Kern National Wildlife Refuge

Water Management Plan

January 14, 2011

Section A - Background

1. *Identify the staff member responsible for developing and implementing the Plan. Provide their contact information*

Name David Hardt Title Project Leader

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2. *Year refuge established* 1960

Define year-type used consistently throughout plan March 1 through February 28

3. *Water supplies*

List each annual entitlement of surface water under each water right and/or contract

Supplier	*Water source*	*Contract #*	*Contract restrictions*	*Acre-feet/year*
Federal level 2	SWP – Buena Vista	03FC203035		9,950
Federal level 4	SWP – Buena Vista	03FC203035		15,050
State	NA			
Appropriative	NA			
Other, riparian	NA			

4. *Provide a narrative on pre-CVPIA refuge water supplies and water management*

Prior to receiving CVPIA water allocations, water purchased by the refuge was only adequate to provide up to 2,000 acres of wetland habitat during the fall and winter. Additionally, fall flood-up was frequently delayed until after October 1 in order to limit evaporation losses, far after the first migrating ducks arrive in the southern San Joaquin Valley (SSJV). Spring and summer water limitations prevented irrigation of extensive moist soil habitat thus limiting the quality of waterfowl habitat provided the following fall and winter. The lack of flooded summer habitat also precluded the nesting of most wetland dependent species such as ducks, shorebirds and wading birds.

Since wetland habitat in the SSJV is extremely limited, failure to adequately flood all suitable habitats on Kern NWR seriously impacts the overall ability of the area to sustain the wintering and migrating populations of waterfowl that have historically used the area.

5. *Land use history--Identify habitat types specific to this refuge. Attach a refuge map showing habitat location and size* **(Attachment 1)**

List refuge habitat-types with 5% or more of total acreage

Habitat type	*Original size*	*1992 acres*	*1997 acres*	*2009 acres **
Seasonal wetland – (no summer water)	NA	846	2,812	3,795
Seasonal wetland – timothy (irrigated)	NA	890	1,064	2,096
Seasonal wetland – smartweed	NA	138	136	
Seasonal wetland - watergrass	NA			50
Permanent wetland	NA			
Semi-permanent wetland/brood pond	NA			
Reverse cycle wetlands	NA			
Riparian	NA		125	100
Irrigated pasture	NA			
Upland	NA			
Upland (not irrigated)	NA	8576	6,313	5,025
Upland (managed)	NA			
Upland (grains)	NA			
Other (>5%)	NA			
Misc. habitat (<5%)	NA			
Sub-total – habitat acres	NA			
Roads, buildings, etc.	NA	168	168	183
Total (size of refuge)	10,618	10,618	10,618	11,249

* Acres in table indicate acreage that received water in 2009. Not all habitat was flooded due to receiving less than a full water allocation

Describe refuge habitat-type water use characteristics

Habitat type	*AF/ac*	*# of irrigations*	*Floodup date*	*Draw down date*
Seasonal wetland (no summer water)	3.00	0	Aug-Sep	March 1
Seasonal wetland - timothy	3.10	1-2	Sep-Oct	Feb 15
Seasonal wetland - watergrass	3.50	2	Sep-Oct	April 1
Permanent wetland				
Semi-permanent wetland/brood pond				
Riparian	2.00	1	October	NA
Irrigated pasture				
Upland (not irrigated)				
Upland (managed)				
Upland (grains)				
Other (>5%)				
Misc. habitat (<5%)				

Section B - Water Management Related Goals and Objectives

1. *Describe the refuge mission relative to water management. (i.e. crop depredation, legislative mandates, service to landowners)*

The majority of purposes for Kern NWR involve habitat for wetland dependant species. In this artificially created and maintained system efficient water management is critical to accomplishing these purposes.

Purposes for this Unit:

On March 11, 1958, the Migratory Bird Conservation Commission, under the authority of the Migratory Bird Conservation Act, approved the purchase of lands to create the Mariposa National Wildlife Refuge, known today as the Kern National Wildlife Refuge.

… for use as an inviolate sanctuary, or for any other management purposes, for migratory birds. 16 U.S.C. 715d (Migratory Bird Conservation Act)

2. Describe specific habitat management objectives. Include pertinent information from refuge management plans

Seasonal Marshes – timothy: Marsh: By far the most numerous and diverse of the wetland habitat types, these units comprise about 94 percent of the wetland habitat base and are typically flooded from early mid-August through mid-April. Their diversity is the product of a variety of water depths that result in diverse patterns of plant species (vegetation) that, in combination, provide habitat for the greatest number of wildlife species throughout the course of a year. Through the fall and winter, seasonally flooded marshes are used by spectacular concentrations of waterfowl and smaller numbers of egrets, herons, ibis, and grebes, to name a few. In addition, a full compliment of raptors descend upon the waterbird prey base upon which they depend. As water is removed in the spring, large concentrations of shorebirds utilize the shallow depth and exposed mudflats on their northern migration. Seed-producing plants germinate and grow to maturity on the moist pond bottoms during the spring and summer. Flood-up in the fall makes this food available to early migrant waterfowl and other waterbirds.

Seasonal Marshes – watergrass: Comprising approximately 1 percent of the wetland habitat base, these units are typically flooded from late September through early April. An irrigation is usually accomplishes in mid-May to bring large quantities of watergrass, sprangletop, and smartweed plants to maturity. During these irrigation periods, these units are often utilized by locally-nesting colonial waterbirds (egrets, herons). Because this habitat type often results in thick monocultures, openings are disced or mowed prior to flood-up. Though not as diverse, once flooded these units provide an abundant food source for waterfowl at a very important time of year. In addition, a number of wading-bird species frequent them throughout the year.

Riparian: Comprised primarily of black willow, but with patches of Fremont's cottonwood, riparian habitat occurs within units 9 and 4A and other managed waterways of the Refuge. Willows and cottonwoods also occur sparsely in and around some managed marsh units. The larger "riparian tracts" are located in Unit 9 and 10. Willows and cottonwoods provide nesting, roosting, and feeding habitat for passerine species and raptors, and shelter and screening for waterfowl, habitat for the endangered Buena Vista Lake Shrew and rookeries for Great Blue Herons. Small mammals and duck broods utilize the water delivery system during summer when most marsh units are dry.

Upland: Non-irrigated annual and perennial grasslands provide habitat for endangered species – i.e., Blunt-nosed Leopard Lizard, Tipton Kangaroo Rat and San Joaquin Kit Fox.

3. Describe the strategies used to attain objectives listed above

On an annual basis conduct a review of the previous habitat management plan, which involves visiting each habitat unit to document accomplishments, establish needs and develop plans for the upcoming year and compile these findings to produce the next habitat management plan.

4. Describe constraints that prevent attainment of objectives and explain the effect on operations

The habitat planning process identifies a far greater workload than can be accomplished in a single year, given present funding, staffing and existing priorities. Typically, CVPIA budget cycles do not allocate water

acquisition funding until six months into the fiscal year, preventing managers from planning an entire year of habitat management and results in inefficient water use and less than optimum habitat results.

5. Describe the strategies used to remedy the constraints listed above
Continue to refine management techniques to improve efficiency and develop alternate/additional funding sources to help address present staffing and water limitations.

Section C - Policies and Procedures

1. Describe the refuge policies/procedures on accepting agricultural drainage water as supply
Upslope drainage water is mixed with the Kern Refuge water supply because Goose Lake canal and the Main Drain, which are used for Kern Refuge deliveries, includes upslope drainage water.

2. Describe the refuge policies/procedures on water pooling, transfers, reallocations or exchanges
The refuge has no Kern NWR or USFWS policies or procedures on pooling, transfers, reallocations or exchanges but follows those established by the CVPIA and in the water supply contracts.

POOLING OF WATER SUPPLIES

6. (a) Whenever the maximum quantities of Level 2 Water Supplies and/or the incremental Level 4 Water Supplies depicted in Exhibit AB@ are reduced pursuant to Article 9 of this Contract, the remaining Level 2 Water Supplies and/or Incremental Level 4 Water Supplies may be pooled for use on other Refuge(s); Provided, that no individual Refuge shall receive more Level 2 Water Supplies than would have been made available to it absent a reduction pursuant to Article 9 of this Contract; or be reduced by more than twenty-five (25) percent; Provided further, that the Contracting Office makes a written determination that pooling of water for use on other Refuge(s) would not have an adverse impact, that cannot be reasonably mitigated, on Project operations, other Project Contractors, or other Project purposes; Provided further, that the Contracting Officer determines that such reallocation is permitted under the terms and conditions of the applicable underlying water right permit and/or license; and Provided still further, that water made available under this contract may not be schedules for delivery outside the Contractor's Boundary without prior written approval of the Contracting Officer.

(b) An Interagency Refuge Water Management Team, to be chaired by the Contracting Officer and to be established upon execution of this Contract, shall be entitled to collaboratively allocate the pooled water supplies and provide a schedule for delivery of the pooled supplies to meet the highest priority needs of the Refuges(s) as depicted in Exhibit AB@; Provided, however, nothing is this Article is intended to require the Contractor to pool the water supply provided for in this Contract. The Interagency Refuge Water Management Team shall be composed of designees of the Bureau of Reclamation, the United States Fish & Wildlife Service, the California Department of Fish & Game, and the Grassland Water District.

TANSFERS, REALLOCATIONS OR EXCHANGES OF WATER

7. Subject to the prior written approval of the Contracting Officer, the Project Water made available under this Contract may be transferred, reallocated or exchanged in the Year to other Refuge(s) or Project contractors if such transfer, reallocation or exchange is requested by the Contractor and is authorized by applicable Federal and California State law, and then-current applicable guidelines or regulations.

3. Describe the refuge water accounting policies/procedures for inflow, internal flow and outflow
Refuge staff collects inflow data daily. Internal flow is monitored and controlled to meet established targets. Some outflow is currently estimated. It is estimated that all outflow will be metered by late 2011.

4.- Attach a copy of the refuge's shortage policies, drought plan, or any similar document.
Each spring and summer, the Refuge Manager and biological staff evaluate the food production within each habitat unit on the refuge. Units are then prioritized based on their anticipated contribution to the food resources needed for the following fall and winter period and a habitat flood-up plan is then prepared based on the anticipated water supplies for that year. Due to prior year water supply variations, spring draw-down schedules, habitat rehabilitation projects, and weather conditions, habitat conditions vary by year and require new plans each fall. The 2009 plan is included as **Attachment 4.**

Section D - Inventory of Existing Facilities

1. *Mapping*

   Attach existing facilities map(s) that show points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, conveyance system, storage facilities, operational loss recovery system, wells, and water quality monitoring locations. Describe in the body of the plan the information contained in each attached map **(Attachment 2)**

The attached map shows points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, operational loss recovery points, the conveyance system and water quality monitoring sampling location. Kern NWR does not have storage facilities or active wells.

2. *Water measurement*
   a. *Inflow/deliveries*

   Total # of inflow locations/points of delivery 1
   Total # of measured points of delivery 1
   Percentage of total inflow (volume) measured during report year 100%

Delivering agency	*Conveyance facility*	*Measuring point*	*Refuge distribution facility*	*% of total inflow*	*Type of measurement*	*Measuring agency*
Buena Vista WSD	Goose Lake Canal	Refuge Boundary	Goose Lake Canal Intertie	100	Propeller/Doppler Meter	F&W and BVWSD

   b. *Internal flow at turnouts*

   Total # of refuge water management units (units) 51
   Total # of refuge water management unit turnouts 101
   Total # of measured turnouts 0
   Estimated % of total internal flow (volume) during report year that was measured at a turnout 0
   Number of turnouts supplying more than one unit or not directly off delivery system 5

Measurement type	*Number of devices*	*Acres served*	*Accuracy (avg or*	*Reading frequency*	*Calibration frequency*	*Maintenance frequency*

			range)		*(months)*	*(months/days)*
Orifices						
Propeller						
Weirs						
Flumes						
Venturi						
Alfalfa valves						
Metered gates						
Other, stop-log and screwgates	101	6,500	None	Monitored, not read	Never	As Needed

c. Outflow

Outflow (AF/yr) 1,000

Total # of outflow locations/points of spill 3

Total # of measured outflow points 1

Percentage of total outflow (volume) measured during report year 10%

Outflow point	*Measuring point*	*Type of measurement*	*Percent of total outflow (estimated)*	*Measuring agency*	*Acres drained*
Unit 7	None	None	90	F&W	5,200
Goose Lake Canal	None	None	0	F&W	unused
Unit 14	Refuge Boundary	Propeller Meter	10	F&W	1,160

3. Identify the type and length of the refuge internal distribution system

Miles unlined canal	*Miles lined canal*	*Miles piped*	*Miles – other*
11.4	0	0	0.8

Describe the location and types of identified leaks and areas of higher than average canal seepage, and any relation to soil type.

None

4. Describe the refuge operational loss recovery system

Pump #	Location	HP
LP3	Unit 2	27
LP4	Unit 14	107

5. Groundwater

Describe groundwater availability, quality and potential for use

The Kern NWR is located in the Kern County Subbasin of the San Joaquin Valley Groundwater Basin. The aquifers are generally quite thick in the San Joaquin Valley subbasins with groundwater wells commonly exceeding 1,000 feet in depth. The maximum thickness of freshwater-bearing deposits (4,400 feet) occurs at the southern end of the San Joquin Valley. Typical well yields in the San Joaquin Valley range from 300 gpm to 2,000 with yields of 4,000-gpm possible.

The extensive use of groundwater in the San Joaquin Valley has historically caused subsidence of the land surface primarily along the west side and the south end of the valley.

Groundwater Quality

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. The primary constituents of concern are high TDS, nitrate, arsenic, and organic compounds.

The areas of high TDS content are primarily along the west side of the San Joaquin Valley and in the trough of the valley. High TDS content of west-side water is due to recharge of stream flow originating from marine sediments in the Coast Range. High TDS content in the trough of the valley is the result of concentrations of salts because of evaporation and poor drainage. In the central and west side portions of the valley where the Corcoran Clay confining layer exists, water quality is generally better beneath the clay than above it. Nitrates may occur naturally or as a result of disposal of human and animal waste products and fertilizer. Areas of high nitrate concentrations are known to exist near the town of Shafter and other isolated areas in the San Joaquin Valley. High levels of arsenic occur locally and appear to be associated with lakebed areas. Elevated arsenic levels have been reported in the Tulare Lake, Kern Lake and Buena Vista bed areas. Organic contaminants can be broken into two categories, agricultural and industrial. Agricultural pesticides and herbicides have been detected throughout the valley, but primarily along the east side where soil permeability is higher and depth to groundwater is shallower. The most notable agricultural contaminant is DBCP, a now-banned fumigant and know carcinogen once used extensively on grapes. Industrial organic contaminants include TCE, DCE, and other solvents. They are found in groundwater near airports, industrial areas, and landfills.

Groundwater plan *No* ___X___ *Yes* _____ *(please attach or provide web link).*

Groundwater basin(s) that underlie the refuge

Name of basin underlying refuge	*Size (sq. mi.)*	*Usable capacity (AF)*	*Safe yield (AF/Y)*	*Management agency*	*Relevant reports*
Kern County Sub-basin	3,040	Unknown	Unknown	NONE	DWR Bulletin 118

Groundwater has elevated levels of boron, arsenic and sodium. The depth to ground water makes the pumping very expensive. All wells are inactive with deteriorated casings and only four of the wells have pumps. These wells would only be used in a short-term emergency and only if money were available to pay the pumping costs.

Identify refuge-operated ground water wells

#	*Location*	*Status*	*HP*	*2003 (AFY)*	*Future plans*
4	Unit I	Inactive	-	0	Inactive
4A	Unit I	Inactive	150	0	Inactive

5	Unit I	Inactive	-	0	Inactive
6	Unit IA	Inactive	-	0	Inactive
7	Unit IA	Inactive	-	0	Inactive
8	Unit 4B	Inactive	150	0	Inactive
9	Unit 4A	Inactive	150	0	Inactive
11	Unit 5A	Inactive	150	0	Inactive
Research	Unit 7	Inactive	-	0	Inactive

Section E Environmental Characteristics

1. Topography - describe and discuss impact on water management
Relative flat – two foot drop from South to North. Water is distributed through a gravity flow system after being lifted one time. It is easy to control the water.

2. Soils - describe and discuss impact on water management See Soils Map **(Attachment 3)**
The five general soil types that have been mapped on the Kern Refuge include: Nahrub, partially drained-lethent complex (3,540 acres); Nahrub, drained-lethent complex (2,760 acres); Nahrub clay, drained (1,830 acres); Nahrub clay, partially drained (1,510 acres); and Garces silt loam (60 acres). When these soil types were mapped in 1982, 870 acres of the Refuge were not mapped because they were flooded. The Nahrub and Lethent soils formed in alluvium from primarily granitic and sedimentary rock. Nahrub soils occur as deep deposits (depth to 61 inches) with little to no surface slope and are poorly drained. They are composed of an upper layer of clay (0to 34 inches) overlying a lower layer of sandy loam, clay loam, and fine sandy loam. Lethent soils are also deep but are moderately well drained and are composed of a surface layer of silt loam (0 to 60 inches) over a clay layer up to 36 inches thick supported by loam to depths greater than 60 inches. Nahrub and Lethent soils are moderately to strongly saline-alkaline and may have toxic levels of boron present in some areas. Permeability is very slow and water capacity is low. A seasonally high water table limits rooting depth to 3 to 6 feet in Nahrub soils; however, rooting depths in Lethent soils are greater than 5 ft.

The soil types on the Kern Refuge have little effect on wetland management. Some shallower moist soil units are periodically farmed or subject to regular maintenance to manage (disc, mow, burn, etc.) wetland vegetation growth. Larger and deeper seasonal wetlands are not farmed but selected areas of vegetation are periodically managed to maintain and enhance open water habitat. During draw down and dry out of wetlands, the characteristics of local clay soils are evident. The saturated and sticky clay soils prohibit access into the wetlands by heavy equipment until the soils are almost completely dry. Earlier dewatering of some units is conducted so that there will be a dry enough substrate for maintenance.

3. Climate

National Weather Service – Wasco (049452), July 1948 to May 2010

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
avg. precip.	1.22	1.79	1.22	0.68	0.27	0.08	0.01	0.02	0.12	0.33	0.59	0.87	7.18
avg. temp	45.7	50.7	55.6	61.6	69.2	76.6	82.5	80.8	74.9	65.4	53.8	46.2	63.6
max temp	56.7	63.2	69.1	76.6	85.1	93.7	100.	98.6	91.9	81.8	68.0	57.7	78.5
min temp	34.7	38.2	42.1	46.5	53.2	59.4	64.9	63.0	57.8	49.0	39.6	34.6	48.6
ETo	1.36	2.08	3.77	5.43	7.03	7.80	8.52	7.72	5.82	3.93	1.90	1.20	56.56

Discuss the impact of climate, and any microclimates, on water management

Mild damp winters and long hot summers. While refuge objectives result in the majority of wetlands being flooded during the fall and winter those acres that remain flooded during spring and early summer result in the greatest amount of water used per habitat acre. No microclimates.

4. Water quality monitoring (attach water quality test result forms)

If the refuge has a water quality monitoring program complete this table

Analyses performed	*Frequency range*	*Concentration range*	*Average*
Dissolved Oxygen	Twice Yearly	5.1 – 11.1mg/l	8.3mg/l
Conductivity	Twice Yearly	190 - 1800umho/cm	600umho/cm
Molybdenum	Twice Yearly	Below Detection Level	<0.01mg/l
Phosphorus	Twice Yearly	<0.1 – 0.39mg/l	0.18mg/l
PH	Twice Yearly	7.7 – 9.7	8.1
TDS	Twice Yearly	180 – 1100mg/l	413mg/l
Boron	Twice Yearly	0.1 – 1.2mg/l	0.24mg/l
Arsenic	Twice Yearly	Below Detection Level	<0.02mg/l
Selenium	Twice Yearly	Below Detection Level	<0.05mg/l
Total Nitrogen	Twice Yearly	0.68 – 2.4mg/l	0.92mg/l

Discuss the impact of water quality on water management

Early season water deliveries to the refuge contain surface return flows from agricultural fields that contain high levels of nutrients that may cause algal growth in refuge ponds. The presence of algal mats covering the ponds interferes with waterfowl feeding and degrades the aesthetics of the area. Algae present in the spring also interfere with the growth and productivity of wetland plants. The high salt load present in the refuge water supply at certain times of the year will create long term soil salinity issues if sufficient water supplies are not provided to allow for adequate flushing of the refuge wetlands.

Section F Transfers, Exchanges and Trades

Provide information on any transfers, exchanges and/or trades into or out of the refuge

From whom	To whom	Report year (AF)	Use
None			
	TOTAL		

Section G Water Inventory

See Tables

Section H Critical Best Management Practices

Describe the 5-year implementation plan and the proposed 3-year funding budget.

The refuge public use and outreach programs incorporate components designed to educate visitors and community members about the value of water conservation, the water needs of wildlife, the importance of the refuge and the historic natural conditions of the local area. While the methodologies of these programs change in appearance over time the basic messages remain constant. Funding levels over the upcoming five year period are not anticipated to fluctuate significantly unless a new program is introduced that will require additional start-up funds.

Other CBMP's such as water monitoring, pump evaluations, and our cooperative efforts with other agencies and organizations are not anticipated to change within the next five years.

1. *Management programs*
   a. *Education*

Program	*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*
Develop, produce and install new visitor interpretive panels	5.0		
Refuge open house events	2.5	2.5	2.5
Student tours	4.0	4.0	4.0
Educational Presentations at schools	2.0	2.0	2.0

Describe the specifics of each program (number of participants, topics, purpose, etc.) and attach program materials, if available.

1. New interpretive panels are being produced for a new kiosk and alternative tour route. These panels discuss water management, public use programs, history of the area, and bird migration.

2. Each fall the refuge hosts an open house event to enlighten visitors about the importance of the refuge, availability of public use programs, and general wildlife resource conservation.

3. Student tours – In 2010 over 400 students from local elementary and middle schools participated in refuge tours and educational programs. This program requires over 20 staff days per year to implement.

4. Each year, refuge employees present programs to various schools ranging from elementary to colleges dealing with a variety of wildlife management topics. These programs encourage students and their families to visit our refuges to learn more about wildlife, habitat, water management, and other public use activities available on refuges.

b. Water quality monitoring

Type of water	*Existing Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*
Surface – USBR and riparian	1.1	1.1	1.1
Upslope drain			
Groundwater			
Outflow	0.5	0.5	0.5

Short description of existing or planned program – i.e., required by which agency, coordinated with

whom, constituents monitored and frequency

Program for Kern NWR involves monitoring of basic inorganics three times a year @ $360 per event, and a testing of organic constituents once a year @ $1,000.

c. Cooperative efforts

Refuge staff works closely with Buena Vista WSD coordinating water delivery-timings, volume and rates. Also work with adjacent landowners, providing technical assistance as part of the Conservation Easement Program, and coordinating discharges so as to make the most beneficial use of refuge runoff. Work with Fish & Game in local implementation of Presley Program (Fish & Game landowner incentive program to maintain wetlands on private land) and in administering waterfowl hunt programs, and in providing technical assistance to private duck clubs. Work with NRCS staff in implementing the Wetland Reserve Program and in providing technical assistance.

d. Pump evaluations (mobile labs)

Total number of groundwater pumps on refuge 4

Total number of surface water (low-lift) pumps on refuge 4

Groundwater pumps	*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*
# of groundwater pumps tested		2@1,500	2@1,500
# of pumps to be fixed or replaced			
# of low-lift pumps to be tested			
# of pumps to be fixed or replaced			

The four groundwater pumps will be tested to determine their continuing ability to serve in an emergency.

e. Policy evaluation

Ability to change USBR pre-determined/scheduled monthly quantities so that the refuge can use the available supply in response to unpredictable weather conditions and changing habitat needs.

4. Water management coordinator

Name: David Hardt *Title:* Refuge Manager

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Telephone: 661-725-2767 *E-mail:* dave_hardt@fws.gov

Section I Exemptible Best Management Practices

Describe the 5-year implementation plan and the proposed 3-year funding budget.

Kern National Wildlife Refuge has been in place for over 50 years with much of the infrastructure being refined over that time to be as water efficient as possible while still creating quality waterfowl habitat. Since passage of CVPIA 18 years ago, refuge wetlands have expanded and the internal distribution and loss recovery systems have been improved with water conservation always being top priority. The five year plan calls for the development of four additional cross levees to maximize water efficiency within the newest wetlands on the refuge. This work is scheduled for 2011. Additionally, with over 100 water control structures on the refuge, we normally replace between 3 and 6 structures a year that begin to leak due to natural degradation of the structure material. This replacement program is necessary to ensure that close

control of water movement through the wetlands is maintained and that water levels within units does not exceed prescribed levels.

Although water use schedules are subject to annual adjustments due to water supply limitations, climatic conditions and habitat quality issues, written schedules will be put in place by the fall of 2012.

Water outflow from the refuge is possible from three locations but 99% occurs at just two locations. By the close of 2012, the two main outflow locations will be addressed and nearly 100% of our outflow will be measured.

The final BMP that is addressed in this plan is the reduction of nonproductive ET in the form of invasive weed control in our water delivery system and wetlands units. Invasive plant species as well as emergent plants that restrict water flow through structures and the delivery system are of major concern to the refuge and are addressed on an annual basis.

1. Improve management unit configuration

Unit name	*Current acres*	*Reason for change*	*Proposed acres*	*Estimated cost (in $1,000s)*		
				2011	*2012*	*2013*
14 A - D	591	Divide units (build cross levees) to permit better water management	591	80		

2. Improve internal distribution system

a. New control structures within distribution system

Proposed location	*Type of structure*	*Reason for new structure*	*Estimated cost (in $1,000s)*		
			2011	*2012*	*2013*
Various	New WCS	Replace deteriorated structures to improve water efficiency	5	5	5

b. Line/pipe sections of distribution system

Proposed reach/sect.	*Reason for new structure*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
None	Unlined ditches provide additional wildlife habitat. There are no sections of ditches with exceptionally high water loss rates.			

c. Independent water control for each unit

Proposed control point	*Reason for new control point*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
None	The very few units without independent control function efficiently.			

d. New internal distribution sections (pipe, canal) to provide water to existing and new habitat units

Proposed new section	*Units served*	*Reason for new section*	*Estimated cost (in $1,000s)*		
			2011	*2012*	*2013*
None needed		The refuge has adequate distribution facilities			

3. Develop a Water Use Schedule

Plan element	*Completion date*	*Estimated development/update cost (in $1,000s)*		
		2011	*2012*	*2013*
Floodup dates by unit	6/2012		0.3	
Drawdown dates by unit	6/2012		0.3	
Irrigation dates by unit	6/2012		0.3	

Plans will contain estimated dates only. Annual adjustments will be necessary to each plan based on annual climatic conditions, water supply and habitat quality.

4. Plan to measure outflow

Identify locations, prioritize, determine best measurement method/cost, submit funding proposal

	Estimated cost (in $1,000s)		
	2011	*2012*	*2013*
Identify locations	Done		
Estimate outflow quantity/rank	Done		
Develop plan	Done		
Estimate construction start date (consultant services)		1.5	
Estimate construction completion date		1.0	

A Doppler meter that has already been purchased will be installed in 2012 in the outflow of Unit 7 which will measure approximately 90% of refuge outflow. A Doppler meter was selected because it is not necessary to maintain a full pipe to achieve measurement accuracy.

6. Construct and operate operational loss recovery systems

Proposed location	*Reason for improvement*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
None	Water quality concerns of returning salty water to internal refuge distribution system prevents extensive use of loss recovery system. Current recovery system recycles as much recovered water as water quality will permit.			

7. Optimize conjunctive use of surface and groundwater

Proposed production/injection well	*Anticipated yield*	*Estimated cost (in $1,000s)*		
		2011	*2012*	*2013*
None - Water Quality and pumping cost concerns prevent use of groundwater				

8. Facilitate use of available recycled urban wastewater that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to wildlife management goals.

NA – No recycled urban wastewater is currently available to the refuge.

9. Mapping

GIS map layers	*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*
None – All necessary mapping has been completed			

10. CALFED Quantifiable Objectives

Describe any past, present, or future plans that address the goals identified for this refuge

We remove invasive weeds from canal banks and bottoms and from wetland units. We also mow and disc canals to improve water flow and reduce ET by emergent plant species.

If reducing nonproductive ET involves removing invasive plants, complete the following:

Invasive unwanted species name	Estimated acres			*Estimated cost (in $1,000s)*		
	2011	*2012*	*2013*	*2011*	*2012*	*2013*
Salt Cedar	5	5	5	8	8	8

Sacramento and Delevan National Wildlife Refuges (NWRs)

1. Describe actions that reduce the salinity of surface return water. (Targeted Benefit (TB) 24)
2. Describe actions that reduce nonproductive ET. (TB 25)

Colusa and Sutter NWR's

1. Describe actions that reduce nonproductive ET. (TB 33)

Gray Lodge Wildlife Area (WA)

1. Describe actions that reduce nonproductive ET. (TB 46)

North Grassland, Volta, and Los Banos WA's

1. Describe actions that reduce selenium concentration in the Grassland Marshes. Reduce selenium concentration to 5 ug/L in the Grassland Marshes. (TB 95)
2. Describe actions that reduce San Joaquin River selenium and boron concentrations. Reduce San Joaquin River selenium concentration to 5 ug/L and boron concentration to 2 mg/L from March 15 to September 15 and to 2.6 mg/L September 16 to March 14. (TB 98)
3. Describe actions that reduce salinity in the Grassland Marshes and Mud and Salt Sloughs. Reduce salinity in the Grassland Marshes and Mud and Salt Sloughs. (TB 102, 103)
4. Describe actions that reduce nonproductive ET. Reduce unwanted ET. (TB 107)

San Luis NWR, Grassland Resource Conservation District

1. Describe actions that reduce salinity in the San Joaquin River, Grassland Marshes and Mud and Salt Sloughs. (TB 95, 96, 98)
2. Describe actions that reduce salinity in the Grassland Marshes and Mud and Salt Sloughs. (TB 102, 103, 104) (All of these six contaminant TBs could be incorporated into one Refuge manager response, e.g. addressed through the Grassland Drainage Program.
3. Describe actions that reduce nonproductive ET. (TB 107)

Merced NWR

1. Describe actions that provide additional flow to San Joaquin River. (TB 148)
2. Describe actions that reduce salinity at Vernalis. (TB 154)
3. Describe actions that reduce nonproductive ET. (TB 157)

Mendota WA

1. Describe actions that reduce flows to salt sink. (TB 167)
2. Describe actions that reduce nonproductive ET. Reduce unwanted ET. (TB 168)

Kern and Pixley NWR

1. Describe actions that reduce nonproductive ET. (TB 189)

Section J BMP Exemption Requests

For each BMP for which the refuge is seeking an exemption, provide a detailed narrative and complete the summary table

Summary of BMP exemptions

BMP	*Constraint*[1]	*Outstanding Need*[2]
N/A	N/A	N/A

1. *Constraint – list existing constraint. Use additional rows for multiple BMPs or constraints. Identify Legal (L), Environmental (EN), or Economic (EC) issues using code. If the BMP is not seen as beneficial, provide detailed information*
2. *Outstanding need – identify assistance required to implement the BMP. State specific funding or other assistance required*

Provide a detailed exemption request below for each BMP listed in the summary table

Non-Applicability (N/A) of Exemptible BMPs

Table 1 **March 1, 2008 to February 28, 2009**

Water Supply

2009	Federal Wtr Level 2 (acre-feet)	Federal Wtr Level 4 (acre-feet)	Local Water Supply (acre-feet)	Refuge Groundwtr (acre-feet)	Up Slope Drain Wtr (acre-feet)	other (define) (acre-feet)	Total (acre-feet)
Method							
Jan-2010	1,109	0	0	0	0	0	**1,109**
February	1,172	563	0	0	0	0	**1,735**
Mar-2009	0	0	0	0	0	0	**0**
April	0	0	0	0	0	0	**0**
May	286	0	0	0	0	0	**286**
June	0	0	0	0	0	0	**0**
July	0	0	0	0	0	0	**0**
August	0	928	0	0	0	0	**928**
September	197	3,072	0	0	0	0	**3,269**
October	3,320	314	0	0	0	0	**3,634**
November	1,510	3,228	0	0	0	0	**4,738**
December	2,642	0	0	0	0	0	**2,642**
TOTAL	**10,236**	**8,105**	**0**	**0**	**0**	**0**	**18,341**

***March 1, 2009 - February 28, 2010**

Measurement Method Definiti	
M1	Measured sum
M2	Measured sum
M3	Measured sum
C1	Calculated (mc
C2	Calculated usir
C3	Calculated usir
E1	Estimated usin
E2	Estimated usin
E3	Estimated usin
O1	Other (attach a

Table 2

Internal Distribution System

Year	2009								
Canal, lateral	Length (feet)	Width (feet)	Surface Area (square feet)	Precip. (acre-feet)	Evaporation (acre-feet)	Seepage (acre-feet)	Operational losses (acre-feet)	Measure method see Cell K5	Total (acre-feet)
Poso Creek	13,700	60	822,000	10.11	40.08	19	0	E2	**(49)**
E. Service Ditch	6,340	13	82,420	1.01	4.02	1	0	E2	**(4)**
Unit 14 Del.	18,480	18	332,640	4.09	16.22	8	0	E2	**(20)**
Service Ditch	25,900	24	621,600	7.65	30.31	14	0	E2	**(37)**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
			0	0.00	0.00				**0**
TOTAL	**64,420**		**1,858,660**	**23**	**91**	**41**	**0**		**(109)**
			43	**acres**					

Table 3

Managed Lands Water Needs

Year	2009									
Habitat Type	Area habitat acres	Habitat Water (AF/ac)	AF/ac water (AF/ac)	Delivered Water (Total AF)	Precip (AF/Ac)	Shallow Groundwtr (AF/Ac)	Evap (AF/Ac)	Cultural Practices (AF/Ac)	Seepage (AF/Ac)
Seasonal wetlands: timothy	2,096	6.00	3.10	6,498	0.51	0.00	1.67	0.50	1.20
Seasonal wetlands: smartweed		5.00	3.20	0	0.53	0.00	2.12	0.50	1.20
Seasonal wetlands: watergrass	50	8.00	3.50	175	0.53	0.00	2.12	0.50	1.50
Permanent wetlands		12.00		0	0.54	0.00	2.12	0.00	0.00
Semi-perm wetlands/brood pond		10.00		0	0.54	0.00	2.12	0.00	0.00
Riparian	100	12.00	2.00	200	0.53	0.00	2.12	0.00	2.00
Irrigated pasture		3.00		0	2.20	0.00	18.28	0.00	0.00
Upland				0	0.29	0.00	5.43	0.00	0.00
Seasonal wetlands (no summer w	3,795	6.00	3.00	11,385	0.51	0.00	1.67	0.50	1.20
(define)				0	0.00	0.00	0.00	0.00	0.00
Total Habitat Acres	**6,041**	**6.12**	**3.02**	**18,258**					

Table 4

Refuge Water Inventory

Year	2009	Reference		
Total Water Supply		**Table 1**		18,341
Precipitation		**Table 2**	**plus**	23
Evaporation		**Table 2**	**minus**	91
Seepage		**Table 2**	**minus**	41
Operational Losses		**Table 2**	**minus**	0
			Deliveries to Managed Lands	18,232
Managed Land needs		**Table 3**	**minus**	36,946
Difference		**(calculated)**		(18,714)
			Balance (Table 3)	871
			Water Inventory Balance	(17,843)

Table 5

Annual Water Quantities Delivered Under Each Right or Contract

Year	Federal Wtr Level 2 (acre-feet)	Federal Wtr Level 4 (acre-feet)	Local Water Supply (acre-feet)	Refuge Groundwtr (acre-feet)	Up Slope Drain Wtr (acre-feet)	other (define) (acre-feet)	Total (acre-feet)
2000	7,575	9,500	0	0	0	0	**17,075**
2001	9,950	8,000	0	0	0	0	**17,950**
2002	9,004	10,713	0	0	0	0	**19,717**
2003	9,195	12,686	0	0	0	0	**21,881**
2004	10,705	8,270	0	0	0	0	**18,975**
2005	9,950	11,514	0	0	0	0	**21,464**
2006	9,950	11,523	0	0	0	0	**21,473**
2007	9,950	7,538	0	0	0	0	**17,488**
2008	9,950	9,000	0	0	0	0	**18,950**
2009	10,236	8,105	0	0	0	0	**18,341**
Total	**96,465**	**96,849**	**0**	**0**	**0**	**0**	**193,314**
Average	**9,647**	**9,685**	**0**	**0**	**0**	**0**	**19,331**