Section 3

Best Management Practices for Agricultural Contractors

CRITICAL BEST MANAGEMENT PRACTICES

For the purposes of the USBR CVPIA Criteria, this Plan needs to describe the program that the District determines will best accomplish each Best Management Practice(BMP). The law specifies that the Criteria identify BMPs including, but not limited to, efficient water management practices being developed according to California State law or reasonable alternatives. For the purposes of these Criteria, a "BMP" means:

1. An established and generally accepted practice among water districts that results in more efficient use, conservation or management of water;
2. A practice for which sufficient data are available from existing water management projects to indicate that a significant efficiency improvement or management related benefit can be achieved; that the practice is technically and economically reasonable and not socially or environmentally unacceptable; and that the practice is not otherwise unreasonable for most water districts to carry out.

BMPs are, for all intents and purposes, identically defined as the Efficient Water Management Practices(EWMP) and will generally be acceptable to the Agricultural Water Management Council(Ag Council), for water management plan purposes, established under provisions of the AB3616 process. While the Ag Council's EWMPs have an economic feasibility component, the classification of practices is similar.

In general, BMPs under the Criteria have been categorized into two general groups:

1. Critical Best Management Practices
2. Exemptible Best Management Practices.

Critical BMPs are required to be implemented or are already implemented. Exemptible BMPs shall be implemented, unless the District demonstrates that the practice does not make sense for the District to implement. For appropriate BMPs, the District will provide a description of the implementation plan and include time schedules, budgets and monitoring plans. If a BMP is to be studied, provide details and schedules of the study. These studies must be expeditious and be completed before the next Plan update. The intent of the exemption process is to demonstrate in a clear and concise manner that a BMP is either not cost-effective, not financially feasible, not legal or not environmentally possible for a District to implement. Reclamation will consider exemption requests prepared using the final AB-3616 exemption process.

The following sections will describe current and proposed District programs which are applicable to each BMP. Please see Appendix F for fore detailed planned budget expenditures.

WATER MEASUREMENT

1. Measure, with a device that is rated to have a maximum error of +/- six percent, the volume of water delivered by the District to each customer.

The use of meters to measure water delivery is a cornerstone of any water conservation program. Meters enable water managers to accurately allocate limited supplies and recoup true delivery costs. They also enable the farmer to precisely measure the amount of water delivered and calculate irrigation efficiency. Without a reliable meter-based delivery system, farmers are more likely to apply a safety factor to each irrigation to avoid crop yield reducing underirrigation.

Recognizing these benefits, District founders elected to install flow meters at each of 3,075 deliveries at a 1991 cost of $1,400 each, for a total of $4.3 million. District-wide meter accuracy is within plus or minus two percent as determined from calibration tests.

Westlands' Meter Shop, located at the District's Five Points Shop and Field Office, is among the state's most modern. Meters are calibrated in the shop on a fixed schedule and repaired as needed.

Meters that fail or are inaccurate are repaired and re-calibrated immediately. To ensure accuracy, all meters are placed on a four-year preventive maintenance cycle ensuring that each is overhauled and recalibrated at least every four years, except for the Rate-A-Flow meters which are on a three year cycle. Preventive maintenance is funded from the O&M Reserve during water-short years.

As of mid-1998, the District's 100 remaining Brooks meter controllers are scheduled to be phased out at the rate of 20 per year and replaced with vertical meter and valve assemblies. The Brooks meter controllers have proved to be difficult to maintain, test, calibrate, and operate; and replacement is the preferred economical method to reduce operating costs and improve service.

In addition to testing approximately 750 District meters annually, the District also tests and calibrates meters on well discharges in conjunction with Westlands' Groundwater Integration Programs and the Groundwater Management Program, which is part of the Groundwater Management Plan adopted in Westlands. These conjunctive use Programs maximize the use of the farmers' groundwater wells during drought periods. Operation and maintenance of all wells is the farmers' responsibility.

Under the present program, accurate metering allows both the farmers and the District to carefully manage and account for all water delivered. Other programs such as the *Irrigation Management Information System (IMIS)* must be built on the foundation of a solid water metering program.

Action

The District's Water Measurement Program will continue as a standard District budget item at its current level as funds permit. The District is in compliance with this BMP.

DISTRICT WATER PRICING STRUCTURE

2. Adopt a water pricing structure for district water users based, at least in part, on quantity delivered.

Westlands' water supply is allocated, metered, and priced in a manner that encourages water conservation and reduces deep percolation. For most farmers, the effect of inefficiency on farm profit is reason enough to implement certain alternative irrigation practices. Farmer's water cost details were presented in section 1, but district farmers operate under overall water pricing conditions that encourage efficient use.

Water cost to a farmer in Westlands is highly variable. Few farmers have the same water cost for their farming operation. District water costs and allocation vary depending on the area of the district (I,II,III), the Reclamation contract category, and type of water year(percent of contract delivered). Cost and quality of groundwater is dependent on the location within the District. The District facilitates water transfers between water users within the district. The District actively seeks supplemental water supplies from outside Westlands to augment limited contract supplies.

Each of these supplies of water available to a district farmer has a different cost. As such, each farmer has different water costs related to the area of the District, the amount of supplemental water required and the supplies available. The individual supply water cost can exceed $100 per acre-foot for an individual component. A farmers ability to pay for water primarily depends on the crop to be grown. High value crops, generally grown on a contract basis, can pay for higher cost water supplies. Other crops grown in a crop rotation to maintain soil productivity, such as grains, may have a low ability to pay for certain water supplies.

With this water supply environment, a farmer's basic allocation can be expected to run about 70% of a full contract amount due to CVPIA restrictions, and less when ESA restrictions further limit export from the delta. The full contract allocation, which is not sufficient for the water needs of Westlands, would generally be about 2.6 AF per acre. The farmer's supplemental supply could be groundwater, depending on the cost of his basic allocation. The cost can be less than surface water, but the quality could be significantly less than surface supplies in most cases. In general, the eastern lands in the district have better groundwater supplies than the western lands.

Permanent crops in general are higher value crops and have higher water quality needs than annual crops. Groundwater is not generally used on these crops. As such, additional water supplies for these crops would come from supplemental water sources, possibly from outside the district at higher cost.

Action

Westlands farmers operate in a tiered water market environment, without the District explicitly implementing this type of pricing structure. The District is in compliance with this BMP.

3. Designate staff responsible for development of the water management plan.

Westlands has designated Russ Freeman as the Conservation Coordinator to coordinate this plan and communicate with the USBR.

Name:	Russ Freeman		
Title:	Supervisor of Resources Management		
Address:	Westlands Water District P.O. Box 6056 Fresno, CA 93703		
Telephone:	(559)241-6241	FAX:	(559)241-6277

In support of the Water Conservation Coordinator is a full-time water management specialist with a graduate degree. This specialist is responsible for developing and preparing district specific water management information for water users to encourage improved water management, providing technical assistance for water management to water user, preparing the Irrigation Guide, administering the low-interest Irrigation System Improvement Program for irrigation equipment and preparation of the Water Management Plan.

Action

Staffing will continue at current level, as funds permit. The District is in compliance with this BMP.

4. Provide or support the availability of the following water management services for water users:

ON-FARM IRRIGATION AND DRAINAGE SYSTEM EVALUATIONS

Westlands has had an active and extensive history of irrigation system evaluation. The five-year Irrigation Improvement Program began in 1985 with the closing of the San Luis Drain and extended through 1991. Over $1,000,000 of cost-sharing assistance was provided to district farmers to contract with Approved Program Advisors to provide irrigation evaluation and water management services. The information from the analysis of the data obtained has been valuable in establishing and documenting the efficient manner water is applied in Westlands. A similar program was funded through the Westside Resource Conservation District from 1987 through 1989. A total of over 740 fields were evaluated at least twice in the season. The District has used this database many times to direct its water conservation efforts.

The National Resources Conservation Service has offered the Water Quality Incentive Program to farmers in Westlands which has provided Irrigation Water Management and Salinity Management assistance to district water users, in recent years. In 1998 this program provided assistance on 4,470 acres for 31 fields with 18 water users for irrigation water management and on 1,781 acres for 11 fields with 11 water users for salinity management.

As a member of the San Luis Delta Mendota Water Authority, Westlands will offer the availability of a Mobile Lab for its water users as of the 1999-2000 water year under the program offered by the SLDMWA.

NORMAL YEAR AND REAL-TIME IRRIGATION SCHEDULING AND CROP ET INFORMATION

Crop ET information is necessary to develop efficient crop irrigation schedules, both real-time and average yearly values. Westlands has provided these types of data since the USBR Irrigation Management Service program was adopted in 1981. Three automated weather stations used to provide real-time ET information currently serve the District; one operated by the District and two that are part of the CIMIS network. Currently Westlands Water District, Tranquillity Irrigation District, Broadview Water District and CIMIS cooperatively operate the northern weather station site.

Irrigation Guide

Farmers know their soil, climate, and crops. But for some, determining precise crop water needs, maintaining water use records, and calculating irrigation efficiency is a matter of tradition and practical experience. Armed with reliable information in a practical format, these farmers are better equipped to schedule irrigations and apply the correct quantity of water for their specific field conditions.

The weekly *Irrigation Guide* was first mailed in 1978 to provide all District farmers with crop-specific water use information. This information was originally based on a manually operated weather station located at the District's Tranquillity Field Office. District climatic measurements are now obtained from the automated weather stations and are used to develop specific water use values to help farmers estimate crop water use and schedule irrigation timing and amounts. As of December 1998, 528 copies of the *Irrigation Guide* were being sent out each week. Half of the Guides were delivered via FAX. Since the Guide is usually a single side of a page, FAX delivery is a considerable cost saving option where applicable. In 1996 the District was awarded a grant by the USBR to implement an intranet server on the computer network to provide real-time access to water delivery information and one of the features will be a daily version of the Irrigation Guide available to any farmer with a computer and a modem.

Daily water use for various crops is presented in the *Guide*. This includes actual daily water use for the past 28 days and a 10-day forecast of crop water use based on National Weather Service forecasts and average historical weather conditions. The *Guide* also includes information on precipitation at the three weather stations in the District and at Shasta Dam and on water storage quantities at San Luis Reservoir and Lake Shasta. On the reverse side of the *Guide*, water conservation information is printed, including upcoming events and deadlines, available assistance, and management tips. Project water quality has recently been added.

The data shown in the *Guide* are the result of extensive monitoring between 1982 and 1995 of the various crops grown in the District to verify and calibrate the computer model used to calculate the crop water use values. While the *Guide* information has proved very accurate, each water user is encouraged to conduct regular soil moisture monitoring with the "feel" method or other means to verify the soil moisture status of each field. Farmers also are encouraged to apply only the amount of water necessary to refill the crop root zone and satisfy salinity control and other cultural water needs. Comments from farmers during routine contacts and District-facilitated focus groups indicate a high level of utilization of the *Guide*. Some farmers use the *Guide's* crop water use information to confirm other methods, while many use it directly to schedule irrigations. The *Irrigation Guide* will continue to be published in its present form.

Irrigation Management Information System

In 1991 the District expanded the computerized water ordering system to reduce manual inputs and processing time and to keep track of a greater amount of necessary information. This computer interface is also a necessary step in the development of the *IMIS*. In the future, on-farm computer systems will be linked via modem to the District's computer system, facilitating greater water management flexibility and the ability of the District to rapidly disseminate timely water management information. On-farm linkage of real-time water management information to District computer systems has been facilitated by a USBR intranet grant.

The current mix of water management information will continue into the foreseeable future, due to its clear cost-effectiveness and usefulness. In addition, Westlands will look for opportunities to publish new and useful water management information. Other media such as computers, video, and slide programs will be considered if they prove to be cost effective.

The popularity of the *Irrigation Guide* and *Irrigation Improvement Program* (cost share) reveals a need by farmers for dependable irrigation data on which to base management decisions. The *IMIS* is intended to present irrigation information in a timely, user-friendly package that can be directly applied to the conditions of a specific field.

With the District's conversion in 1999 to a networked computer water ordering system, irrigation dates and quantity of water delivered to each field are now available. This information can be captured for use in *IMIS* to produce several products useful to farmers.

Ultimately, hand-held computers are expected to be used to collect monthly or better water delivery data, replacing and improving upon the current manual system.

Farm Water Budget

With the implementation of the USBR intranet grant, one of the interactive features will be a Farm Water Budget preparation page that will allow District water users to enter projected cropping patterns and acreages to display or print seasonal water supply needs.

Irrigation Guide

The current weekly *Irrigation Guide* provides farmers with crop water use data for specific crops in three climatic regions of the District. In addition to the generalized *Guide*, the custom *Irrigation Guide* is expected to be available to District farmers and is expected to provide the following features for each field and crop:

- Cumulative seasonal water delivery
- Cumulative seasonal evapotranspiration
- Current crop water use
- Projected evapotranspiration

- Most recent water delivery start date and amount applied

Farm Water Summary

An additional feature of the District intranet might allow farmers, in the District to prepare an end-of-year summary of all Project and well water used by field, crop, irrigation, and seasonal total. Effective precipitation and evapotranspiration totals would be calculated to arrive at an estimate of each field's seasonal application efficiency. This information will help the farmer identify irrigation strengths, correct problems, and plan the upcoming year's cropping pattern.

The data collected through the *IMIS* will enable the District to better analyze the efficiency with which irrigation water is used, to target *Water Conservation Program* resources, and to identify critical water delivery periods. The *IMIS* will provide both participating farmers and the District more accurate and timely information with which to form an irrigation strategy. Farmers will know how much water they need, how much they applied, and where improvements can be made for each crop. District staff will be able to monitor crop water needs and irrigation deliveries and thereby calculate efficiencies. These efficiencies can then be used as a reference point for the application of *Water Conservation Program* resources and to more accurately determine District water requirements.

When the Water Information Management System(WMIS) conversion is complete in 1999, the resources will be available to begin the IMIS implementation. It is expected that the IMIS program will require a minimum of one year to become operational. Individual components of the total system will be online earlier since the system will be implemented using Internet web browser programs as the client software used by each farmer.

SHALLOW GROUNDWATER MONITORING

Since 1964 the Bureau has conducted monitoring of shallow groundwater depth quarterly from a grid of monitoring wells located throughout Westlands. The Bureau also performs limited shallow groundwater monitoring well maintenance, including replacement of wells as needed. The District will continue to supplement the Bureau's well maintenance and replacement activities to ensure that the required number and quality of sites are maintained.

Westlands currently collects water samples, analyzes the water for salinity, and maps both salinity and shallow groundwater depths from these and Bureau data. In addition, the District identifies wells to be cleaned, replaced, and sites and depths of new wells. District farmers have always found the shallow groundwater and deep groundwater maps produced by Westlands to be useful.

In the past, shallow groundwater data has been used only to prepare District-wide maps and not for problem identification and diagnosis at the field level. Shallow groundwater data can be used as a diagnostic tool. For example, where groundwater levels are found to be shallow and salinity relatively low, excess deep percolation from overapplication is indicated. On the other hand, a shallow water table with relatively high salinity could indicate little or no leaching, requiring more extensive on-farm management, such as the installation of subsurface drains or alternative land use.

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WATER MANAGEMENT INFORMATION PROGRAM

The final decisions on irrigation must be made by those whose livelihoods depend on it--the farmers. By nature, farming demands both a command of the art and science of working the land, the business and skills of operating the farm, and marketing its crops. Anything the farmer can do to reduce costs will improve his profit margin and increase competitiveness in the marketplace and ensure ultimate survival of the farm.

Discussion with farmers in small focus groups reveals a need for reliable water management information presented in a user-friendly manner. Farmers have indicated that they want concise, factual data on which to base decisions. In addition, they want creative and innovative water management ideas, particularly those tried and tested by other farmers, presented in a straightforward, informal manner.

The Westlands' *Water Management Information Program (WMIP)* was developed to provide farmers with this kind of useable, straightforward information and has been the cornerstone of the District's *Water Conservation Program*. Providing information in this manner has proven year in and year out to be the most cost-effective means of promoting water and energy conservation and reduction of deep percolation.

Data Collection and Analysis

The foundation of *WMIP* is and will continue to be the timely collection and accurate analysis of field conditions related to irrigation management. Weather, soil, applied water, irrigation system, and crop data were collected on a routine basis. Once interpreted, these data form the basis of the various informational publications and services such as the District's *Irrigation Guide, Irrigation Management Handbook*, and technical support to District farmers.

Westlands began collecting weather data in 1973 from a manual station located at the District's Tranquillity Field Office. The District started using weather information from it's own and the Department of Water Resources' California Irrigation Management Information System (CIMIS) automated weather stations in 1983.

Today, Westlands operates one weather station in the southern region of the District and receives data from two CIMIS stations in the northern and central regions. These stations are accessed by telephone to a computer at Fresno Office, where temperature, dew point, solar radiation, precipitation, and wind data are stored for later use.

The data are used in a modified Penman computer model which calculates the potential evapotranspiration (ETP) of unstressed alfalfa. This value is then applied to historic coefficients for each crop. These crop coefficients have been developed specifically for conditions in Westlands. Climatic data are also provided upon request to various farms, farm service companies, and governmental agencies for use with their own water management programs.

Until 1995, the District collected data from approximately 50 neutron probe sites annually to monitor soil moisture change; determine actual crop water use; the depth, expansion rate, and maximum seasonal depth of the root zone; and effective precipitation. About 20 of these are permanent access tubes in orchards and vines and the remainder were installed seasonally in cropped fields. The access tubes were installed to a depth of 6 to 10 feet depending on the effective rooting depth of the crop. Installing, maintaining, and making weekly observations of these sites required one full-time person during the irrigation season. The soil moisture was monitored in one-foot increments at each access tube.

The primary use of this data is to determine the crop coefficients used with the ETP to calculate crop water use. Water deliveries are also recorded for each field with a neutron probe site and can be used to estimate efficiency for each irrigation and the entire season. Soil samples from the surface to a depth of six feet are collected at neutron probe sites. These soil samples are analyzed for texture and available water-holding capacities. The District maintains a data base of soil information which is continually updated. Besides being used to calibrate the neutron probe, the average soil moisture holding capacities of common soil types are published in the District's *Irrigation Management Handbook.*

Data collection and analysis are integral parts of the *Water Conservation Program* and will continue at current levels during the next five years.

Irrigation Management Handbook

In 1981 the *Water Conservation and Management Handbook* was prepared and distributed to each of the District's water users. The American Society of Agricultural Engineers awarded the *Handbook* a blue ribbon as an outstanding entry in the 1984 Educational Aids Competition. The information contained in the *Handbook* is targeted specifically at water management problems found in the District and is expected to be revised as a part of preparing information for the water conservation pages on the District intranet for water users.

The *Handbook* contains information on soils, crop characteristics, irrigation scheduling, water use planning, and salinity management. The soils information section includes methods of determining texture and moisture status and available water-holding capacities for typical soil textures. The crop information section includes root zone development and recommends allowable soil moisture depletion for common crops. Methods to determine the amount of water required to refill the soil profile are also described. The irrigation scheduling section addresses the use of the *Irrigation Guide*, methods to calculate application efficiency, and methods to schedule irrigation dates and amounts using the data contained in the *Handbook* and shown on the *Irrigation Guide*.

Effective farm water use planning is necessary to best utilize the available water supply. The *Handbook* contains three water budget forms to assist farmers with their planning. The farm water budget helps farmers select the cropping patterns and match crop needs with available water supply.

The monthly water budget is prepared after the selected farm water budget is completed. The monthly water requirements can then be reconciled against the Water Allocation and Use Summary each water user receives with the monthly water bill. A comparison of the projected water requirements and the actual water use can be made for each month and action taken to correct any identified problems.

The field water budget is prepared after the final cropping pattern is determined. This information allows the farmer to keep accurate historical water use records on a field-by-field basis, allowing him to identify problem areas that he otherwise might miss. The water required for a specific field can be calculated for preirrigations, shallow groundwater available to the crop, expected variation in application efficiency, effective precipitation, and other factors that may influence the water requirement. The farmer then records his actual water deliveries. This enables him to identify water deficiencies or surpluses in time to take necessary action. The seasonal application efficiency for the field can also be determined.

The *Handbook* contains techniques for managing soil salinity, specifically, defining the problem and identifying irrigation and cultural practices to minimize reductions in crop yield. The *Handbook* also includes data sheets for selected crops displaying crop water use, effective precipitation, effective root zone, allowable depletion and stress-sensitive periods. The updated information will include updated crop water use, water budgeting methods, and soil salinity management information in addition to irrigation system management and evaluation techniques.

The Irrigator

Profitable Practices was conceived in 1987 to satisfy the farmers' interest in increasing profits by keeping informed of innovative approaches to water management used by other farmers. Originally this bimonthly publication highlighted progressive efforts to conserve water and energy, reduce costs, and increase income, but now is a recurrent feature in the District monthly water conservation newsletter *The Irrigator*. It presents cost-effective techniques actually used on District farms that have proved to be worthwhile in increasing profit through alternative water management practices. *Profitable Practices* has included topics related to shallow groundwater monitoring, soil moisture probing, furrow torpedoes, groundwater wells, sprinkler irrigation, tailwater reuse systems, and drip irrigation system management. As of December 1998, over 850 farmers and other interested parties receive this publication.

Profitable Practices became one of the features implemented in 1993 in *The Irrigator* and continues to highlight new and innovated irrigation management practices or to reinforce previously identified practices. The information in *The Irrigator* will also be made available on the water conservation pages of the District intranet server.

Action

These conservation efforts, begun before the time of Water Management Plans, will continue within the bounds of water conservation and public information staff time availability. The District is in compliance with this BMP.

EXEMPTIBLE BEST MANAGEMENT PRACTICES FOR AGRICULTURAL CONTRACTORS

Each district shall develop a program to implement the following best management practices unless the district demonstrates that the practice does not make sense for the district to implement. A district is exempt from implementation as described in Step 5D of the Criteria for evaluating Water Management Plans.

1. Distribution system lining/piping - line or pipe distribution systems to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage.

CANAL LINING

Aside from the 1,000 plus miles of buried pipe in the District distribution system, Westlands operates three Bureau owned pumping plants that draw water from Mendota Pool via 7.4 miles of unlined canal (Figure 8). The Mendota Wildlife Management Area (MWMA) which borders 3.9 miles of the canal also draws water from the Mendota Pool. The majority of the canal (those portions serving Pumping Plants 6-1 and 7-2), as well as the MWMA lands adjacent to the canal, operate at the same water elevation as the Mendota Pool.

Seepage Loss Estimates

The District has not conducted actual seepage loss tests on this canal. However, other data is available and was used to develop estimates of losses. These data include: (1) ditch and reservoir seepage loss tests of textually similar soils, (2) hydraulic conductivity tests in the vicinity of Pumping Plant 7-1, and (3) published soil surveys with permeability data covering the area between Pumping Plants 7-1 and 7-2.

District engineers conducted field surveys to determine the existing cross sections of the canal to estimate its wetted perimeter. These data were then combined with the soil properties and other data to develop the estimated canal seepage loss. This analysis indicates an average seepage loss of .25 acre-feet/day/mile in the 3-mile reach between Pumping Plants 7-1 and 7-2. The seepage rate for the remaining one-half mile not adjoining the MWMA is assumed to be similar based on the available data and field inspection.

The remaining 3.9 miles of canal abutting the MWMA probably has a lower loss rate due to high groundwater conditions brought about by the long-term flooding of the wetlands refuge areas within the MWMA. Also, since both this reach of the canal and the MWMA ponds operate at or near the same water surface elevation, hydraulic gradients are at or near zero. Therefore, canal seepage, to the extent it occurs, probably reduces losses from the MWMA ponds. Alternatively, if the canal is empty, the ponds will likely seep into the canal.

In summary, seepage from this reach is likely negligible and less than other reaches. Further, canal seepage is probably beneficial to the MWMA.

Lining Cost

Detailed estimates of the cost to concrete slip form line the canal were developed for the reach between Pumping Plants 7-1 and 7-2. Unit costs are based upon similar public works construction projects completed during the last 12 months in Fresno County.

The analysis assumes that the existing channel would first be backfilled, then excavated and lined to the original design cross section which calls for: (1) a total lined depth of 6 feet, (2) a flow depth of 5 feet, (3) a bottom width of 12 feet, (4) a side slope ratio of 1.5 to 1, and (5) a lining thickness of 2.5 inches.

Table 29 shows the estimated costs to line and maintain the three-mile reach. The annual cost is $205,700 or $13 per lined foot per year. The total estimated annual seepage loss is 275 acre-feet which equates to a cost of approximately $750 per acre-foot per year.

It should be noted that this analysis assumes that concrete lining has zero seepage loss. Therefore, the analysis above can be considered a best-case scenario since some seepage will occur.

Action

Based on this analysis, lining this canal is not financially feasible.

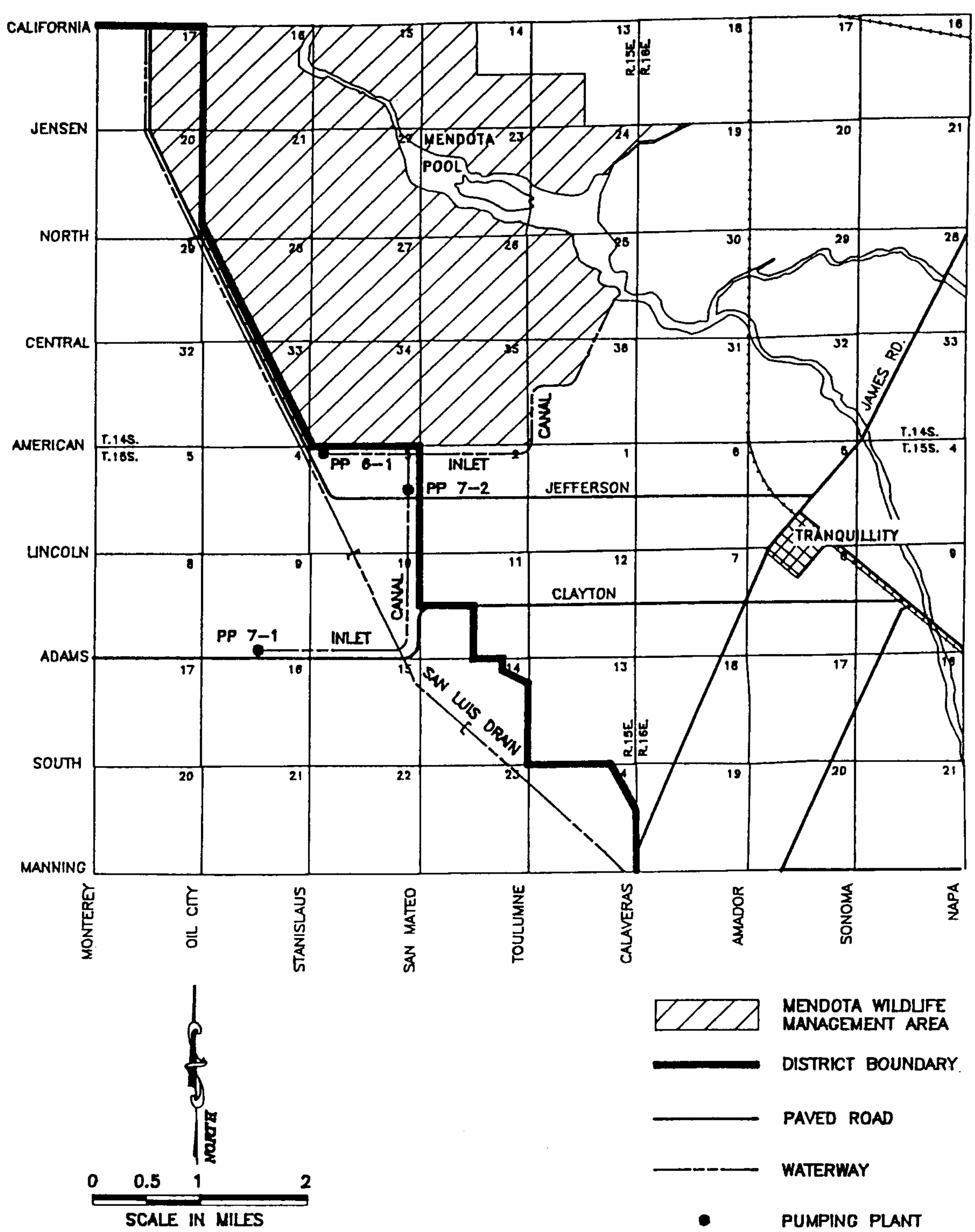

Figure 8. Location of Unlined Canals

Table 31

Estimates of Costs
Lateral 7 Intake Canal Lining to
Pumping Plants 7-1 to 7-2

Item No.	Work or Material	Quantity	Unit Price	Amount
1	Backfill and compact existing channel	147,000 c.y.	$ 2.25	$ 330,750
2	Excavate new channel [1/]	96,624 c.y.	.75	72,468
3	Slip form lining with fiber reinforcement [1/]	570,240 s.f	1.25	712,800
4	Trim and grade spoil	15,840 l.f.	.50	7,920
5	Road crossing	3 ea.	50,000.00	150,000
6	Rock and chip seal 16-foot service road	253,440 s.f.	.50	126,720
	Subtotal			$1,400,658
	Engineering, surveying, and administration	15%		210,098
	Contingencies	20%		280,131
	Total Cost			$1,890,888
	Annualized Cost: (CRF - 8%/30 yr.) CRF = 0.0888 = 1,890,888			$ 167,900
	Maintenance at 2% of initial cost			37,800
	Total Annual Cost			$ 205,700

Estimated Seepage Loss
.25 AF/mi./day x 3 mi. x 365 days/yr. = 275 AF/yr.

Cost of Conserved Water = $205,000/275 AF/Yr=$748.00 AF

[1/] Canal Cross Section: b = 12 feet; D = 6 feet; ss = 1.5 to 1

2. Construct or line regulatory reservoirs – construct regulatory reservoirs to improve distribution system delivery flexibility.

RESERVOIR SEEPAGE EVALUATION

Virtually all of Westlands' water supply is delivered through pipeline, eliminating losses to evaporation, seepage, and spills. In the distribution system there are, however, 16 regulating reservoirs designed to provide a constant water supply at the upper reach pumping plants. Two of the reservoirs have synthetic Hypalon liners while the other 14 are unlined.

Seepage tests were conducted on three of the unlined reservoirs in 1998 during triennial inspections, 13 RA, 17RA and 17RB. Based on these evaluations it was determined that the average seepage loss for a regulating reservoir was 14 AF per year. The estimate for all of the 14 unlined reservoirs is 196 AF per year. The previous Water Conservation Plan estimated that a potential water savings of about 68 AF per year was possible if reservoirs are lined. Because of the upslope location of the reservoirs, there is no measurable drainage impact associated with the seepage.

Lining a reservoir with synthetic materials is cost prohibitive while Bentonite treatments are reported to reduce seepage up to 80 percent. The cost of lining reservoirs with a membrane is expected to exceed $40,000 each, and is not considered feasible. Bentonite treatment, the least cost option, would cost about $9,000 per reservoir, considering the cost of excavator rental, labor, other equipment and materials. Water cost of $50 per AF would return the expenditure for this treatment in water savings, 180 AF, in about thirteen years per reservoir, at 14 AF of water conservation per year. Even if this was considered financially feasible, it is not practical to take the distribution system out of service for the month that would be required to allow the soil in the reservoir to dry during the summer months, which is the busy irrigation season. When these reservoirs were constructed water was less than $10 per AF and it was not considered feasible, at that time, to line more than 2 of the 16 regulating reservoirs constructed on the delivery system.

Action

Lining these reservoirs is not feasible.

3. Distribution Control - Modify distribution facilities and controls to increase the reliability, consistency and flexibility of water deliveries.

Westlands already operates automated closed pipeline systems from the San Luis Canal. Water users are able to turn their flows on and off after the District is given a 24-hour notice.

Action

The District is in compliance with this BMP.

4. Reuse Systems - Construct facilities to capture and reuse district operational spills.

No operational spills occur in the District.

Action

This BMP does not apply to the District.

5. Incentive Pricing - Implement a pricing structure that promotes one or more of the following goals: a) encouraging more efficient water use at the farm level, b) supporting planned conjunctive use of groundwater, c) increasing groundwater recharge, d) reducing problem drainage, and e) improved management of environmental resources.

Westlands' water supply is allocated, metered, and priced in a manner that encourages water conservation and reduces deep percolation. For most farmers, the effect of inefficiency on farm profit is reason enough to implement certain alternative irrigation practices. Westlands believes that it qualifies for this BMP by virtue of High Volumetric Pricing provisions, as described in "Incentive Pricing Best Management Practice for Agricultural Irrigation Districts", USBR, June 1998.

Westlands' water supply is less than required for full cropping with the Reclamation surface water contract and a safe groundwater yield of 150,000-200,000 AF, especially since the long-term reliability of the contract surface water supply is 70%, or less, of a full contract amount. The total water supply is less than the potential crop water requirement. Additionally, the irrigation technology currently in use results in an average on-farm efficiency greater than 80 percent. Both of these are criteria for effectiveness under this publication.

Furthermore, the District acts, under District regulations, as a clearinghouse for internal water transfers and as a broker for external water trades, which are two more criteria for incentive pricing under this publication. See Appendix A, section 2.6.

Additionally, Westlands has had its water supply reliability reduced to approximately 70% of the historical average, by 1998, due to ESA, CVPIA and water quality limitations in the Delta. It is expected that regulatory conditions will further reduce the water supply reliability. A significant amount of Westlands' water supply is obtained on the annual spot market at prices generally twice the cost of CVP contract supplies. Therefore the cost of water minimizes overuse or waste.

Action

The District is in compliance with this BMP.

6. On-farm program incentives - Facilitate, and/or provide, financial incentives and assistance for on-farm water management improvements.

District studies indicate management alternatives to existing practices and irrigation systems can, in certain cases, significantly improve *Seasonal Application Efficiency (SAE)*, distribution uniformity (DU), irrigation efficiency (IE) and reduce underirrigation. This in turn can improve a farm's profitability by reducing the need to use some fertilizers, improving crop yields, and reducing the effects of excess deep percolation and soil salinity. Switching to alternative practices and equipment, however, generally requires up-front capital, sometimes beyond the economic means of individual farmers.

The District has served as an informational source on other available funding and assistance for alternative irrigation methods and equipment. These sources include the U.S. Department of Agriculture (USDA), which offers cost-share funding of irrigation system improvements through the Agricultural Stabilization and Conservation Service and engineering design through the Soil Conservation Service (SCS).

A capital improvement program with $1,000,000 of low-interest State Revolving Fund loan has been in place since 1995 and a second, $5,000,000, expanded program was initiated in 1998. These lease-to-own programs provide farmers with further savings when compared to a conventional loan. The funds from the 20 year SRF loan are used to finance 4 year improved irrigation equipment lease-purchase agreements. These low interest funds are recycled at the end of 4 years to provide additional low interest leases. It is estimated that a total of over $32,000,000 worth of improved technology irrigation equipment will be facilitated through these loans. Administrative costs are covered by an additional 0.5% increase in interest on the SRF loan.

Organizations that provide services are summarized in Table 30.

Table 32

Organizations Providing Financial Assistance for Irrigation System Improvements

Source	Description	Terms
ASCS	Cost share equipment Cost share management	$3,500/yr. for up to 10 years $3,500/yr. for up to 10 years
USDA-SCS	System design	No cost to farmer
WWD	Low Interest Lease/Purchase	3.1% to 3.3% interest for 4 years

Action

The Districts SRF funded low-interest Irrigation System Improvement Program has a 20 year life. The individual leases of equipment to District farmers have a term of 4 years, which allows the SRF loan money to be reused many times for improvements to irrigation systems in Westlands. Funding for the administration of this program is provided by an extra 0.5% on the interest rate charged on the equipment lease.

Water users will continue to be encouraged to invest in alternative improved irrigation systems and management practices to the extent practical. Beyond this, the District will also continue to provide information to farmers on the sources and availability of funding for irrigation improvements. The District is in compliance with this BMP.

7. Conjunctive Use-Increase planned conjunctive use of surface and ground water within the District.

CONJUNCTIVE USE

The land in Westlands has always relied on groundwater to satisfy a portion or all of its agricultural water requirement. Prior to the development of the San Luis Unit (SLU) of the CVP, District farmers relied exclusively on groundwater. Groundwater pumping decreased when the SLU of the CVP became operational, especially in wet and normal water years.

One of the CVP project purposes was to reduce overdraft of groundwater. Therefore, the original 1963 Contract Supply Demand was set at 900,000 AF of CVP surface water supply, 1,100,000 AF less 200,000 AF groundwater supply. Any additional use of groundwater above 150,000-200,000 AF, the annual safe yield, will result in overdraft and resumption of detrimental subsidence.

Westlands' farmers have been engaged in individual conjunctive use of surface and groundwater since Central Valley Project (CVP) surface water deliveries started in 1968. Initially farmers pumped groundwater as their primary irrigation source, supplementing the supply with whatever Project water was available. When the current full Contract deliveries of 1.15 million acre-feet (AF) became available in 1975, farmer pumping decreased dramatically, resulting in a reduction of a severe overdraft of the groundwater aquifer.

Recovery of groundwater levels reduced pumping costs for those farmers who needed to continue pumping to augment Project water allocations. More importantly, it allowed for conservation of groundwater for future droughts. The first true test of full-scale conjunctive use came just two years later with the 1977 drought in which Project water deliveries were reduced 75 percent to approximately 300,000 AF. To make up the shortfall, farmers resumed large-scale groundwater use, pumping an estimated 472,000 AF. When the rains returned in 1978, groundwater pumping again returned to its pre-drought level of less than the estimated safe yield of about 135,000 AF annually and groundwater elevations rose to historic levels.

The District's current strategy regarding conjunctive use of surface and groundwater considers both source components of the District's overall water supply and seeks to maximize beneficial optimum use of this supply (i.e., conserve). The goals of the District's conjunctive use efforts are to (1) allow for maximum flexibility in the use of both surface and groundwater supplies, (2) increase firm surface deliveries in normal and wetter years, and (3) improve drought-year water supply reliability.

The most direct way to accomplish these goals concurrently is to maximize the use of surface water when it is available, thereby conserving groundwater for use in water-deficient years. This can be accomplished by exchanging a small quantity of firm Project water with another entity in deficient years for a greater amount of Project water in normal or wetter years. This arrangement will increase the District's supply to water-deficient lands in normal years, thus decreasing groundwater pumping and conserving groundwater and energy resources for use during drought periods. In effect, the District's overall water supply is increased without impacting drought water supplies. The urban district(s) gain a vital firm drought water supply without costly new water supply development

Groundwater Integration Program

In 1990, farmers faced a CVP water reductions of 50 percent, and the need for additional use of groundwater to make up the shortfall became essential. The problem confronting farmers was how to maximize the total output from their wells' relatively low but constant flow, without the benefit of surface storage, when trying to meet the high flow demands of the summer growing season. A concept evolved that would allow farmers could pump into District, state and/or federal delivery facilities during periods of low crop water demand and, through exchange, store water in San Luis Reservoir for later use. The concept became reality in 1991 with the adoption of the *Groundwater Integration Program* that allowed farmers to pump, subject to strict water quality and engineering standards, into the Mendota Pool, the San Luis and Coalinga Canals, and the District's distribution system. Approval for pumping into the San Luis canal was withdrawn by the State in 1995.

Current and Future Program Description

While adequate surface water supplies have been available and the use of these programs have been minimal in the past few years, these programs are still available to District water users, should the need arise. Farmers desiring to participate in the *Program* must submit an application package detailing their plan to pump water into the facilities. Before pumping into the Coalinga Canal or the District's distribution system can begin, the water must be tested at farmer expense to ensure that state drinking water quality standards are met. The District then evaluates the plan for potential impact on protected species before applying to the Bureau for a Warren Act contract to convey non-Project water through federal facilities.

From an engineering standpoint, the District must ensure that pumpers construct conveyance facilities that do not interfere with normal canal and system operation, protect the distribution system from possible damage, and do not negatively impact the environment.

Once the farmer's plan is approved and construction completed, he must report all pump-in activity to the District and routinely test the quality of the pumped water. Westlands' Operations Department monitors pump-in to ensure system capacities and water quality standards are not exceeded. Well water meters are read weekly and the pumper's account credited for each AF of pump-in.

<u>Groundwater Management Plan</u>

The District has adopted a Groundwater Management Plan in accordance with the AB3030 process, attached in Appendix E. Within the scope of the Plan a new Groundwater Management Program was initiated in 1998. All wells within the program will be metered and will be ordered on and off as if they were a District delivery. This program is expected to provide improved estimates of groundwater usage within Westlands.

Action

These plans and programs are part of the District operating procedures and will continue to be supported and implemented. The District is in compliance with this BMP.

8. Land Management-Facilitate alternative uses for lands with exceptionally high water duties, or whose irrigation contributes to significant problems.

The USBR has instituted a voluntary land retirement program in 1998 with a goal of retiring 15,000 acres of drainage impacted lands. Westlands has an agreement to participate in this program with the Bureau and in return will keep the water allocation from retired lands.

Westlands believes that any land retirement program must be voluntary and will work toward developing policies for the orderly retirement of land in the District. These policies must take into account farming practices and environmental concerns to minimize the impacts on wildlife and crop production.

Westlands determined in 1999 that a land retirement plan needed to be developed for the drainage-impacted areas and has begun to purchase drainage affected lands as part of a long-term supplemental water acquisition program. At the time of this writing the District was in the process of purchasing over 10,000 acres of lands. This land will be retired from irrigated agriculture and the water allocation will be apportioned to the remaining lands in the District.

Action

The District will implement this agreement with the USBR and will continue to investigate other possibilities that facilitate orderly land retirement. The District is in compliance with this BMP.

9. Pump Efficiency Evaluations - Coordinate the evaluation of District and private pumps with local utilities, evaluating both energy and water efficiency.

PUMP EFFICIENCY TESTING

District Distribution System Pumps

The District uses about 100-million kWh of electricity annually to operate distribution system pumping plants. The cost of approximately 94 million kWh of power provided by the CVP is included in the water rates charged to the District by the Bureau. The remaining six million kWh is purchased directly by the District at a higher rate.

Westlands' goal, as stated in the *1990 Energy Conservation Plan*, is to "reduce the electrical pumping energy by four percent through a *Pump Efficiency Testing Program*. A savings of 4.4 million kWh annually might ultimately be expected when this program is fully implemented."

The District delivers an average of 400,000 acre-feet of water per year from pumped (versus gravity flow) laterals. Some deliveries at the outer reaches of the pumped laterals receive water that has been pumped four times and lifted as much as 320 feet from the San Luis Canal. At times the demand on a pumped lateral can exceed its pumping capacity, resulting in the need to reduce demand by prorating delivery allotments.

Over time, pump and electric motor components wear, decreasing pump efficiency in terms of both electric power consumption and maximum delivery capacity. In 1985 the District adopted a pump test program to keep pumps and motors running at peak efficiency and to reduce unscheduled system outages due to failures. The District pump maintenance facilities are fully utilized for pump maintenance and rebuilding activities before contracting with outside vendors. Under the current program, any District pump found to be in poor condition is scheduled for repair the following year. During times of drought when the District's operating budget is trimmed, testing and preventive maintenance was deferred, as was the case in 1990, 1991, and 1992. The subsequent years with near full water supplies available have allowed he District to update these deferrals to the greatest extent possible. Currently an O&M reserve is used to fund maintenance in times of drought. In 1998 the District overhauled and repaired 39 units at a total cost of over $276,000. The cost of District pump repairs is directly proportional to the number of tests and repairs performed. Labor and materials for pump overhauls are computed at the average rate of about $7,077 per unit. Repairs take place one year after testing.

The primary benefits of an aggressive pump maintenance program are enhanced reliability, reduced unscheduled outages and energy costs, and greater peak system delivery capacity. The current pump efficiency testing and pump and motor maintenance program will continue indefinitely. The District will also monitor advances in pump and motor technology for ways to further increase efficiency.

On-Farm Pumps

District farmers pump about 15,000 AF to more than 600,000 AF of groundwater annually from private wells with electric, diesel, and natural gas-powered engines, consuming an electricity equivalent of more than 100 to 400 million kWh. Diesel and electric booster pumps are used with pressurized irrigation systems such as drip and sprinklers, adding to on-farm energy use.

The simple economics of pump efficiency is considered sufficient to ensure an acceptable level of energy conservation. For this reason, it is not necessary for the District to maintain a formal on-farm efficiency testing program.

Action

However, pumped groundwater is potentially a large factor in the District's overall water supply; and it is, therefore, in the District's best interest to promote pump efficiency. Pump efficiency has been, and will continue to be, the topic of *Profitable Practices*, several farmer workshops, and included in the *Irrigation Management Handbook*. These activities will continue as long as groundwater is part of the farmers' supply. The District is in compliance with this BMP.

10. Operational Practices and Procedures - Evaluate potential district, state and federal policy and institutional changes which could allow more flexibility in water delivery and carry-over storage.

Rescheduling

Rescheduling of District contract water supply that is remaining at the end of a water year for use in the subsequent year can be used to enhance the efficient use of the available water resources of the state. In circumstances where USBR regulations force a water user to "Use it or Lose it" at the end of a water year, rescheduling by using available reservoir storage space can provide a larger window to efficiently use their allocated resource.

Currently there is no existing permanent USBR rescheduling policy, although rescheduling of remaining water supply has been administered on an annual basis since

1985. A reliable rescheduling policy would provide Westlands' water users with increased flexibility in managing their limited water supplies from year to year. Experience obtained during the last several could serve as a basis for instituting a permanent policy. Currently, farmers are uncertain if water can be rescheduled into the next water year. This uncertainty creates a "use it or lose it" situation in which farmers may be forced to apply water before the end of the water year. If applied during this time, the water may be less efficiently used instead of saving it for the next water year when it can be more efficiently used to match crop water requirements. Since 1989, about 10% of the following year water supply has been comprised of rescheduled water from the prior water year.

Westlands joined with the USBR and other CVP contractors in changing the start of the water year from January 1 to March 1, which allowed water users more flexibility in adjusting their irrigations to take advantage of winter rainfall. A long-term rescheduling policy combined with the previous change in the water year would maximize the water users' abilities to manage their allocated water as efficiently as possible.

Transfers

Water transfers have become an important part of Westlands' overall water supply. Historically, water transfers were used to meet water shortages in the District due to hydrology and/or shortages due to ESA, CVPIA or water quality considerations. Transfers allow water users to better utilize their other supplies by extending their operational flexibility and reduce the number of fallowed acres, which impact farm profitability. As stated earlier, transfer water is often more expensive than other water supplies and is only purchased by District water users when it can be beneficially used in a timely manner.

Transfers must be expedited as quickly as possible for this water to be efficiently managed by the District and provided to water users when and in the quantities needed. This is not always the case. Currently the State Water Resources Control Board (SWRCB) must approve all transfers which will deliver the transferred water to an area not included in the permitted place of use. This is cumbersome when DWR and USBR approval are also required. In fact, the District's recent experience has been that the approval process has resulted in delaying transfers and reducing or eliminating the benefits derived from some of the transferred water.

The transfer approval process needs to be streamlined in order to maximize the beneficial use of water already available in the system. Short- and long-term historical transfers must not be burdened with a cumbersome yearly approval process, which delays the transfers and reduces the District's and water users' efficient use of this important source of water.

Groundwater Pumping

The Groundwater Integration Program was available at the end of the drought that ended in 1992. A program that allowed groundwater that met all drinking water quality requirements of Title 22, State of California Drinking Water Standards and was metered in an acceptable fashion, to be pumped into the San Luis and Coalinga Canals for conveyance was implemented. This program was also negatively impacted by the lack of a long-term state policy for the San Luis Canal. This program is limited/restricted by California Environmental Quality Act (CEQA). The program is only economically feasible during declared State Drought Emergencies; a regulatory drought doesn't count. CEQA requires at a minimum an EIS. Some at DWR think that an environmental impact report is needed for any long-term pumping of groundwater into the San Luis Canal. This requirement is too expensive for individual pumpers, and the groundwater integration program is not a District project. The District assists water users to access the canals. Approval comes from USBR and DWR. The requirements changed annually and has caused some water users to lose credit for water they pumped into the canal. This does not allow for farmers to reliably determine what their future water resources will be and how they will best manage those resources in a cost-effective manner. In addition, the water quality monitoring requirements are cumbersome and change annually which in many cases delays or prevents farmers from utilizing this option to better manage their groundwater.

A long-term policy should be developed which provides farmers with more certainty on the time and amounts that water can be pumped into the canals. Also monitoring requirements should be streamlined and standardized where possible.

Delta Pumping

The state and federal projects do not have joint permitted points of diversion for Delta pumping or place of use which severely restricts the effective management of the water resources which could otherwise be pumped when surpluses exist. This reduces the water supply that could be dedicated to District farmers. Such a permit(s) could increase Delta pumping without exacerbating adverse environmental impacts. Without joint permitted points of diversion, the annual water supply available to the District is further clouded. The lack of such a permit along with uncertainties due to natural events and regulatory actions will continue to result in financial hardships and in some cases farm failures for Westlands' farmers.