pixley, Sacramento, Sutter and San Luis consisting of the East Bear Creek, Freitas, Kesterson, San Luis, and West Bear Creek units) along with six state Wildlife Areas (China Island, Gray Lodge, Los Banos, Mendota, Salt Slough, and Volta), and numerous private duck clubs. The location of the nineteen Refuges is shown on Figure 7 and Figure 8.

Although some of these areas were established to preserve and promote hunting of waterfowl, the functions of the Refuges include the conservation and protection of resident and other wetland-dependent species. Unfortunately as many of the Refuges are relatively small "postage stamp" habitats spread throughout a "sea" of agricultural lands and suburban development, the potential to maintain plant communities and less-mobile resident wildlife is compromised. Nevertheless, these Refuges remain of critical importance to the sizable but decreasing populations of shorebirds and migrant waterbirds along the Pacific Flyway and numerous threatened and endangered species, some of which are listed in Table 2.

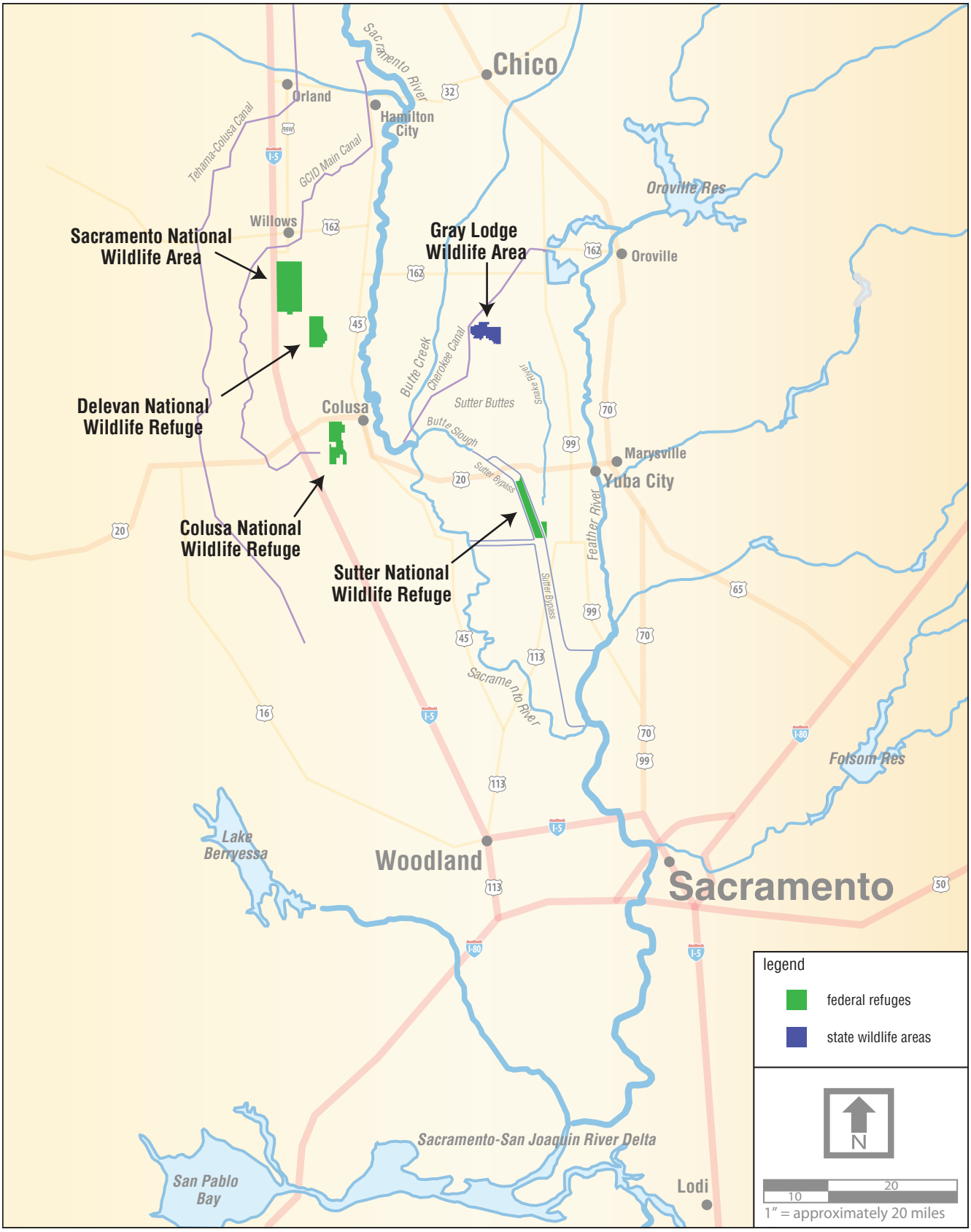

Figure 7 North-of-Delta Refuges Receiving CVPIA Water
SOURCE: Circlepoint, 2009

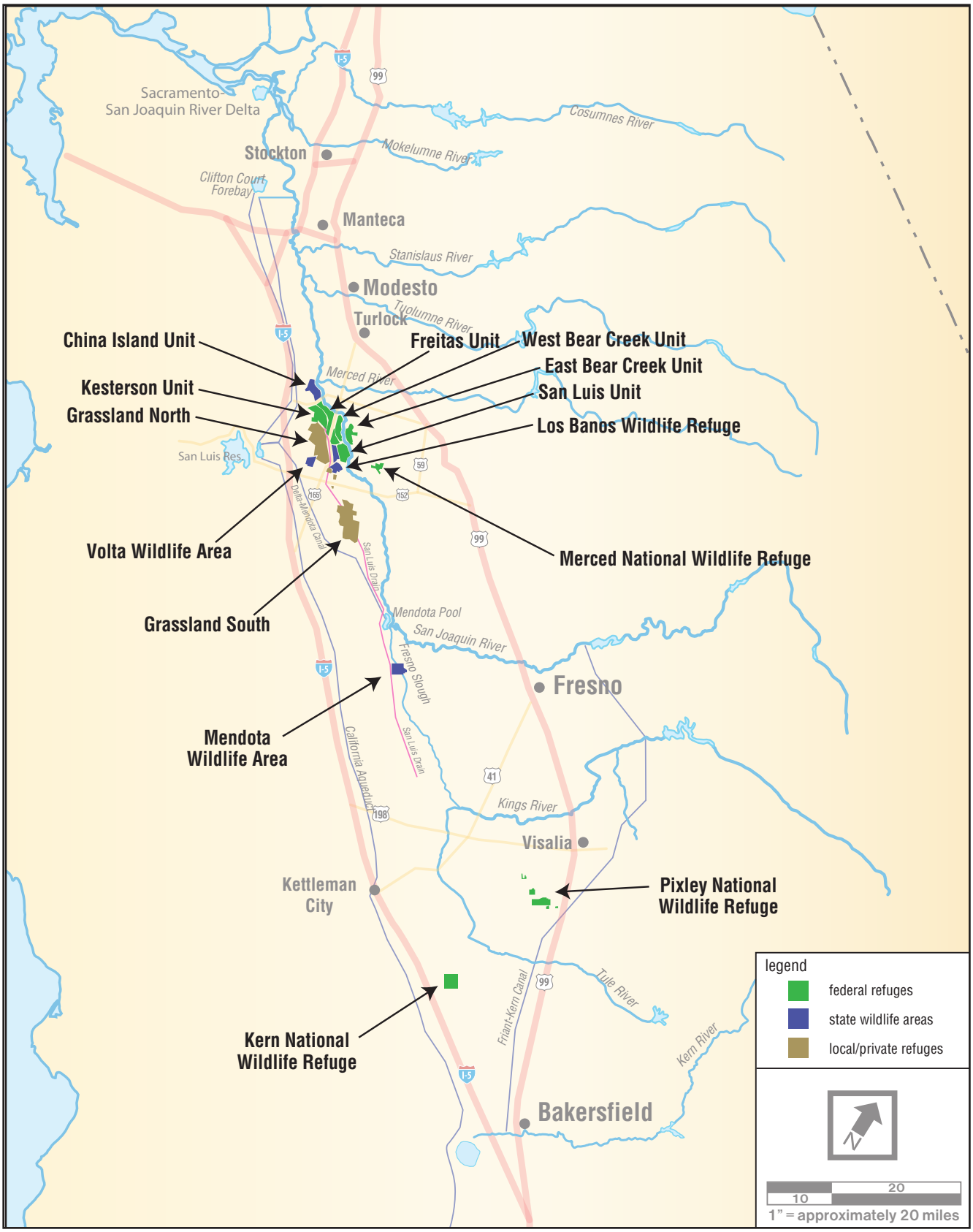

Figure 8 South-of-Delta Refuges Receiving CVPIA Water
SOURCE: Circlepoint, 2009

Table 2 Selected Federally Listed Species by Refuge

Refuge/Wildlife Area	Selected Threatened and Endangered Species												
	Tiger Salamander	San Joaquin Kit Fox	Swainson's Hawk	Palmate-Bracted Birds-Beak	Blunt-Nosed Leopard Lizard	Giant Garter Snake	Bald Eagle	Vernal Pool Fairy Shrimp	Vernal Pool Tadpole Shrimp	Peregrine Falcon	Tricolored Blackbird	Winter Run Chinook Salmon	Yellow-Billed Cuckoo
Sacramento Valley													
Sacramento NWR			X			X	X	X	X	X	X		
Delevan NWR				X		X	X			X	X		
Colusa NWR				X		X	X						X
Sutter NWR			X			X						X	
Gray Lodge Wildlife Area			X			X	X				X		X
San Joaquin Valley													
San Luis		X			X	X							
West Bear		X			X	X							
East Bear													
Kesterson		X											
Freitas		X											
Merced NWR	X	X	X			X		X	X		X		
Kern NWR		X			X								
Pixley NWR		X			X								
Volta			X				X			X			
Los Banos Wildlife Area		X	X			X	X			X	X		X
China Island			X			X	X				X		
Salt Slough			X			X	X				X		
Mendota Wildlife Area		X	X		X	X	X			X	X		X
Grassland RCD		X			X	X				X			

Human activity has reduced and fragmented wetland habitats throughout the Central Valley, such that today the Refuges represent only 5 percent of the historical area of wetlands. Some additional wetlands have been restored on private lands, and although these wetlands can provide valuable opportunities for wildlife to forage, roost, and nest, their availability to wildlife is highly seasonal and variable. Although some private wetlands are protected by easements, potential changes in agricultural practices

and the potential for conversion to other uses (including development) make the long-term availability of many private wetlands to wildlife uncertain.

Understanding the formative forces of Valley habitats and their physical evolution is the foundation of understanding the value of the Refuges and how these highly modified settings can be managed to maintain their remaining ecological integrity and maximize their ability to sustain both resident and migratory species. Those who envisioned the Central Valley Project Improvement Act and the authors of the Act identified the need to enhance the functions of the Refuges through the provision of adequate and reliable water supplies and the timely delivery of those supplies.

Wetland habitats in the Valley are distributed within Tulare Basin and San Joaquin Valley south of the Delta and the Sacramento River Valley north of the Delta (which the CVJV further divided into seven smaller basins because of their unique hydrologic conditions). The remnant wetlands within these areas have a discontinuous distribution, degraded functions, and are not present in the same proportions that existed prior to the mid-1800s.

Historically, the 4 million acres of wetlands in the Central Valley were immensely important to many resident and migratory wetland-dependent plant and animal species. Millions of birds and other wildlife used Valley wetlands continuously throughout the year, during migratory stopovers, and as a southern terminus during winter. During winter, these wetland habitats were invaded by millions of migrant waterfowl that depended upon the foods and security of these vast wetland areas to assure their continued existence on the North American continent. The migratory birds that moved into and through the Valley had many options to acquire the food resources needed for survival and reproduction, within the Central Valley and at more distant locations.

Today, the options for wetland-dependent migrant and resident species in the Central Valley are constrained and limited, especially during years of moderate to severe drought and during times of the year when private wetlands do not contain water. At those times, the Refuges may have the only water needed by wetland-dependent migrant and resident species.

The migratory species moving through and within the Valley must depend on the highly modified and managed wetlands within the boundaries of the Refuges and limited seasonal wetlands on private lands. The ability of migratory species to rely on wetlands outside of the Central Valley has declined. The Salton Sea, a large salt sink that receives agricultural drainage water in the Coachella Valley, provided valuable habitat during much of the twentieth century, but is rapidly becoming too saline, degrading the amount and availability of foods for waterfowl. Wetland habitats in the Colorado River Delta, other coastal areas of Mexico, and Highlands of Mexico are also greatly degraded.

Because of the changes to the wetlands surrounding the Central Valley, the condition of the remaining wetlands in the Central Valley is crucial to the reproductive success and survival of many migratory species. The Service has identified several bird species that are below desired numbers, including: canvasback, ring-necked duck, western population of wood duck, cackling Canada goose, greater white-fronted goose, tule white-fronted goose, northern pintail, western population of mallard, redhead, lesser scaup, and American wigeon. Because these migrants arrive in the Valley on different schedules and have different food, habitat, and social preferences and requirements, management of

the Refuges is not an easy task, and is made even more difficult by yearly fluctuations in water availability resulting from the lack of Full Level 4 Water deliveries.

The potential success of all wildlife that depend on the Refuges can be described and measured in terms of bioenergetics, which quantifies the energy value and availability of foods consumed by wildlife. Each species must have the necessary type and abundance of foods available when needed to maintain body condition for growth, reproduction, and survival. For example, geese are dependent upon plants to meet their protein needs, thus the habitat and hydrologic conditions that favor establishment and growth of plants desired by geese is essential to meet the geese's bioenergetic needs for molt and reproduction. For most shorebirds and ducks, invertebrates provide the protein required to meet their nutritional needs. The production, abundance, and availability of desired plant and invertebrate foods in wetlands are directly linked to the presence, timing, and abundance of water. Therefore, provision of water with the proper volume, timing, frequency, and depth is critical to insure that the ecological potential of a refuge can be maximized.

As the concept of refuge management has moved from protecting individual species to the preservation of habitats and biodiversity, the biological significance of the Refuges can no longer be measured solely in terms of the amount of water delivered or the numbers of individual birds of a species roosting on a refuge. Instead, the connection between timely water deliveries and the bioenergetic production capacity of the Refuges should guide RWSP management decisions. In addition, although individual Refuges may be isolated islands, if operated cooperatively and in unison within biologically significant geographic areas, they have the potential to function as a more tightly integrated system, offering a wider array of habitats that more closely mimic historic diversity and can better enhance both resident and migrant wildlife populations. Because the Central Valley Refuges provide the primary remnant habitat for the majority of Pacific Flyway waterfowl during the winter, those species would benefit from the improved integration of refuge management throughout the entire Central Valley.

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III. RATIONALE FOR RECOMMENDATIONS

A. Introduction

This section outlines the rationale that the Panel used in developing their recommendations for the five areas of the program that were reviewed by the Panel. For each of these areas, this report provides:

- An overview of the topic;
- Identification of the critical questions to be addressed;
- Identification of what is working;
- Identification of what is not working; and
- Panel Recommendations.

B. Water Supply

1. Overview

Prior to the passage of CVPIA, the firm water supply provided through surface water rights or long-term water contracts for the Refuges was approximately 121,700 AFY, while total annual deliveries averaged 422,251 AFY, including surplus CVP water, surplus runoff flows, agricultural return flows, and some wastewater treatment flows at some locations. Quantity, quality and timing of delivery varied, often challenging effective refuge management. Since the Act was passed, firm water supplies with scheduled delivery to the Refuges' boundaries have been increased (to approximately[8] 386,000 AFY since 2002) and the total average amount of water delivered to the Refuges has increased by 16 percent (to approximately 443,000 AFY). The passage of the Act has improved the quantity, quality, delivery flexibility, and reliability of water delivered to the 14 Refuges with completed delivery facilities out of the 19 federal, state, and private Refuges covered by the Act. As discussed previously, this has resulted in important improvements to the management and biological productivity of the Refuges. However, annual deliveries since the Act was passed have averaged only 80 percent of the Full Level 4 mandated 555,515 AFY annual water supply, with substantial annual fluctuations in Incremental Level 4 water supplied.

Because the Refuges generally focus on utilizing available water to accommodate migratory and wintering waterbirds, despite the shortfall in supply, the "fall flood-up" at the Refuges still occurs on an annual basis. The effect of the shortfall is most noticeable at other times of the year in spring, summer and very early fall, when water is needed to improve annual food production for resident and migratory wildlife, provide seasonal water for breeding birds, assure adequate habitat for broods, and

[8] The Panel cannot independently confirm the actual level of water deliveries, as it was provided conflicting data and was informed that the data variations relate to discrepancies in water volumes that were contracted for, delivered to a refuge boundary, or reported during the 1990s. The water supply numbers contained herein (and in Appendix E: Supporting Tables) are the Panel's best guess to determine which numbers may be closest to actual, although given the poor underlying data, this issue cannot be resolved with any more precision. Thus, all water supply numbers should be considered approximations.

maintain year-round water pools for both resident and migratory species. In practice, the firm Level 2 Water supplies are primarily used for the fall flood-up, while Incremental Level 4, when available, may in addition be used to support year-round habitat needs (e.g., during the spring and summer).

2. Critical Questions

Reclamation provided the Panel with the following critical questions related to Water Supply:

1. How well have short-term and long-term water supply strategies supported refuge water supply goals? What strategies would maximize program goals given past levels of funding appropriations?
2. How can the program address external water supply constraints and trends that affect the refuge water supply program?

3. What is Working?

a) Level 2 Water

The provision of Level 2 Water was intended to provide firm and dependable deliveries scheduled to meet the individual Refuge's water requirements in place of the historically delivered average but variable and unscheduled annual supplies. This was to be done by providing CVP (and other) water to replace and/or augment the historical supplies. Since 2002, Level 2 Water supplies have averaged approximately 386,000 acre-feet annually, or approximately 92 percent of the specified amount of Level 2 Water, as shown in Figure 9.

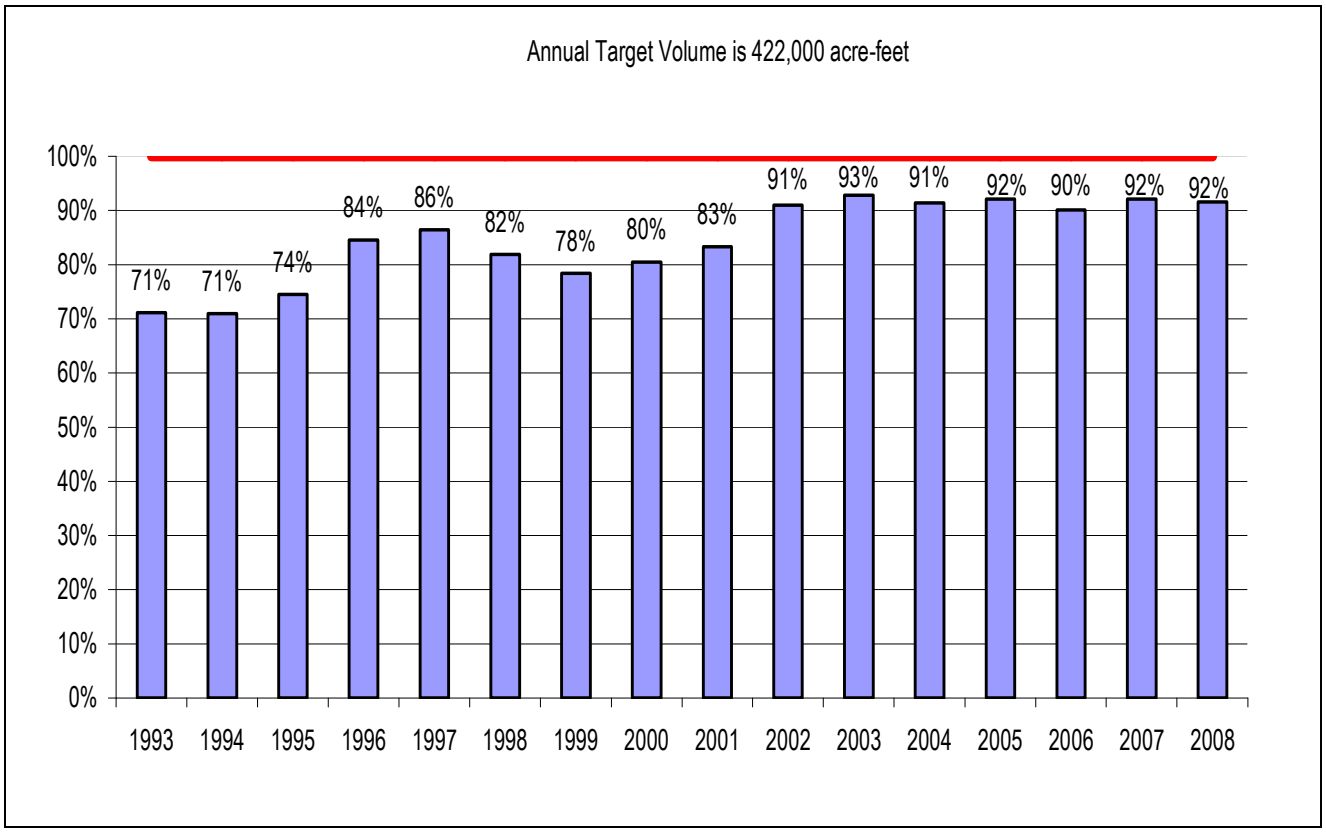

Figure 9 Actual Annual Deliveries of Level 2 Water Compared to Mandated Level of 422,251 AFY

As the historical firm supplies to the Refuges were only approximately 121,700 AFY prior to CVPIA and since the Act mandates the delivery of Level 2 Water from CVP supplies (which come from a variety of sources including surface storage reservoirs) and other diverse non-CVP sources, the delivery of scheduled water supplies to meet individual Refuge needs has improved. As the remaining conveyance construction projects are completed, and if water supplies are treated as one fungible pool, annual Level 2 deliveries should increase to fulfill the Act's Level 2 requirements. Additionally, the Act assures that the Refuges will receive at least a 75 percent allocation of Level 2 in dry years. Thus, the Panel concludes any efforts to reduce dry-year deliveries to the Refuges to a lesser amount are unwarranted.

b) Incremental Level 4 Water

Annual Incremental Level 4 Water deliveries have averaged approximately 55,000 acre-feet since 1994, which when combined with Level 2 supplies, represent a 13-percent increase over historical water deliveries to the Refuges. While this long-term average is an increase in Refuge water, the Level 4 supplies may now be trending downward, as 2008 Level 4 Water deliveries decreased to just 38,000 acre-feet (see Figure 10). Reclamation has utilized some medium (e.g., 5-year) and long-term (e.g., 20- to 25-year) contracts to provide Incremental Level 4 Water. These contracts have helped improve water supply reliability and cost management and reduce transaction costs to Reclamation staff, when compared to single-year, spot market purchases.

The 5-year agreement with the San Joaquin River Exchange Contractors Water Association (SJRECWA) has proven to be an effective agreement that provides between 9,750 and 39,833 acre-feet depending on CVP's south of Delta allocations for agricultural contractors. Significantly, the contractors initiated the agreement.

RWSP has executed two contracts to acquire long-term water supplies. In 1998, RWSP acquired 6,300 acre-feet of contract supply water from Corning Canal Contractors (Corning-Proberta-Thomes Districts) at $700 per acre-foot for the remaining life of the contract. In 2006, Reclamation acquired a total of 3,000 AFY at $700 per acre-foot under a long-term contract from Anderson-Cottonwood Irrigation District, a Sacramento River CVP contractor. Of this amount, 1,000 AFY was purchased as Incremental Level 4 Water.

With respect to the cost of water acquisitions purchased on the spot market, it appears that the prices paid by the RWSP between 2004 and 2008 are generally consistent with the costs that other entities are likely to have paid during that period. For example, the EIS/EIR for the Water Transfer Program of the SJRECWA included water cost estimates (from a database of ninety transactions in the San Joaquin Valley between 1990 and 2004). This analysis determined that water prices increased approximately $8 per acre-foot per year, that prices were $30 to $40 per acre-foot higher in critically dry years than non-critically dry years, and that groundwater prices were $35 dollars higher than surface water prices. Table 3 identifies the prices used in the EIR/EIS analysis.

Table 3 Assumed Water Prices to Different Groups of Transferees in Noncritical and Critical Years (Dollars per Acre-Foot)

Transferee Group	Noncritical	Critical
Agricultural	$90	$150
Refuges	$125	$200
M&I	$185	$300

SOURCE: Final EIS/EIR SCH# 2003101106, *Water Transfer Program for the San Joaquin River Exchange Contractors Water Authority 2005–2014* (Prepared by URS for Department of Interior and San Joaquin River Contractors Authority, December 2004) Table 8-17, p. 8-21.

c) Water Quality

Water quality has improved compared to pre-CVPIA conditions, largely because of a shift in sources. Groundwater and agricultural drainage were largely phased out under CVPIA, particularly for the Refuges south of the Delta, in favor of CVP water from developed surface storage facilities and other surface sources.

4. What is Not Working?

a) Level 2 Water

Although CVPIA Level 2 deliveries have averaged approximately 92 percent of the mandated levels, some Refuges have received substantially less than their allocations, primarily due to a lack of completed conveyance facilities (as discussed below). For example, during the period of 2002–2007, East Bear Creek received less than 38 percent, Pixley NWR received 55 percent, and Sutter NWR received only 68 percent of their Level 2 Water supplies. It appears that the lack of external conveyance facilities may have limited systemwide deliveries to only 92% of the mandate over the last seven years. If the completion of the external conveyance facilities is ongoing, it is unclear why the Level 2 delivery gap appears to be holding steady. In addition, the Panel has been informed that Level 2 water is fungible in terms of timing and delivery location. Rather than meet the Level 2 mandate and deliver water to any Refuge that needs it, it appears Reclamation holds approximately 34,000 AFY per year in the CVP pool and makes that water available to other CVP users. The panel cannot comprehend why this "lost" refuge water isn't used to minimize the shortfall in Incremental Level 4 Water deliveries (discussed below) to those Refuges with adequate conveyance capacity.

b) Incremental Level 4 Water

The sum of Incremental Level 4 Water requirements for all Refuges is 133,264 AFY, with a total of 27,750 AFY for the Sacramento Valley Refuges and 105,514 AFY for San Joaquin Valley Refuges. Figure 10 shows the actual deliveries of Incremental Level 4 water deliveries compared to the objectives mandated in the Act. Actual deliveries fell far short of the Incremental Level 4 mandate.

The Panel considered detrimental Reclamation's discretionary decision to manage Levels 2 and Incremental Level 4 separately instead of as one fungible pool. The evidence indicates that had Reclamation managed Levels 2 and Incremental Level 4 water as one fungible pool, the unused L2 water could have allowed the program to fully meet its Incremental Level 4 mandate in some years and almost double its deliveries in others (See Figure 10, "Inc Level 4 with Unused L2"). Since 2002, the 8% of unused Level 2 amounted to about 34,000 acre-feet, which would have been equal to or greater than Incremental Level 4 acquisitions in some years. Managing both water pools as one, as the Panel recommends, would have paid handsome dividends to those habitats that rely disproportionately on Incremental Level 4 supplies, namely the south-of-Delta refuges and year-round wetland habitats.

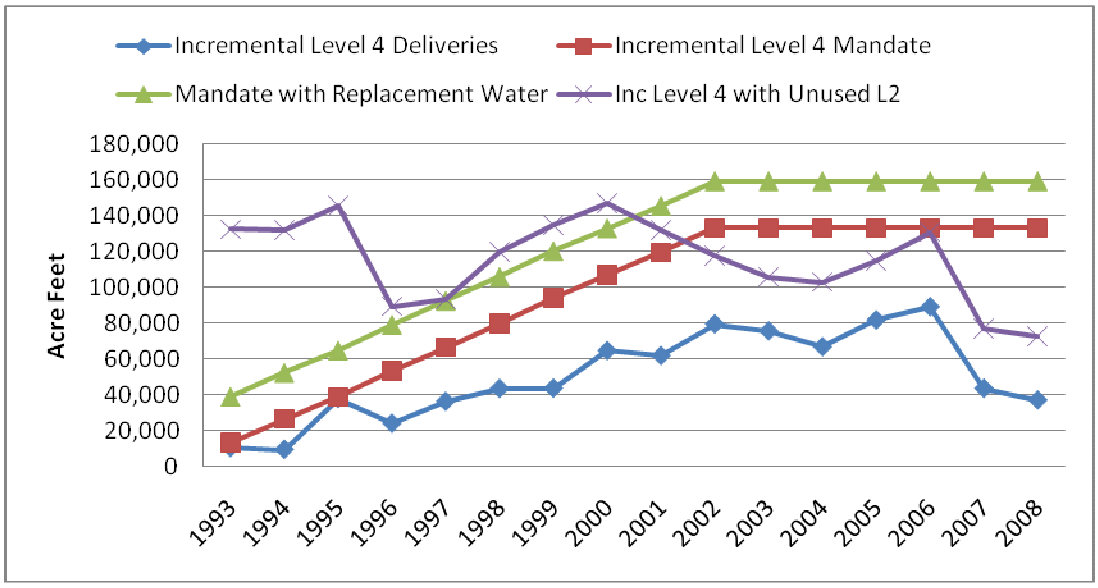

Figure 10 Incremental Level 4 Supplies 1993–2008

Prior to the enactment of CVPIA, Reclamation agreed to acquire water from willing sellers and "replace" a portion of the water that was to be allocated to the federal and state Refuges in the Grasslands complex.[9] Although the Panel was informed that the precise details of this agreement are somewhat unclear, the implication is clear: Reclamation must acquire an additional 26,007 AFY of "replacement" water above and beyond the level of Incremental Level 4 Water specified in the Act. Thus, the total amount of water that must be acquired to satisfy the mandate of the Act and Reclamation's agreement for replacement water is 159,271 AFY (see Figure 10, "Mandate with Replacement Water.").

The delivery of Incremental Level 4 Water has fallen far short of the mandated levels, which totaled 159,271 AFY by 2002, as shown in Figure 10. Annual Incremental Level 4 Water acquisitions have been subject to significant variation, making it difficult for refuge managers to plan effectively and maximize ecological productivity, which has diminished habitat quality and quantity for wetland-dependent species in some years.

Although the Act mandated the acquisition of Incremental Level 4 Water in cumulating increments over a 10-year period "… through long-term contractual agreements with appropriate parties …" to date Reclamation has primarily utilized short- and medium-term transactions from the spot-market,

[9] Per the Refuge Water Delivery Tables (Reclamation, July 31, 2009), Replacement Water is the amount of water that the San Luis, Freitas and Kesterson Units of the San Luis National Wildlife Refuge Complex and the Volta and Mendota Wildlife Management Areas have historically received and used which is more than the Level 2 amounts identified in the "1989 Reports" but may be less than or equal to the Incremental Level 4 amounts. Replacement Water was originally provided by groundwater and tailwater but due to water quality concerns, Reclamation entered into agreements authorized by P.L. 83-674, Waterfowl Management, Central Valley Project, August 27, 1954, as amended by the Act of November 8, 1978, and P.L. 99-456, Water Resource and Small Reclamation Projects Act, October 27, 1986, to provide the Replacement Water prior to CVPIA. Reclamation will acquire and provide water to the Project to replace the Replacement Water when willing sellers and funds are available so as to minimize the impact to CVP contractors South of the Delta.

which requires substantial staff time and effort and creates significant annual transaction costs, repetitive regulatory burdens, and annual variability in water supply reliability, timing, and planning.

Perhaps most significantly, the Act required development of a proactive program to strategically utilize a variety of mechanisms to assemble a portfolio of diverse water sources that would provide firm, dependable Incremental Level 4 water supplies. It appears no such strategic plan was designed, developed, or finalized. Instead, RWSP seems to have conducted transactions in an ad-hoc manner, leasing short-term, annual water, and waiting to see if any agricultural contractors walk in the door with surplus agricultural water. This practice of acquiring annual spot market water provides neither firm nor dependable water and undermines refuge managers' abilities to optimize habitat management. It appears however, that there have been lost opportunities to add to firm water supplies that RWSP didn't pursue or develop.

RWSP has participated in two transactions to acquire long-term water supplies. In 1998, RWSP acquired 6,300 acre-feet of contract supply water from Corning Canal Contractors (Corning-Proberta-Thomes Districts) at $700 per acre-foot for the remaining life of the contract. In 2006, Reclamation acquired a total of 3,000 AFY at $700 per acre-foot under a long-term contract from Anderson-Cottonwood Irrigation District, a Sacramento River CVP contractor. Of this amount, 1,000 AFY was purchased as Incremental Level 4 Water. Despite the substantial need for Incremental Level 4 Water south of the Delta, most of these supplies have been delivered north of the Delta.[10]

Thus, in the nearly 17 years since passage of the Act, RWSP has only secured 7,300 acre-feet under two long-term contracts with Sacramento Exchange contractors and an additional 9,750 to 39,833 acre-feet under a 5-year contract with the SJRECWA. Despite the mandate to provide firm dependable supplies of 159,271 AFY (for both Incremental Level 4 and Replacement Water), only minor amount of long-term water has been secured.

With wheeling rates climbing quickly and water costs on the rise, the dependence on the spot market is not financially sustainable. For example, if the RWSP hypothetically acquired and delivered all Incremental Level 4 Water supplies at current spot market water costs and wheeling rates,[11] acquisition of the water would cost approximately $47.8 million and wheeling that water would cost approximately $3.2 million, for a combined total of $51 million, nearly as much as the entire Restoration Fund budget. Without future cost control and management of wheeling rates and water costs through long-term and dependable water sources, the program is likely to be financially unsustainable. While all future years are unlikely to be dry or critically dry, firm water supplies are vitally important to the Refuges in such years.

In recent years, a good example of providing dependable supplies has been the 5-year contract with the SJRCWA. This is the kind of deal RWSP should do more of: multiple year, firm, dependable water supplies that refuge managers can integrate into their habitat planning. Even so, RWSP has placed too

[10] In response to a Panel query about the utilization of the long-term water acquired from the Anderson-Cottonwood Irrigation District, RWSP staff reported "Some of this water is delivered to Refuges NOD, mostly to Delevan NWR. On occasion we have been able to deliver some of this water south of the Delta, but these opportunities are rare as this water is given a relatively low priority for pumping across the Delta."

[11] Assuming acquisition costs of $300 per acre foot and wheeling costs of $20 per acre-feet.

much reliance on this single water supplier. During the WY2002–2008 period, the RWSP secured 58 percent of the Incremental Level 4 Water supply from this supplier. As a result, it is likely that RWSP holds very little leverage in negotiating more favorable prices.

The RWSP has not developed sufficient local water sources for use during critically dry years. Thus, RWSP risks being subjected to increasing water prices, especially if market conditions continue to be unfavorable due to variable supply availability; continued restrictions on Delta pumping capacity; increasing demand by M&I and agricultural users; reductions in source water quality, and increased reliance on lower-quality groundwater.

Despite the mandate of the Act to acquire and deliver Full Level 4 supplies by 2002, Reclamation staff indicated that the reasons for the under-performance of Incremental Level 4 Water acquisitions are the lack of water (e.g., dry years), deals (e.g., willing sellers), and money (e.g., available funding in restoration fund). Yet, it appears that water deals between CVP contractors occur frequently, even in dry years. For example, this year Westlands Water District purchased 240,000 acre-feet of surface water that is in carryover storage in San Luis Reservoir. And while several regional water banks have been developed in the San Joaquin Valley since 1992, the RWSP has not participated.

The outlook for funding could also be improved. Despite the ongoing potential for water acquisitions, after requests by program staff to include supplemental funding in Reclamation's budget request to Congress were denied in the early years of the RWSP, it appears that staff ceased requesting any supplemental funding and no longer aggressively pursues all potential opportunities.

RWSP staff has drafted various strategies for long-term water acquisition. However, it appears that few, if any actions from any of these strategies have been implemented. Limitations on the acquisition of reliable, long-term water supplies may have been due to:

- **Seller Perceptions**. Reluctance of sellers to offer water for sale to Reclamation for various reasons. Potential reasons may include beliefs that RWSP won't pay sufficient prices and can't complete transactions in a timely manner (due to bureaucratic requirements or red tape).
- **Pumping Priority**. Reclamation appears to have imposed a low priority to acquired refuge water at the Delta pumps, which discourages increased investment in water north of the Delta for use in the San Joaquin Valley.
- **Funding Source and Availability**. Due to increasing costs over time, funding for the RWSP is insufficient to make the acquisitions needed to achieve Incremental Level 4 requirements and RWSP staff long ago ceased requests for supplemental federal funding. RWSP also cannot carry-over funds from year to year to establish a pool of funds to cover the high costs of reliable acquisitions. Therefore, RWSP would need to rely on special appropriations, non-federal funding, or money that would otherwise be used for spot purchases. These options may undermine assurances for getting a deal done, and therefore weaken the perception of RWSP as a potential buyer.

- **Federal appraisal hurdles**. RWSP cannot meet market water prices because of perceived "Yellow Book"[12] limitations on the federal appraisal guidelines for acquiring real property.
- **Low Priority**. Very little staff time and energy has been devoted to developing or implementing strategies or programmatic plans for acquiring reliable water supplies.
- **Competing Priorities**. Staff acknowledges that it is useless to even have a conversation about acquiring senior water rights, because of the internal hurdles and constraints regarding funding, approvals and internal politics related to competing water allocations and funding needs within Reclamation, especially given the perceived low priority status for refuge water vis-à-vis other CVP contractors.

As the relative proportion of Incremental Level 4 Water (as a percent of Full Level 4) varies between the Refuges (between 0 and 79 percent), the effect of inadequate water acquisitions also varies, with a disproportionate impact to the Refuges located south of the Delta. Several Refuges are at a significant disadvantage, particularly Kern NWR and Pixley NWR (where few, if any, wetland habitats are available in the surrounding areas). Thus, one result of the ongoing failure to acquire sufficient Incremental Level 4 Water (or reallocate Level 2 Water supplies among Refuges to augment the shortfalls in Incremental Level 4 Water) has been a significant loss of ecological productivity in the very area where wildlife could most benefit from adequate water supplies. For example, the 1989 Refuge Water Supply Report estimated that delivery of Full Level 4 water supplies would increase annual bird-use days[13] from 6,000 to 4.2 million at Pixley NWR and from 7.2 million to 73 million at Kern NWR.

c) Water Quality

While water quality in the San Joaquin Refuges post-CVPIA enactment has been improved, quality continues to be of significant concern to refuge managers especially for salts, selenium, and boron. To assure that high-quality water is supplied to the Refuges, testing of water supplies has been implemented by Reclamation, but testing has only been implemented relatively recently and it is not clear whether there is a systematic approach to such monitoring for all Refuges.

Existing water supply contracts (for both acquisition and conveyance) generally specify that water delivered to Refuges should be of suitable quality, but there are apparently no numeric standards in existing contracts for specific contaminants and no requirements that contractors test supplies to assure the quality of the water is suitable for refuge purposes.

[12] The "Uniform Appraisal Standards for Federal Land Acquisitions" (or Yellow Book) sets standards for allowable appraisal and valuation methods for all federal acquisitions of real estate, but are also applied to water right acquisitions. Hence, an appraisal of water right acquisitions by a federal agency is based on what are often characterized as inappropriate standards. As a result, water transactions with federal agencies may be subject to a higher degree of risk, due to the difficulty of reaching agreement on the market value of a water right.

[13] A "bird use day" is the number of days that a single bird would be present for a 24-hour period.

5. Recommendations

To achieve the aims of the Act, the Panel recommends the following actions:

a) Within 18 months of the public release of this report, Reclamation should, in consultation with the Inter-agency Refuge Water Management Team, contract with an independent, third-party entity for the purpose of acquiring all Incremental Level 4 water. All Restoration Fund monies available for acquiring Incremental Level 4 Water should be made available to this independent entity, and the entity will be responsible for all Level 4 Water transactions undertaken using these monies.. This independent entity would select and fund proposals from other qualified public and private entities to acquire Incremental Level 4 Water and, if cost-effective, wheel the acquired water. This program should be modeled after other successful programs such as the Columbia River Basin Water Transaction Program and the Deschutes River Conservancy.

   The attributes of the independent entity should include:

   - Authority to receive and disperse funds (from the CVPIA Restoration Fund and other public and private sources), including disbursements to partner entities for transaction and operational costs related to the development of diverse water sources;
   - Representative decision-making board which shall establish criteria to assess the merits of proposals, which shall include the full suite of measures identified in the Act, including water conservation, transfers, conjunctive use, purchase, lease, donations, fallowing, land acquisition, or similar activities;
   - Public process for the solicitation, review, and approval of grant proposals for water acquisition projects with clear conflict-of-interest guidelines;
   - Administrative and technical competence and capacity to originate, review, and execute water acquisition, development, and wheeling proposals;
   - Process to qualify entities that can develop water supply sources; and
   - Ability to establish a close working relationship with the funding agency.

   This third-party entity and its program should adopt a portfolio approach to develop alternative water supplies to provide leverage against increasing spot market prices, especially in dry and critically dry years, in order to assemble a diversity of sources, in different water year types and in all geographic locations, which could include:

   - Acquisition of senior water rights;
   - Acquisition of long-term leases (e.g. 15-50 year);
   - Leasing of mid-term contracts of 5-10 years (similar to the current contract for the San Joaquin River Exchange Contractors Water Authority) with potential suppliers;
   - Spot market purchases of short-term water supplies to supplement firm and reliable supplies (medium and long-term supplies) as needed;

- Short- and mid-term contracts for spot market water as needed (similar to the current contract for the San Joaquin River Exchange Contractors Water Authority) with other potential suppliers;
- Further development of local water resources, especially for use in dry years, such as groundwater and conjunctive use capacity and water treatment capability to accept brackish groundwater or irrigation return water with degraded water quality; and
- Development of partnerships with others to develop regional groundwater banking operations, conservation, or purchase of shares in existing groundwater banking operations if total costs are below projected critical-dry year water costs.

Proposals to the third-party entity to acquire water should include analysis of wheeling options and costs, and if deemed cost-effective, could result in negotiations and agreements to wheel, exchange, or otherwise deliver the water. Reclamation would be responsible for constructing conveyance to ensure that Full Level 4 water could be delivered per the CVPIA.

The third-party entity should include water quality specifications in all future water supply and conveyance contracts to assure that acquired and conveyed water supplies are of suitable quality.

Given the unmet deadline to reach the mandate for the provision of Full Level 4 Water by 2002, Reclamation should place the highest priority on the funding and implementation of this recommendation and proceed as expeditiously as possible.

C. Water Conveyance (Delivery)

1. Overview

Prior to the CVPIA, the Refuges had varying levels of water rights and few options to convey water from distant sources. Most Refuges had to utilize on-site water sources, including surface flows, which were highly seasonal, and groundwater and agricultural return flows, which often were of poor quality. In addition, water distribution systems internal to the Refuges suffered from poor design, inefficient application methods, and aging infrastructure.

Following passage of the Act, Reclamation analyzed two options to convey water from CVP canals or river systems to meet Refuge water needs: (1) an independent system that would require building and operating a network of dedicated canals and associated facilities (which would be “independent” of the network of existing canals owned and operated by other entities); and (2) a dependent system that would rely on existing water conveyance facilities located near Refuges, which are owned and operated by water and irrigation districts. In addition, the dependent system would require new conveyance facilities to convey water from the existing network of canals to the boundary of the Refuges. Ultimately, Reclamation elected to pursue the dependent system, including the construction of new conveyance canals (by Reclamation) and the subsequent transfer of ownership of the canals to water and irrigation districts. These districts operate and maintain the new conveyance facilities, convey water to the Refuges, and charge Reclamation for the costs of conveyance (including recovery of their operating and maintenance costs).

As a result, CVPIA has substantially improved the ability to deliver water to the Refuges via these external conveyance facilities and contracts with the local water and irrigation districts. The improved ability to deliver water to the Refuges served as an impetus to upgrade the internal water distribution systems within individual Refuges. As a result, the application and management of water within the Refuges has also substantially improved.

2. Critical Questions

Reclamation provided the Panel with the following critical questions related to Water Delivery:

3. How well has the program prioritized actions and allocated available funding for construction and conveyance activities, to maximize achievement of the goals stated in the Act? What additional actions still need to be addressed?

4. What options are available to improve water deliveries to the Refuges? Considering conveyance costs and available funding, how can the conveyance program best be sustained over time?

3. What Is Working?

a) Conveyance Construction

Since passage of the Act, Reclamation (and the Service at some locations) has completed construction of external conveyance facilities to high points on the Refuges' boundaries with sufficient capacity to deliver Full Level 4 Water supplies (if and when available) to fourteen Refuges, including: Sacramento NWR, Delevan NWR, Colusa NWR, San Luis Unit, West Bear Creek Unit, Kesterson Unit, Freitas Unit, Kern NWR, Los Banos WA, China Island Unit, Salt Slough Unit, and the Grassland RCD.

b) Timely Deliveries

Since enactment, based on input from Refuge managers, it appears that when fully available, Level 2 Water has generally been delivered on schedule and on-demand.

c) Conveyance Costs

Reclamation successfully negotiated long-term wheeling agreements with the water and irrigation districts to convey water to Refuges boundaries via the new conveyance facilities. One significant success since CVPIA was enacted is that the costs to convey water have remained flat for the Biggs West Gridley Water District, Central California Water District, Grassland Water District, and the San Luis Canal Company.

4. What Is Not Working?

a) Conveyance Construction

Despite the Act's mandate to deliver, and thus convey, Full Level 4 water by 2002, external conveyance facilities with sufficient capacity for Full Level 4 supplies have not been completed at five

of the nineteen Refuges covered by the CVPIA. It appears that Reclamation completed the conveyance construction projects with the most straight-forward solutions first and did not prioritize the projects based on (1) potential biological benefits, such as the information provided in the 1989 Refuge Water Supply Investigations (e.g., Table II-3, which estimated potential increases in bird-days from increased water supplies); (2) the magnitude of water supply needs of individual Refuges; or (3) the total cost of each construction project, as it may have been more cost-efficient to construct the most expensive projects first, reducing the budgetary impact of future cost escalations (due to inflation).

The five Refuges for which conveyance construction has not been completed are:

- **Gray Lodge Wildlife Area**—The project is underway and will be complete by 2011.
- **Sutter National Wildlife Refuge**—The conveyance system is still in the planning stage, and as a result, the refuge currently lacks sufficient external conveyance facilities to receive Full Level 4 Water supplies.
- **East Bear Unit**—Phase 1 has been completed but Phase 2 is still in the planning stage.
- **Mendota Wildlife Area**—Negotiations with Central California Irrigation District are pending to determine an equitable federal and non-federal cost share for the project. The results of negotiation will determine which of two proposed alternatives will be implemented.
- **Pixley National Wildlife Refuge**—The conveyance system is still in the planning stage, and as a result, the refuge currently lacks any external conveyance capacity to receive Full Level 4 Water supplies.

b) Timely Water Deliveries

Changes in the availability of water have occasionally resulted in the cessation of water deliveries to the Refuges. For example, in summer of 2008 Reclamation requested that June through August allocations of Incremental Level 4 Water to the Refuges be deferred until the fall. It appears that Refuge managers believed they had little choice but to comply, despite the potential for adverse biological consequences. Presumably, delivery of spring semi-permanent/brood water and year-round pond water had occurred and wildlife drawn to the Refuges were likely subjected to deleterious conditions when the lack of summer water deliveries resulted in the loss of wetland habitats.

As noted above, Incremental Level 4 Water was seen as the means to supplement historical water application patterns, provide for year-round water, and expand wetland acreage. The inability of the RWSP to secure long-term or firm Incremental Level 4 Water supplies has resulted in considerable variation in the availability of this source. This has limited the ability of refuge managers to provide year-round water or expand wetland acreage and has undoubtedly resulted in adverse biological consequences. The effective use of Level 2 and Incremental Level 4 Water must be synchronized to optimize Refuge management, as there is no distinction between the two sources of water once it crosses refuge boundaries.

c) Conveyance Costs

Overall program costs for conveyance have increased dramatically during the program lifetime, as the total amount of conveyed water has generally increased and contractual cost escalation clauses have

been invoked. The FY09 Restoration Fund budget identifies an operating budget of $8.9 million, the largest single item in the entire Restoration Fund budget. From 2003 to 2007, wheeling costs totaled $81,437,343, again the largest budget item in the Restoration Fund over that period (exceeding even the expenditures to acquire Incremental Level 4 Water: $78,618,809).

Cost-escalation clauses in many conveyance contracts allow contractors to request increases in wheeling rates to cover operational costs, which has substantially increased wheeling costs for several contractors (from 115 to 169 percent since execution of these contracts, as shown in the Tables in Appendix C), and it is presumed that these contractors will likely continue to seek future rate increases, consistent with their contracts. The conveyors with the largest increases in wheeling rates represent 56 percent of the water delivered to the Refuges. What is not clear is why during this same period, wheeling rates for some contractors (as noted above) have remained flat.

The decision to pursue a dependent system, build and then transfer ownership of the new conveyance facilities to third parties, and enter into long-term conveyance contracts, many with built-in cost escalation clauses, essentially predetermined ongoing increases in conveyance costs. The history of cost increases suggests that wheeling rates will continue to increase, reducing overall budget resources for other CVPIA programs. For example, under a scenario of Full Level 4 deliveries, and if all conveyance costs come from the Restoration Fund, wheeling costs (in 2009 dollars) could be approximately $11.6 million annually. Thus, while the cost of water is likely to continue rising, the amount of funds available (from the Restoration Fund[14]) for water purchases could decline, thus creating an unsustainable situation that could undermine the ability of the RWSP and the Restoration Fund to achieve CVPIA water delivery mandates.

5. Recommendations

To achieve the aims of the Act, the Panel recommends the following actions:

a) The Service should prioritize the funding and completion of remaining external conveyance construction projects at Gray Lodge Wildlife Area (WA), East Bear Creek Unit of the San Luis National Wildlife Refuge (NWR), Mendota WA, Pixley NWR and Sutter NWR, based on balancing the potential biological improvements with the length of time required to complete the projects, extent of work completed to date, and the status of environmental permitting.

b) The Department of Interior (DOI) should request that the General Accounting Office (GAO) immediately conduct an independent audit of the RWSP's water conveyance costs and efficiencies to determine if the Restoration Fund is paying a disproportionate share of wheeling costs and conveyance losses. If GAO determines that the program's costs are disproportionate to other users in a system or district, Reclamation should then renegotiate the corresponding delivery contracts to adjust conveyance rates and assure that future cost increases are reasonable.

[14] This assumes that Level 2 Water conveyance costs would continue to be paid from the Restoration Fund, a practice which the Panel does not support.

The GAO analysis should also include a systemwide cost-benefit assessment of conveyance options and operations and maintenance practices to determine the most efficient and cost-effective strategies for delivering timely water supplies to each refuge. Reclamation should immediately incorporate the results of the GAO analysis in all subsequent operational conveyance decisions to assure that water is delivered to the Refuges in the most cost-effective method feasible, thereby reducing conveyance costs and losses.

c) Reclamation should maintain rate structures with those conveyance contractors that have had no annual cost increases, and where feasible negotiate permanent rate structures with other conveyance contractors that limit future cost increases.

d) Reclamation should include specifications in all future water conveyance contracts to assure the quality of water delivered to the boundary of the Refuges is consistent with the quality of the incoming source water.

D. Program Measurement and Benefits

1. Overview

Prior to the CVPIA, measurement of benefits of the provision of water to the Refuges appears to have been limited and sporadic, primarily focused on population counts of selected species.

Subsequent to the passage of the CVPIA, the primary program measurements appear to be limited to (1) total deliveries of Level 2 and Incremental Level 4 Water; (2) the number of conveyance projects that have been completed; (3) and the amount of funds expended in support of the RWSP. Particularly, the federal Refuges, and to a somewhat lesser degree state refuges, have substantial programs to collect biological data, with waterfowl counts conducted regularly on all Refuges. However no systemwide cumulative long-term reporting of this biological data, except for waterfowl counts, by the Refuges exists.

2. Critical Questions

Reclamation provided the Panel with the following critical questions related to Program Measurement and Benefits:

5. In addition to measurements of the quantity of water acquired and delivered, what other goals or metrics could be used to measure refuge program accomplishments?

6. In addition to current activities, what other program monitoring, analysis, and reporting actions could support continuous improvement of knowledge and program effectiveness?

3. What Has Worked Well?

CVPIA program staff have monitored total water deliveries and funds expended annually and the number of conveyance projects that have been completed.

Water management plans have been developed for each of the Refuges to identify when and where water is needed and to identify Best Management Practices that would increase the efficiency of water use.

4. What Has Not Worked?

In the early years, it appears that reported water deliveries were simply estimates, because no means of accurately measuring actual deliveries were in place. In recent years, with installation of various monitoring devices, the measurement of actual water deliveries has improved substantially, although it is not clear if monitoring of water deliveries is done consistently on a systemwide basis.

The quality of water delivered to the Refuges has only recently begun to be monitored, although it is not clear if this monitoring is done consistently on a systemwide basis.

Timely delivery of water in adequate amounts is critical to assure that biological productivity of each Refuge is maximized. At the beginning of each water year, refuge managers are asked to provide an annual schedule of their monthly water supply needs, but these delivery schedules appear to be adjusted frequently, sometimes to meet changing needs (due to unexpected circumstance) and sometimes due to a lack of available water, especially late in the water year. It appears that there have been no attempts to track the number of times water deliveries were cancelled or deferred, the number of times irrigations had to be cancelled and the resulting loss of acres of food, or the number of acres of wetland habitats that went dry due to failures to deliver water as planned. Each of these could be a surrogate for the more relevant issue: the degradation in ecological productivity of the Refuges that is a result of the lack of adequate and timely water deliveries.

The production, abundance, and availability of plant and invertebrate foods in wetlands are directly linked to the presence and amount of water. Therefore, provision of water with the proper volume, timing, frequency, and depth is critical to insure that the ecological potential of the Refuges can be maximized. This is a particularly important point in light of the significance of the wetlands on the Refuges relative to the limited amount of wetlands habitat elsewhere in the Valley – every refuge wetland acre counts.

Although the concept of refuge management has evolved from protecting individual species to the preservation of habitats and biodiversity, long-term monitoring information is generally available only for population counts of waterfowl and the number of wetland units that were flooded. It appears that there have been no long-term efforts to measure and evaluate the overall and direct effect of the CVPIA in terms of the improved aquatic, wetland, riparian, and upland habitats or the ecological productivity of the entire refuge system, or of the impact of departures from planned deliveries or the lost potential biological production the result of failure to receive Full Level 4 supplies for optimal refuge management.

5. Recommendations

To achieve the aims of the Act, the Panel recommends the following actions:

Reclamation should expand and enhance monitoring and public reporting, at the end of each water year, the following water-related metrics:

- Accurate, weekly volumes of water delivery at refuge boundaries;
- Total cost (including acquisition and conveyance) of all Incremental Level 4 Water delivered to the boundary of each individual refuge (both in total and on a per-AF basis), by refuge;
- Quality of water delivered to each refuge with specific emphasis on constituents of concern, including boron, mercury, selenium, and salts, and identify when the samples were acquired and compare these parameters to the maximum contaminant levels recommended by the Service.

b) Reclamation should publicly report on a monthly basis, the actual monthly water deliveries to each refuge (for the prior month) versus the planned deliveries identified in each refuge manager's annual water delivery schedules. In addition, Reclamation should publicly report at the end of each water year, a summary of the previous year's performance in meeting each refuge's monthly water delivery schedules.

c) At the end of each water year, the Service should report on actual versus planned acres of the following habitat-types (identified in the Water Management Plans) for each refuge: (1) seasonal wetland (this may be subdivided further by type seasonal habitat on a refuge-specific basis, e.g., swamp timothy, smartweed, and watergrass), (2) permanent wetland, (3) semi-permanent/brood pond, (4) riparian, and (5) other refuge-specific types (e.g., vernal pool)

d) Within 18 months of the release of this report, the Service should implement a systemwide ecological monitoring and evaluation program for all CVPIA Refuges, which integrates existing and newly collected information (identified herein) and produce an annual report at the end of each water year.

The annual report should include an evaluation of the systemwide ecological benefits of all Central Valley refuges that receive CVPIA water, based on the following[15]:

- The result of ongoing monitoring, including (1) the Service's Animal Health Lab disease reports; (2) mid-winter waterfowl inventories, (3) nesting and brood surveys; and (4) any

[15] The purpose of this proposed reporting is not to determine year-to-year water allocations or to measure the success or failure of refuge management or the RWSP on a yearly basis, as the data in each report will not provide for a year-to-year comparison. Instead this reporting is intended to provide a long-term, systemwide information base to allow a comprehensive evaluation of the extent to which the entire system of CVPIA refuges is making progress to meet the Act's goals to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley. This information will also enable Reclamation to better manage the RWSP on a systemwide basis than is feasible with currently available information.

additional data collected regularly by the Refuges, such as herptile distribution and abundance.

- New coordinated systemwide monitoring effort for at least 1 key migrant species and 2 resident Threatened and Endangered (T&E) species (including one warm-blooded and one cold-blooded), which is included (in the Annual report) every five years and identifies population numbers and survival rates for the 3 previous years.
- An estimate of the bioenergetic food production benefits to migrant waterfowl, consistent with the methodology used by the Central Valley Joint Venture, to compliment and inform the CVJV implementation plan.

E. Refuge Water Supply Program Management

1. Overview

Prior to CVPIA, the refuge water supplies were managed on an individual refuge basis and there were few attempts to manage or address Central Valley wetland habitats on a systematic basis, beyond the efforts of the Central Valley Joint Habitat Venture (which began in 1988).

Since the passage of the CVPIA, the acquisition and delivery of water to the Refuges has been managed by Reclamation on a comprehensive basis and the potential to manage the nineteen federal, state, and private Refuges as an integrated system has greatly improved.

2. Critical Questions

Reclamation provided the Panel with the following critical questions related to program management:

7. What organizational or program management changes could be made to reduce program costs and/or improve program performance, efficiencies, and effectiveness?

3. What Has Worked Well?

The RWSP has resulted in increased amounts and reliability of water deliveries to the Refuges, resulted in construction of external conveyance facilities, and improved on-refuge water management (via the development of Water Management Plans for each refuge).

4. What Has Not Worked?

Management of the CVPIA program is split between two federal agencies and dozens of individual program managers. Management of the RWSP is split between four positions: three at Reclamation (separately responsible for acquisition, conveyance, and construction) and one at the Service (responsible for all three elements).

Limited staff resources, competing program priorities, inadequate funding, repeated demands for new and redundant reporting, and institutional inertia, have restricted the effectiveness of management of the RWSP. Management of the program appears focused on continuation of a limited number of existing strategies, with little enthusiasm or incentives for innovation. Managers of the individual

elements of the RWSP are not empowered to make key decisions that are outside of agency cultural norms. Reclamation seems to make the bulk of decisions related to budget and water allocations, without few if any attempts at collaborative decision-making with the Service, state agencies such as DFG and DWR, or the CVJV. Thus, the Panel concludes that there is little evidence that current management practices will ever achieve the mandate to deliver Full Level 4 Water.

Currently there is only a single staff person at Reclamation focused on acquiring Incremental Level 4 Water. This extremely limited capacity appears to preclude the investigation and/or response to every potential acquisition opportunity given the geographic scope and number of water users and contractors that exist in the Central Valley (and outside of the Valley, given the potential for water exchanges with distant contractors). Thus, it appears that existing staffing levels are not sufficient to meet the water acquisition mandates of the Act, especially given the wide array of tools available under the Act. However, it is not even clear that additional staff could acquire sufficient water given the institutional constraints and magnitude of the task, especially since firm water supplies, from a variety of sources and mechanisms would be preferable to a perpetual reliance on spot market leases.

Level 2 and Incremental Level 4 Water have been managed in a bifurcated, or siloed, manner, as Reclamation accounts for the resources separately. This uncoordinated management of these two water sources has likely resulted in significant inefficiency in optimizing the portfolio of source water. While the rationale for this practice may be rooted in the underlying difference in the firm availability of each source, from a refuge management or ecological standpoint, there should be no difference: water is life in the Refuges, regardless of the management actions needed to secure and deliver it. Although the Panel was informed that Level 2 Water could be allocated across time and between Refuges, Reclamation clearly does not take advantage of this potential fungibility to improve water deliveries.

Although it appears that Reclamation has established a junior priority at the Delta pumps for all refuge water, Incremental Level 4 Water appears to be at the bottom of this priority scheme. The Panel was informed of several instances when Incremental Level 4 Water could not be moved across the Delta due to current pumping constraints. Because Reclamation regularly moves enormous volumes of water across the Delta, the purported inability to move even 1,000 AF suggests that Incremental Level 4 Water has no priority at the pumps. Despite the mandate to "achieve a reasonable balance among competing demands for use of Central Valley Project water," it appears Reclamation has (1) failed to provide Level 2 Water an equivalent priority with other CVP agricultural users at the pumps and (2) relegated Incremental Level 4 Water to the bottom of the pumping priority scheme. The Panel concludes the current practice of giving refuge water a low priority at the pumps is contrary to Congress' intent to address the impacts of the CVP and to protect, restore, and enhance wildlife and associated habitats in the Central Valley. Nor is it consistent with the directive to utilize "improvements in or modifications of the operations of the project" to increase the quantity of water delivered to the Refuges.

Although the Act explicitly authorizes Reclamation to implement "water banking as a strategy to meet refuge water deliveries" the Panel was informed that refuge water is not eligible for carry-over storage. Thus, the Panel concludes that the current management practice to preclude carry-over storage for

refuge water is not consistent with the Act and clearly results in water intended for the Refuges being diverted to other CVP contractors.

Opportunities to secure additional program funding have not been fully seized. We cite the following examples to make the overall point. The state's 25% cost share has never been provided, despite the execution of a congressionally mandated cost-share agreement. The agencies could have requested annual federal appropriations to augment the Restoration Fund to completely fund Full Level 4 water supply acquisition or completion of conveyance systems.

In another lost funding opportunity, the Panel concludes the agencies have misinterpreted the Act's funding mandate and utilized the CVPIA Restoration Fund to cover Level 2 wheeling costs, thereby reducing the availability of this source for other purposes. The Act clearly delineates that Level 2 and Level 4 activities are to be funded from different sources, with all costs associated with Level 2 water funded by sources in existence prior to passage of the Act. The Panel concludes the intent of the Act was to provide Level 2 Water as a part of Reclamation's historic, base operations of the CVP, and to create a new fund source (the Restoration Fund) to facilitate the acquisition and delivery of additional water (Incremental Level 4 water) that would mitigate the impacts of the CVP and enhance wildlife habitat.

The delivery of water to Refuges typically requires electrical power to operate pumps and other equipment, which results in operational costs to both conveying entities and individual Refuges, yet subsidized CVP power is not provided for this purpose, although many other CVP users receive this benefit. Reclamation's failure to subsidize refuge power is counterintuitive, particularly since the Refuges are implementing provisions of the Act (which requires electrical power to comply) along with numerous other federal mandates related to species and habitat protection.

5. Recommendations

To meet the mandates of the Act, the Panel recommends:

a) Reclamation should redesign the RWSP to emphasize systemwide strategic planning and management; elevate the optimization of biological productivity into decision-making; maximize transparency and public reporting in its decision-making relative to administrative powers; and better integrate the RWSP and Anadromous Fisheries Restoration Program.

b) Reclamation should realign and optimize management structure of the RWSP to optimize flexibility and fungibility of Level 2 Water and any Incremental Level 4 Water to optimize ecological productivity of the Refuges as determined by Refuge managers.

c) Concurrent with the establishment of an independent third-party to acquire Incremental Level 4 water supplies, Reclamation should make funding available to that entity in an amount equal to or greater than the previous 5-year historical average of funding for acquisitions and wheeling of Incremental Level 4 water, plus any supplemental appropriations made available by Congress or any other sources.

d) To support expansion of long-term ecological monitoring and evaluation on the Refuges, Reclamation should allocate 3 percent of the Restoration Fund (available to the Refuges) to the CVJV to supervise this new effort, including the hiring of a new staff biologist (in coordination with the Service) with significant experience in ecological monitoring and evaluation to supervise the compilation, synthesis and reporting of data, and to coordinate similar data collection efforts on private Refuges that receive CVPIA water. As needed and appropriate, these newly allocated funds can be expended to compile and/or collect new data as described below.

e) Reclamation and the Service should increase the effectiveness of the Inter-agency Refuge Water Management Team (IRWMT) as a forum to collaborate and reach consensus on the availability and timely allocation of water to and among Refuges with appropriate representation of CVPIA program managers, federal, state, and private refuge managers, CVJV partners, and other interested parties. The IRWMT should meet regularly to address water needs, at the beginning of the water year and seasonally to deal with changes in water availability or unanticipated needs or demands.

f) Prior to the start of each water year, the Service should compile all individual refuge water orders for the coming water year into a cumulative water order for the entire system, which identifies the quantity and timing of water from the Level 2 pool, plus any available Incremental Level 4 Water. The Service will subsequently communicate that schedule to Reclamation for planning its annual water deliveries and concurrently make the cumulative refuge water schedule publicly available.

g) Reclamation should immediately modify policies and practices that are inconsistent with the intent of the Act to improve CVP operations and deliver 100 percent of all Level 2 water to the refuge system (regardless of any external conveyance constraints) and assure that all refuge water (both Level 2 and Incremental Level 4):
   - Is fungible in time and space across the entire CVPIA refuge system;
   - Has highest priority at the pumps, equivalent with the exchange contractors;
   - Is eligible for, prioritized and provided carry-over storage; and
   - Is no longer subject to the current practice, where water that cannot be conveyed to a refuge is returned to the CVP pool. Reclamation should annually report to the Inter-agency Refuge Water Management Team on the operational decisions that affected Reclamation's ability to make timely water deliveries to the Refuges, including all decisions related to Delta pumping, carry-over storage, or allocations of Level 2 and Incremental Level 4 Water to non-refuge users.

h) Reclamation should immediately cease using the Restoration Fund to pay Level 2 wheeling costs and shift those costs to other CVP operational fund sources, consistent with §3406d(3) of the Act.

i) Within 18 months of the public release of this report, Reclamation shall complete an investigation of barriers to providing subsidized CVP power to meet refuge electrical needs and

report to the Inter-agency Refuge Water Management Team. Where feasible, within three years, Reclamation should provide CVP power to reduce energy costs associated with all potential refuge water sources and conveyances that require power, including surface and groundwater pumping and water treatment.

j) Reclamation should request annual federal appropriations to augment the Restoration Fund to completely fund Full Level 4 water supply acquisition, completion of conveyance systems and operation of the third-party entity that will manage water acquisitions. Funding for conveyance systems should be requested immediately and water acquisition funding should be requested on an annual basis until sufficient firm water supplies are secured to reach the Full Level 4 mandate. Reclamation should provide information on budget requests to the CVJV and other potential supporters to who can help secure the necessary funding from Congress and other potential sources as appropriate.

k) Reclamation should use all appropriate and legal means to assure that the State of California annually reimburses the CVPIA Restoration Fund for the State's share of program costs, as established by the Act and required by the Central Valley Project Improvement Act Sharing of Costs Agreement for Mitigation Projects and Improvements (SCAMPI) between Reclamation and the State of California.

l) The Service should immediately retain and/or hire a CVP operations expert to represent the interests of the refuge program to advise the Service on optimal delivery strategies related to in-year CVP water operations delivery decisions.

F. Central Valley Refuge Management

1. Overview

Prior to CVPIA, the water supplies of Refuges were managed on an individual basis and there were few attempts to manage Central Valley wetland habitats on a systematic basis, beyond the efforts of the Central Valley Joint Habitat Venture (which began in 1988).

Since the enactment of CVPIA, Refuges that receive CVPIA water are required to prepare a Water Management Plan, which describes the relationship between water management and habitat management objectives, identifies the refuge's water management policies, including contingency plans during a water shortage, and describes how Best Management Practices will be implemented to enhance on-site water management. In addition, federal Refuges are required to develop a Comprehensive Conservation Plans (CCPs) and Habitat Management Plans (HMPs) to guide refuge management.

2. Critical Questions

Although the Panel was not provided any critical questions specific to refuge management, the program management question provided by Reclamation is relevant to refuge management:

7. What organizational or program management changes could be made to reduce program costs and/or improve program performance, efficiencies, and effectiveness?

3. What Has Worked Well?

The promise of more reliable water and construction of external conveyance facilities to deliver that water resulted in substantial improvements to on-site water management at most Refuges. Federal, state, and private interests have cooperatively invested significant funding to upgrade internal refuge water management infrastructure by adding contours, water channels, swales and potholes, side canals and modern water control structures. The management units within the Refuges have become smaller and more numerous, the number and total acreage of wetland units has increased, and more diversity and structure has been integrated into the design of wetland units. This allows for more intensive and effective habitat management. In addition, on several Refuges new wells have been drilled and/or new infrastructure has been installed to facilitate recirculation of water between management units.

Federal Refuges are subject to substantial requirements for management planning, review and monitoring of species and program effectiveness. Federal refuge managers are also generally well trained and supported by a relatively large number of skilled support staff (in comparison to the number of staff at state and private Refuges). As such, the federal Refuges are managed according to CCPs and are at times organized into "complexes" within ecological areas. The CCPs recognize ecological attributes and identify management strategies that are often similar among Refuges within the complex, as well as associated management areas and adjacent private lands that are managed under easements (even though such areas do not receive CVPIA water).

Federal refuge planning efforts are guided by CCPs for each refuge, which are intended to assure that refuge management follows federal and state legal mandates and policies, including the National Environmental Policy Act, the Endangered Species Act, Migratory Bird Act, North American Waterfowl Management Plan, Partners in Flight North American Landbird Conservation Plan, North American Waterbird Conservation Plan, U.S. Shorebird Conservation Plan, California Wildlife Action Plan, and the Central Valley Joint Venture Implementation Plan. In addition, Refuges are required to develop Habitat Management Plans that guide management activities and monitoring as a means to evaluate effectiveness in an adaptive approach. These plans include specific objectives for wetlands as well as other associated habitats.

The level of detail of management planning on the private wetlands within the Grasslands complex varies, but has improved over time due to the oversight requirements imposed by federal wetland easements. These easements require professionally designed and science based wetlands management plans, which are updated on an annual basis and reviewed by the Service's wetlands managers. To comply with these requirements, many owners of private wetlands employ professional wetlands managers. However, the goals of private wetlands generally differ from those of federal and state

Refuges, as the private owners typically limit their efforts to providing seasonal waterfowl habitat, immediately prior to and throughout the hunting season. Some private wetland owners recognize the value of providing food and sanctuary in a more comprehensive way, and management of those lands may occur on a year-round basis and be as scientifically based as some public Refuges.

Prior to and after the Act, refuge managers in the Central Valley have implemented "adaptive management" techniques, due to the year-to-year variation in water availability, and recurring potential for drought conditions to severely impact their management options. While adaptively managing habitat, refuge managers have slowly built a knowledge base and modified refuge infrastructure to better adapt to these varying conditions and to maximize the quality and acreage of seasonal wetlands as well as wetlands with more semi-permanent and year-round water regimes.

Refuge planning efforts are augmented through the Central Valley Joint Venture which has developed Valley-wide management goals. These goals do not treat the CVPIA Refuges in isolation, but leave detailed unit-by-unit planning to the federal, state, and private refuge managers. Federal refuge managers do coordinate planning in assemblages (termed complexes) that correspond to four physiographic regions: Sacramento Valley; the Delta; San Joaquin Valley; and Tulare Basin. Additionally, planning is also coordinated among the federal, state, and private Refuges in the Grasslands complex, which integrates these public and private refuge lands in a comprehensive management approach.

4. What Has Not Worked?

While professional management of federal Refuges is highly evolved, management planning within the state Refuges is hampered by a relative lack of resources and staff. As a result, state management planning is less robust than for federal Refuges. However, the state Refuges are still managed to provide great value to wintering waterfowl and other wildlife. These benefits are driven less by intensive science based planning than by the experience of the refuge managers and lessons shared by their colleagues at the federal and private Refuges.

In late summer and the spring, when water in the Refuges is often limited and there are few habitat alternatives in the Valley outside the Refuges, the significance of the Refuges to wetlands-dependent wildlife increases and creates considerable demand on Refuges for food, water and other essentials of life. Currently, there are only limited attempts to coordinate planning between Refuges to assure that sufficient habitat resources are available on a Valley-wide basis. This is particularly important during dry and critically dry years, when the efficient utilization of water could maximize potential food production, semi-permanent wetlands, and summer ponds if water was allocated to the Refuges on a more strategic basis. However, it appears the current practice of allocating water to the Refuges is more historic and opportunistic than strategic.

5. Recommendations

To achieve the aims of the Act, the Panel recommends the following actions:

a) The Service should immediately implement a coordinated systemwide effort among all Refuges to enhance the availability of early- and late-season habitat sufficient to meet refuge management needs and identify any other gaps in habitat availability that can be addressed by providing sufficient quantities of properly timed water to those Refuges that can best support Valley-wide species and habitat goals, especially in dry- and critically dry years.

b) The Service should use the results of ecological monitoring to identify and promote adaptive management techniques and procedures to continually enhance the means and methods to manage water within Refuges and enhance habitat productivity.

c) The Service should ask the RWSP with the assistance of the IRWMT and the CVJV to consider the combined Level 2 and Incremental Level 4 water for all nineteen refuges as one pool and manage its allocation to achieve the greatest overall systemwide benefits, i.e., make the water pool fully fungible within the constraints of the CVP delivery system,

IV. APPENDICES

A. Panel Charge

1. Independent Review

In February 2006, the Federal Office of Management and Budget (OMB) initiated a review of the CVPIA program using its Performance Assessment and Rating Tool (PART) process. Reclamation has been engaged in this process for the last 3 years, preparing responses to PART questions and OMB data requests. In the process, OMB required Reclamation to develop performance goals for the CVPIA program and is now requiring completion of Improvement Actions, including an Independent Review. Reclamation and the Service have decided to conduct the evaluations on the program elements related to fish restoration and Refuges as these two elements represent a substantial portion of the annual Restoration Fund expenditures.

The purpose of this report is to document the findings of the Refuge Water Supply Program Independent Review, whose purpose is to provide programmatic recommendations and guidance to the program to improve effectiveness and efficiency. The activities of the Refuges Panel (and the separate Fisheries Panel) are planned to inform the development of a long-term management plan for CVPIA that is being developed under a separate process.

2. Objective, Scope and Methodology of Review

The Independent Review of the refuge water supply program is designed to help Reclamation and the Service achieve four objectives:

1. Improve the effectiveness and efficiency of programs and implementation actions to achieve the refuge goals of the Act;
2. Enhance the agencies' ability to learn from and optimize program actions;
3. Improve the transparency and accountability of the refuge programs to management, stakeholders, and the public; and
4. By achieving the first three objectives, enhance public understanding and support for the Program and continuing restoration actions.

The design of Independent Review process is informed by three documents that provide guidance on and standards for convening independent panels: U.S. General Accounting Office (GAO) reports, "Designing Evaluations" and "Performance Measurement and Evaluation: Definitions and Relationships" and the OMB memo, "What Constitutes Strong Evidence of a Program's Effectiveness?" These documents set forth relevant guidance on selecting panelists, preventing conflict of interest, and defining the charge of an independent panel. While the Independent Review is focused on evaluating the management of the CVPIA rather than on evaluating the science used to guide the

program, we have also sought to follow the National Academy of Sciences' study process for ensuring independent, objective advice.

3. Critical Questions

A list of critical questions has been developed in advance of recruiting the Refuges Panel members. The critical questions are designed to engage the Refuges Panel in evaluating CVPIA's performance toward goals and focus them on providing recommendations to management at Reclamation and the Service. The questions are:

How could the CVPIA Program best deploy its available resources to achieve the refuge water supply objectives described in the Act?

Water Supply

1. How well have short-term and long-term water supply strategies supported refuge water supply goals? What strategies would maximize program goals given past levels of funding appropriations?

2. How can the program address external water supply constraints and trends that affect the refuge water supply program?

Water Delivery

3. How well has the program prioritized actions and allocated available funding for construction and conveyance activities, to maximize achievement of the goals stated in the Act? What additional actions still need to be addressed?

4. What options are available to improve water deliveries to the Refuges? Considering conveyance costs and available funding, how can the conveyance program best be sustained over time?

Measurement and Benefits

5. In addition to measurements of the quantity of water acquired and delivered, what other goals or metrics could be used to measure refuge program accomplishments?

6. In addition to current activities, what other program monitoring, analysis, and reporting actions could support continuous improvement of knowledge and program effectiveness?

Program Management

7. What organizational or program management changes could be made to reduce program costs and/or improve program performance, efficiencies, and effectiveness?

4. Panel Support

Reclamation retained the consulting firm of Circlepoint to organize the independent panel and oversee the public aspects of the review process, including the creation and maintenance of a website

(www.cvpiaindependentreview.com) which served the both the Fisheries and RWSP panels. The primary support from Circlepoint was provided by Mary Bean and Shay Humphrey. To support and facilitate Panel deliberations, Circlepoint retained PBS&J. Mark Horne facilitated meetings of the panel and assisted in development of the Panel's report with support from John Spranza.

B. Panel Biographies

Leigh Fredrickson

Current Employment: Dr. Fredrickson is currently a Senior Biologist for the nonprofit, Wetland Management and Educational Services, Inc. He holds an Adjunct appointment at South Dakota State University in Brookings, South Dakota and is an Emeritus Professor at the University of Missouri, Columbia.

Prior Employment: Dr. Fredrickson was a Rucker Professor of Fisheries and Wildlife at the University of Missouri and Director of Gaylord Memorial Laboratory for 36 years. He is the author of innumerable articles and books on waterfowl, waterbirds, and wetlands, and is considered by many the dean of American waterfowl scientists. His areas of expertise include wetland and waterfowl ecology. He also has both academic and field experience, and significant writing experience.

Affiliations: Society of Wetland Scientists, The Wildlife Society, Wilson Ornithological Society, American Ornithologists Union, American Institute of Biological Sciences, Sigma Xi, Society of Field Ornithologists, Waterbird Society,

Jack Keller

Current Employment: Dr. Keller has a unique blend of engineering experiences that include teaching, research, extension, and consulting. He is a nationally and internationally recognized expert in the design, implementation, and management of irrigation systems. He is currently involved in consulting activities related to: efficient irrigated agricultural development; river basin water management and conservation planning; irrigation water monitoring, verification and conservation planning; and developing efficient low-cost irrigation technologies for small farms. He is founder and presently Chief Executive Officer of Keller Bliesner Engineering LLC. He is also Professor Emeritus in the Biological and Irrigation Engineering Department at Utah State University, where he was Department Head between 1980 and 1986.

Prior Employment: Prior to becoming a professor at Utah State University in 1960, he was the Chief Irrigation Engineer in charge of product development for W.R. Ames Company, a leading U.S. manufacturer of irrigation equipment. Two recent consulting activities include membership on the CALFED Independent Science Board and analysis of on-farm irrigation efficiencies in the Imperial Irrigation District to free up water to satisfy agreements to transfer agricultural water to the Metropolitan Water District and San Diego.

Affiliations: Member of National Academy of Engineering, Member of American Society of Agricultural and Biological Engineers, Fellow of American Society of Civil Engineers, Member of United States Commission on Irrigation and Drainage, Member of The Irrigation Association, Honor Societies: Sigma Xi; Phi Kappa Phi

Michael Powelson

Current Employment: Michael Powelson currently works for The Nature Conservancy as the Director of Government Relations, Western US. Roles & Responsibilities: (1) Oversee and support Government Relations programs for the thirteen states that make up the Conservancy's Western Division: program development, hiring, congressional and federal agency strategies; (2) development of and lobbying for the Conservancy's national, regional and chapter (state) federal policy and appropriations priorities; (3) Coordination, facilitation and relationship development with the Conservancy's key federal agency partners: USFS, FWS, BLM, COE, Reclamation, DOD, NOAA, etc. Starting in 2009, I will also be serving as interim TNC US Government Relations Senior Policy Advisor for the USFS/NRCS for our DC office.

Prior Employment: Prior to becoming the Western Director of Government Relations, Powelson was the Director of Agency Relations for the Conservancy's Pacific North America Region and the Northwest Division. His focus is primarily working on federal issues of regional and national significance, working with federal agencies, the Administration and Congress. Prior to that, he spent eight years as a Fish and Wildlife Policy Analyst for the Northwest Power and Conservation Council and the Oregon Governor's Natural Resources Office. Previous employment includes 5 years in micro-computer sales and consulting and 3 years as a concrete carpenter.

Affiliations: None

Rudolph Rosen

Current Employment: Dr. Rosen joined Ducks Unlimited, Inc. (DU) in November 2003, as Director of the Western Regional Office in Sacramento, CA. In this capacity he is responsible for DU's habitat conservation programs in nine-western states, including managing about 600 cooperatively developed and financed land acquisition, ecosystem restoration and management projects in wetlands, river floodplains and estuaries. Ongoing projects constitute $90 million funded through over 2,000 grants and partnership agreements. He is also responsible for research and planning, including mapping and classifying ecosystems on over 25 million acres annually in Canada and Alaska using remote sensing and Geographic Information Systems techniques.

Prior Employment: Prior to joining DU, Dr. Rosen was the president of Professional Management Group, Inc., where he provided start-up and turn-around management and fundraising services for international nonprofit foundations. In that capacity he served as start-up executive director of the International Consortium for Health and Environmental Security. Previous government and nonprofit conservation experience includes (1) Executive Director of the Oregon Department of Fish and Wildlife, Portland, OR; (2) Director of Fish, Wildlife and Coastal Marine Resources, Texas Parks and Wildlife Department, Austin, TX; (3) Executive Director of Safari Club International Foundation and Safari Club International, Tucson, AZ; (4) Director, Southeastern Natural Resources Center (Atlanta, GA) and Fisheries Resource Specialist (Washington, DC) for the National Wildlife Federation

Dr. Rosen has served on over eighty national and international commissions, boards, foundations, councils, and committees in the field of natural resource conservation. He has specialized in public

policy, management of fish and wildlife agencies and nongovernmental conservation organizations, and has technical expertise in aquatic systems ecology and fisheries. He is a Certified Fisheries Scientist and has been elected Fellow of the American Institute of Fishery Research Biologists.

Affiliations: American Fisheries Society; The Wildlife Society; American Institute of Fishery Research Biologists; Western Association of Fish and Wildlife Agencies; Sigma Xi; Phi Sigma; Gamma Sigma Delta; Phi Kappa Phi.

Peter Yolles

Current Employment: Mr. Yolles is the owner and sole proprietor of Water Insight (WaterInsight.com), a consulting company engaged in water, energy, and climate issues. Water Insight consults businesses, government agencies, and NGOs about water use, river restoration, and water's relationship with energy consumption and climate impacts. He also continues to advise on water rights and water transfers. Water Insight is based in Tiburon, CA.

Prior Employment: Most recently, Peter Yolles was Director of Water Resource Protection for The Nature Conservancy. He also serves as President of the Board of the Scott River Water Trust. Previously, Mr. Yolles was vice president of Western Water Company where he negotiated water sales and transfers, including completing a 7,000 acre-foot water transfer approved by the State Water Resources Control Board. From 1997 to 1999, he worked for GE Capital analyzing water, energy, and timber transactions. He holds a B.A. degree in political science from the University of Colorado at Boulder, and received an M.B.A. degree in finance and a Master's of Environmental Studies in Water Science, Policy and Management from Yale University.

Affiliations: None

C. Water Conveyance Tables

Table C1 Refuge Water (L2 and Incremental L4) Conveyance Rates, Cost/Acre-Foot ($) (Revised 3/17/2009)

Contract Administered by:	Conveyor	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average Annual Change	Total Rate Change
Bureau of Reclamation	Biggs West Gridley Water District		9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	9.64	8.41	8.41	8.41	9.40	9.40	9.40	0%	-2%
	Glenn-Colusa Irrigation District						5.92	5.92	5.92	10.63	11.06	11.32	11.81	12.48	13.70	14.25	14.89	14%	152%
	Central California Irrigation District					Private Takeouts	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	12.75	0%	0%
						Mendota Pool	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	0%	0%
						DMC MP 76.05 Turnout	4.59	4.59	4.59	4.59	4.59	4.59	4.59	4.59	4.59	4.59	4.59	0%	0%
	Grassland Water District						13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	13.75	0%	0%
	San Luis Canal Company						14.09	14.09	14.09	14.09	14.09	14.09	14.09	14.09	14.09	14.09	14.09	0%	0%
	San Luis Delta Mendota Water Authority					Upper DMC	3.66	4.47	4.25	5.17	5.64	4.82	6.54	7.02	7.68	7.71	8.28	11%	126%
						Lower DMC/Pool	4.72	5.46	5.46	6.42	6.86	6.21	7.99	8.64	9.34	9.51	10.15	10%	115%
						San Luis Canal above Dos Amigos	8.26	9.91	10.15	12.34	11.29	10.87	12.52	13.82	13.04	16.27	21.31	14%	158%
	Buena Vista Water Storage District		4.25	4.25	4.25	4.25	4.25	5.75	5.75	6.05	6.05	6.20	10.22	10.22	10.74	11.10	11.45	13%	169%
	CA Department of Water Resources	Reach 12E	3.69	3.92	4.01	4.29	4.35	4.51	4.64	4.64	4.64	4.84	4.75	4.78	4.78	4.78	4.68	1%	17%
		Reach 10A	1.82	1.93	1.94	2.07	2.11	2.19	2.26	2.26	2.26	2.37	2.31	2.33	2.33	2.33	2.28	1%	18%
FWS	San Luis Canal Company	11.58	11.89	12.19	12.19	12.68	12.98	13.34	13.40	13.99	14.36	14.48	14.97	15.46	16.99	17.98	18.71	4%	53%

Rates provided start with execution of formal agreements.

Table C2 Refuge Water (L2 and Incremental L4) Conveyance Rates, Annual Change in Wheeling Costs (%) (Revised 3/17/2009)

Contract Administered by:	Conveyor	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Bureau of Reclamation	Biggs West Gridley Water District		NA	0%	0%	0%	0%	0%	0%	0%	0%	-15%	0%	0%	11%	0%	0%
	Glenn-Colusa Irrigation District						NA	0%	0%	44%	4%	2%	4%	5%	9%	4%	4%
	Central California Irrigation District					Private Takeouts	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
						Mendota Pool	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
						DMC MP 76.05 Turnout	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Grassland Water District						NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	San Luis Canal Company						NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	San Luis Delta Mendota Water Authority					Upper DMC	NA	18%	-5%	18%	8%	-17%	26%	7%	9%	0%	7%
						Lower DMC/Pool	NA	14%	0%	15%	6%	-10%	22%	8%	7%	2%	6%
						San Luis Canal above Dos Amigos	NA	17%	2%	18%	-9%	-4%	13%	9%	-6%	20%	24%
	Buena Vista Water Storage District		NA	0%	0%	0%	0%	26%	0%	5%	0%	2%	39%	0%	5%	3%	3%
	CA Department of Water Resources	Reach 12E	*NA*	6%	2%	7%	1%	4%	3%	0%	0%	4%	-2%	1%	0%	0%	-2%
		Reach 10A	*NA*	6%	1%	6%	2%	4%	3%	0%	0%	5%	-3%	1%	0%	0%	-2%
FWS	San Luis Canal Company	NA	3%	2%	0%	4%	2%	3%	0%	4%	3%	1%	3%	3%	9%	6%	4%

Table C3 Refuge Water Delivering Contractors Water Deliveries and Conveyance Costs Water Years 2006–2008

Contractor	Refuges Directly Served by Contractor	Other Refuge Conveying Contractors Receiving Refuge Water through Contractor [a]	Total Acre-Feet Conveyed by Contractor and Total Payments to Contractor					
			WY 2006		WY 2007		WY 2008	
			AF Conv.	Payments	AF Conv.	Payments	AF Conv.	Payments
Biggs-West Gridley Water District (BWGWD)	Gray Lodge WA	N/A	20,125	$187,984	11,711	$110,083	8,398	$78,941
Buena Vista Water Storage District (BVWSD)	Kern NWR	N/A	21,255	$233,812	17,488	$198,513	18,950	$242,320
California Department of Water Resources (DWR)	Kern NWR	BVWSD	22,112	$58,270	18,455	$48,740	20,448	$50,722
California Department of Fish and Game (DFG)(groundwater pumping only)	Gray Lodge WA	N/A	6,020	$200,052	4,241	$158,895	6,479	$205,305
Central California Irrigation District (CCID)	China Island Unit	GWD	178,648	$1,007,005	136,004	$754,831	144,734	$816,949
Glenn-Colusa Irrigation District (GCID)	Sacrament, Delevan and Colusa NWRs	N/A	81,934	$1,122,537	83,006	$1,182,836	83,944	$1,249,927
Grassland Water District (GWD)	Grassland Resource Conservation District; Los Banos WA; Salt Slough Unit; Freitas and Kesterson Units	N/A	37,325	$513,219	31,839	$437,786	32,452	$446,215
San Luis Canal Company (SLCC) (aka Henry Miller Reclamation District)(administered by Reclamation)	Grassland Resource Conservation District; Los Banos WA	N/A	12,202	$179,549	15,089	$204,982	11,601	$163,458
San Luis Canal Company (SLCC) (aka Henry Miller Reclamation District)(administered by U.S. Fish & Wildlife Service)	San Luis and West Bear Creek Units	N/A	26,145	$466,080	25,863	$483,905	26,205	$511,260
San Luis & Delta-Mendota Water Authority (SLDMWA) [b]	Volta WA	CCID; SLCC	340,522	$3,686,567	250,793	$3,276,187	222,170	$2,608,920

Table developed April 9, 2009

a. Some conveying contractors deliver water to other conveying contractors ("receiving" contractors) for the specific purpose of the "receiving" contractor to convey this water through the "receiving" contractor's facilities to the boundary of specific refuges. This is due to the geographic location of certain refuges relative to the proximity of conveying contractors. And the amount of water delivered to the "receiving" contractor must include sufficient quantities to cover conveyance losses (carriage losses) within the facilities of that "receiving" contractor.

b. Data is not yet available for February 2009 (WY08) delivery and payment. In regards to the numbers provided for WY06 and WY07, three to four documents were not immediately available from sources used. Estimates, developed from refuge deliveries for those months from recent years, were used to provide this missing data. These are strong estimates and may be off by only a few thousand acre feet, resulting in a payment difference of up to approximately $40,000.

D. Supporting Tables

Table D1 Total CVPIA Water Deliveries to Central Valley Refuges (Figure 2)

Year	Level 2	Incremental Level 4	Level 4
1993	300,010	10,550	435,551
1994	299,380	29,415	448,851
1995	314,086	88,009	461,251
1996	356,579	36,395	475,551
1997	364,793	69,800	488,851
1998	345,445	6,300	502,251
1999	330,762	43,618	516,651
2000	339,448	67,748	529,251
2001	351,654	63,005	541,851
2002	383,842	85,390	555,515
2003	391,635	70,000	555,515
2004	385,731	67,710	555,515
2005	388,803	67,962	555,515
2006	380,072	83,822	555,515
2007	388,521	41,111	555,515
2008	386,181	18,248	555,515

Table D2 Proposed Monthly Deliveries of Water to Central Valley Refuges (Figure 5)

Month	Level 2	Incremental Level 4	Full Level 4
Mar	7,500	9,185	16,6845
Apr	14,091	7,802	21,893
May	30,185	19,100	49,285
Jun	34,898	17,178	52,076
Jul	18,793	13,363	32,156
Aug	29,073	15,608	44,681
Sep	70,414	11,866	82,280
Oct	84,188	11,574	95,762
Nov	54,077	7,637	61,714
Dec	29,517	5,707	35,224
Jan	14,303	5,751	20,054
Feb	10,203	9,651	19,854

Table D3 North and South Variation in Proposed Monthly Deliveries of Water to Central Valley Refuges (Figure 6)

Month	Sacramento Valley	San Joaquin Valley
Mar	4,845	12,950
Apr	3,715	20,411
May	8,835	43,543
Jun	12,580	41,622
Jul	14,090	20,569
Aug	21,025	26,159
Sep	30,665	54,011
Oct	31,225	66,847
Nov	23,695	39,616
Dec	14,435	22,576
Jan	7,345	14,005
Feb	6,545	14,205

Table D4 Incremental Level 4 Deliveries and Mandate (Figure 10)

Year	Incremental Level 4 Deliveries	Incremental Level 4 Mandate	Mandate with Replacement Water
1993	10,550	13,300	39,307
1994	9,523	26,600	52,607
1995	37,855	39,000	65,007
1996	24,066	53,300	79,307
1997	36,280	66,600	92,607
1998	43,467	80,000	106,007
1999	43,621	94,400	120,407
2000	64,605	107,000	133,007
2001	61,822	119,600	145,607
2002	79,470	133,264	159,271
2003	75,553	133,264	159,271
2004	66,762	133,264	159,271
2005	81,711	133,264	159,271
2006	89,045	133,264	159,271
2007	43,549	133,264	159,271
2008	37,066	133,264	159,271

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