Conceptual Monitoring, Compliance, and Adaptive Management Plan for the San Luis Unit Drainage Management Plan

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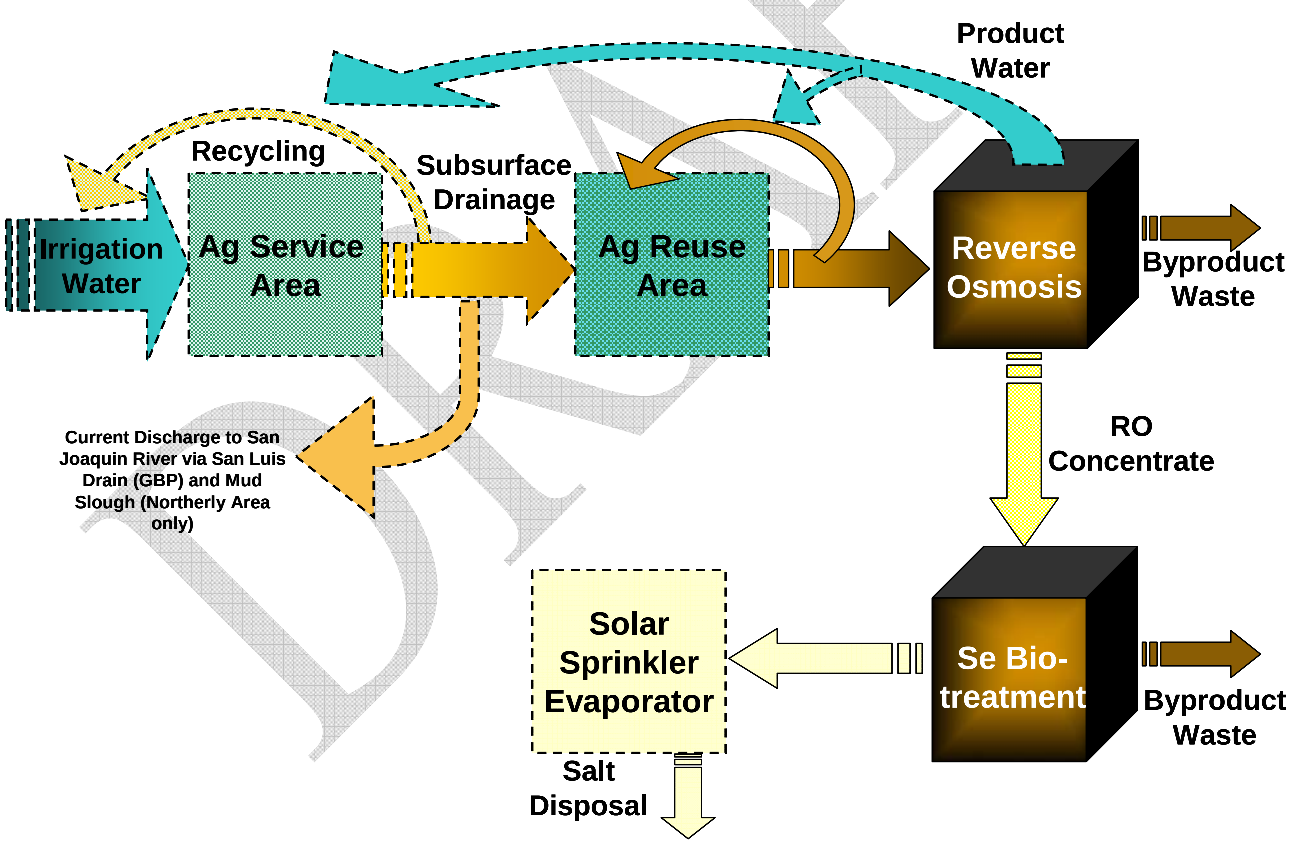
2/29/2008

U.S. Fish and Wildlife Service
Sacramento Fish and Wildlife Office



February 2008

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1. Introduction

Drainage Issues and Management Plan

The west side of the San Joaquin Valley—the San Luis Unit (SLU) of the Central Valley Project (CVP)—has received CVP contract water through local water districts (primarily Westlands Water District) for 40 years. About 379,000 acres of the land are drainage-impaired, allowing water and salt to accumulate in the root zone of the crops. Subsurface drains can remove this water; however, the drainwater contains high concentrations of naturally-occurring selenium—50 to 1,000 μg/L (parts per billion). The current EPA water quality criterion for protection of aquatic life from the chronic effects of selenium is 5 μg/L, while the U. S. Fish and Wildlife Service (Service) recommends 2 μg/L for the protection of wetland ecosystems. Wetland supply channels to the Grassland Area have a 2 μg/L (monthly mean) standard in place.

Federal law requires the Bureau of Reclamation (BOR) to provide drainage to the San Luis Unit. Several years ago the landowners won a lawsuit directing BOR to comply with the law. In response, BOR completed an EIS for the San Luis Drainage Feature Re-Evaluation Project (SLDFR-FEIS) in July 2006 (USBR 2006). The drainage plan identified in the SLDFR-FEIS utilizes regional drainwater reuse areas, reverse osmosis (RO) and selenium treatment facilities, and ends with evaporation ponds (USBR 2006).

As an alternative to the BOR Record of Decision (ROD) the Westlands Water District (WWD) has proposed a drainage plan (WWD et al., July 2007; Appendix A; hereafter the WWD Drainage Plan) based upon the March 2007 ROD for the SLDFR EIS and the selected In-Valley Water Needs Land Retirement Alternative. Like the ROD, the WWD Drainage Plan includes land retirement, drainage reduction measures, collector systems, reuse facilities, treatment systems, evaporation facilities and mitigation measures. The WWD Drainage Plan differs from the ROD in several important ways, including 1) the evaporation element of the plan would be accomplished through the use of sprinkler technology and would not involve the use of evaporation ponds because of the associated potential environmental impacts, and 2) the retirement of land under the settlement would be approximately 100,000 acres, rather than 194,000 acres under the ROD. Figure 1 is a map of proposed facility locations from the In-Valley Groundwater Land Retirement alternative in the SLDFR-FEIS and provides a general approximation of the locations and sizes of the drainage management facilities.

During subsequent drainage resolution discussions in October 2007, concerns about trust resource impacts and the need for a drainwater monitoring and compliance plan were identified. The Service's Regional Director offered to assist in developing a monitoring and compliance plan to start the process. The Sacramento Fish and Wildlife Office was asked to coordinate with stakeholders to develop a conceptual monitoring, compliance, and adaptive management plan (hereafter the Conceptual Monitoring Plan) to address the various risks associated with the proposed drainage plan.

Differences Between the Final EIS and the Westland Water District Drainage Proposal

A discrepancy was identified between the WWD Drainage Plan and a response from WWD to

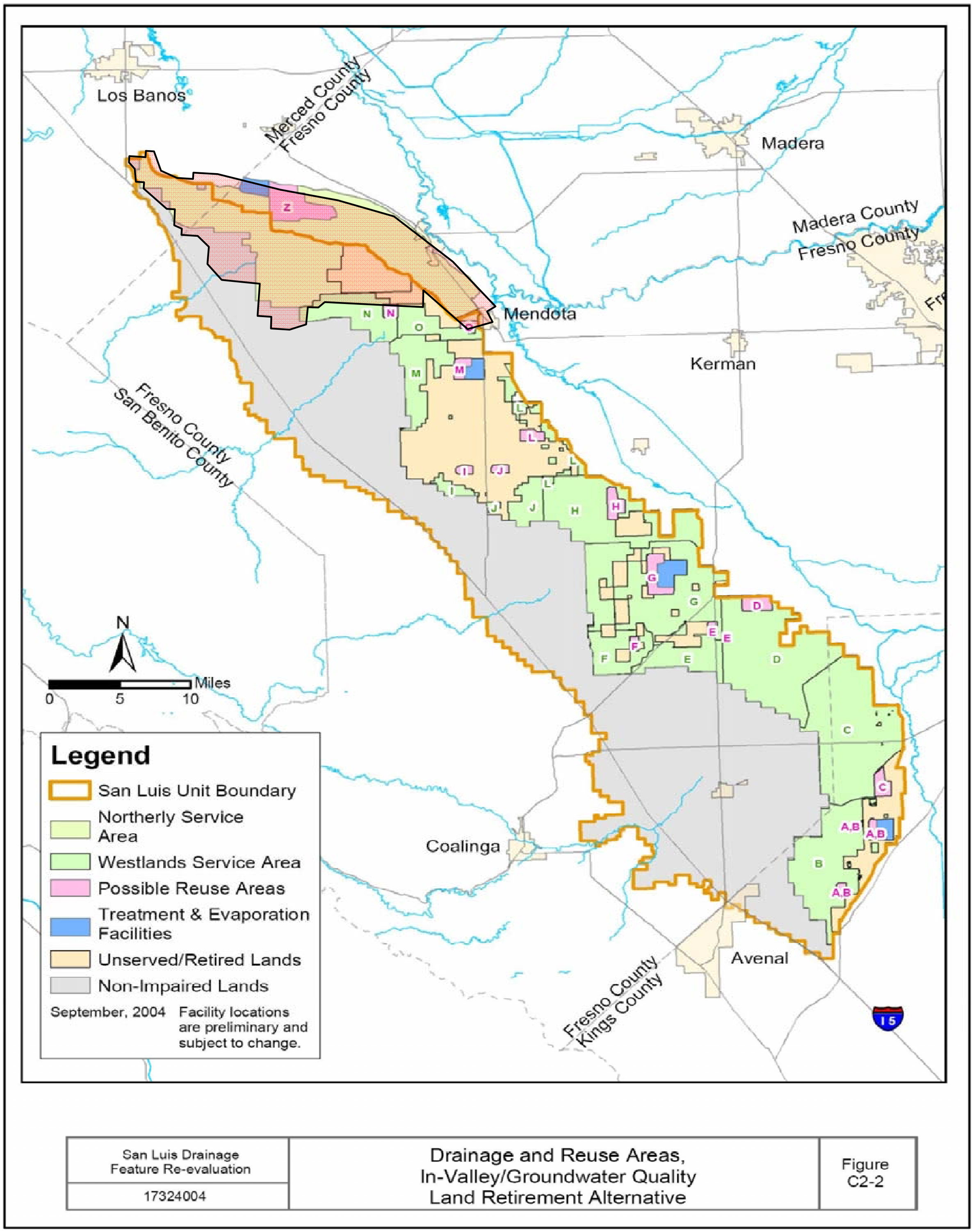
Service questions (WWD Nov 2007) regarding the acreage of drainage management facilities that will be implemented. The July 2007 document stated that, "Westlands initial land retirement plan would be 100,000 acres, at a minimum." The 100,000 acres of retired lands would be comprised of 60,000 acres that WWD has already acquired as part of its land acquisition program (Sagouspe Settlement lands), in addition to the approximately 40,000 acres retired in connection with the settlement of Sumner Peck Ranch, Inc., v. United States. The SLDFR In-Valley Alternative that is most consistent with this level of land retirement would be the In-Valley Groundwater Alternative. The number and acreage of reuse areas associated with the SLDFR In-Valley Groundwater Alternative is 15 and 16,700 acres, respectively. However, as described in the WWD Drainage Plan, "Drainage service components are described more fully below and are based in large part on Reclamation's In-Valley Water Needs Alternative described in the Final EIS and selected in the ROD." The SLDFR In-Valley Water Needs Alternative includes 194,000 acres of land retirement. Given this discrepancy, it is unclear how drainage from the remaining 94,000 acres in the Water Needs Alternative would be managed by WWD, as the land retirement/drainage management facilities as identified in the SLDFR In-Valley Water Needs Alternative would be insufficient to manage drainage volumes within the WWD according to what was modeled and assumed in the SLDFR FEIS (see Table 1 for a comparison of SLDFR In-Valley Alternatives with the WWD Drainage Plan). Acreage of land requiring drainage will dictate the size of the reuse and treatment facilities, which will influence the level of monitoring needed. Discrepancies such as these will need to be resolved in order to complete a detailed monitoring and compliance plan.

Table 1. Discrepancies between SLDFR-FEIS In-Valley Alternatives and the WWD Drainage Plan.

Plan Features	SLDFR FEIS In-Valley/ Groundwater Quality Alternative	SLDFR FEIS In-Valley/ Water Needs Alternative	WWD Drainage Plan
Acres with Tile Drains Installed (Northerly Area and WWD)	187,116	122,833	122,833[1]
Acres of Land Retirement	92,592 (in WWD)	193,956 (in WWD and Broadview WD)	100,000[1]
Drainage Volume before reduction (AF/Year)	85,000	63,000	63,000[2]
# Of Reuse Areas (WWD)	14	13	15[1], 12[2]
Acres of Reuse Areas (Northerly Area and WWD)	16,700	12,500	12,500[2]
Drainage Inflow to Reverse Osmosis Treatment (Northerly Area and WWD)	18,458 AFY	13,730 AFY	13,730 AFY[1]
Flowrate to Biotreatment (WWD)	5,179 AFY	2,815 AFY	2,815 AFY[1,2]
Drainage Inflow to Disposal Facilities (WWD)	5,179 AFY[3]	2,815 AFY[3]	5,500 AFY[2]

[1]WWD et al. July 2007; [2] WWD November 2007; [3] SLDFR Plan Formulation Report Addendum, July 2004

Figure 1. General location and size of drainage management facilities based on the In-Valley Groundwater Quality Land Retirement alternative from the San Luis Drainage Feature Re-evaluation Final EIS.



Northerly Area

The Conceptual Monitoring Plan was developed from the WWD Drainage Plan. That document as well as the SLDFR FEIS included drainage management for both WWD and the Northerly Area districts. The Northerly Area would have one large reuse area (4,000 to 6,000 acres) feeding into a reverse osmosis (RO) and selenium treatment facility and ending with an enclosed dehumidification system. The Northerly Area is considered generally throughout the document since the two drainage management programs are so intricately intertwined and there are more similarities than differences. We will distinctly note when we are referring to the Northerly Area only or WWD only. Since the Grassland Bypass Project addresses discharges to the San Joaquin River from the Northerly Area we will not include monitoring and compliance for this discharge but have noted it within the conceptual plan and associated diagrams.

Integrated On-Farm Drainage Management (IFDM)

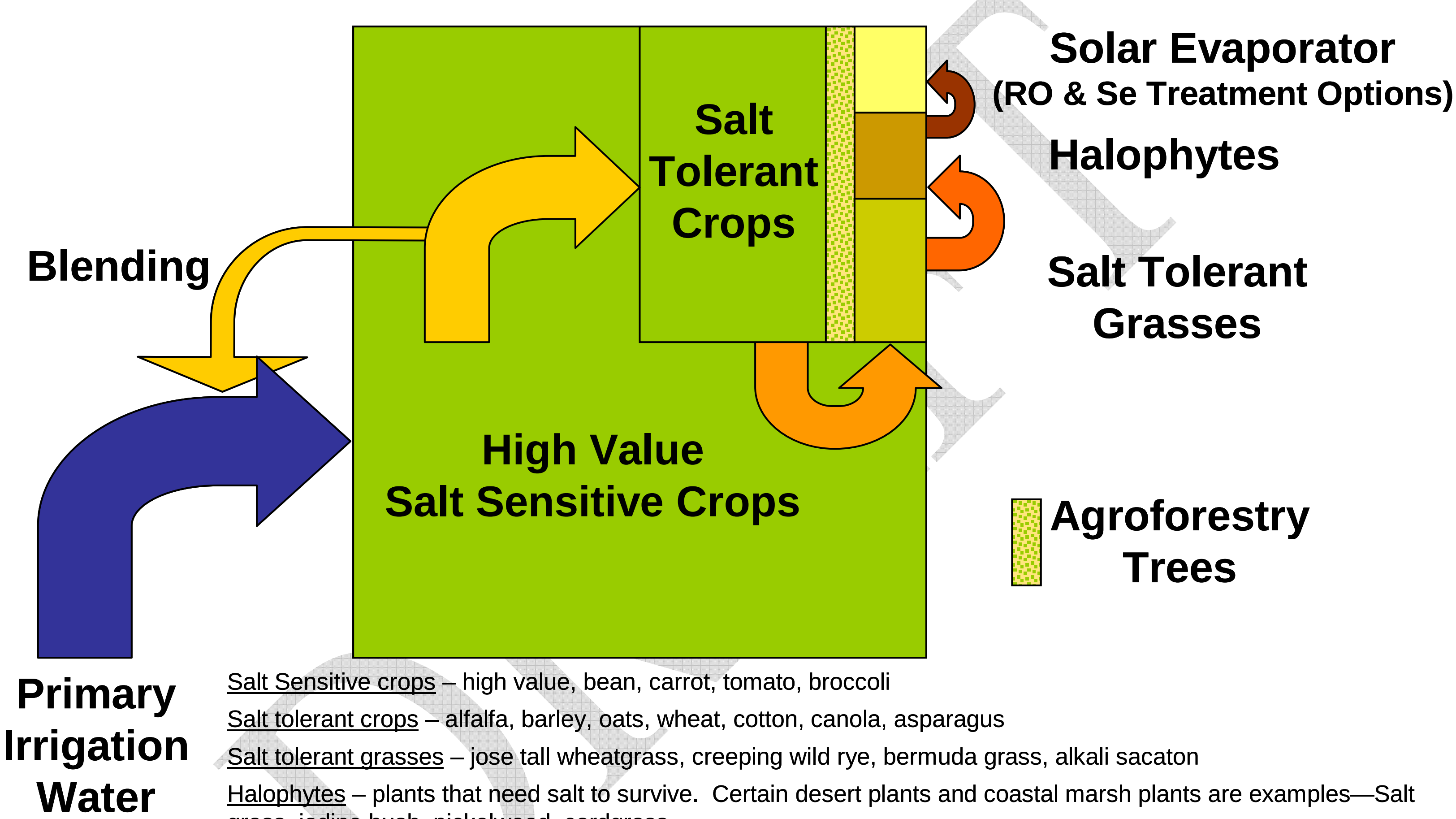
The WWD Drainage Plan is based on an Integrated On-Farm Drainage Management (IFDM) system (Figure 2). Under the WWD Drainage Plan, like the SLDFR-FEIS, the selenium-contaminated drainwater is sequentially reused on salt tolerant crops and the drainage from the reuse area is treated to remove salt and selenium. Remaining wastewater is discharged via spray nozzles into regional solar evaporators rather than the traditional evaporation ponds proposed in the SLDFR-FEIS (Figure 2). WWD proposes land retirement on less acreage than in the SLDFR-FEIS. Multiple reuse areas within WWD would feed into three treatment facilities.

The California Health and Safety Code, Section 25209.11 includes the definition of On-farm as *". . . land within the boundaries of a property or geographically contiguous properties, owned or under the control of a single owner or operator or a publicly organized land-based agency, that is used for the commercial production of agricultural commodities and that contains an integrated on-farm drainage management system and a solar evaporator."*

Section 25209.11 goes on to further define an IFDM system as *". . . a facility for the on-farm management of agricultural drainage water that does all of the following: (1) Reduces levels of salt and selenium in soil by the application of irrigation water to agricultural fields. (2) Collects agricultural drainage water from irrigated fields and sequentially reuses that water to irrigate successive crops until the volume of residual agricultural drainage water is substantially decreased and its salt content significantly increased. (3) Discharges the residual agricultural drainage water to an on-farm solar evaporator for evaporation and appropriate salt management. (4) Eliminates discharge of agricultural drainage water to evaporation ponds and outside the boundaries of the property or properties that produces the agricultural drainage water and that is served by the integrated on-farm drainage management system and the solar evaporator."*

The code defines a "Publicly organized land-based agency" as *". . . a resource conservation district, as described in Division 9 (commencing with Section 9001) of the Public Resources Code, an irrigation district, as described in Division 11 (commencing with Section 20500) of the Water Code, any other district established pursuant to the Water Code whose operations may include managing agricultural irrigation or drainage, or a joint powers authority formed for the purpose of managing agricultural drainage or salt."*

Figure 2. The basics of an integrated on-farm drainage management system (IFDM).



<u>Salt Sensitive crops</u> – high value, bean, carrot, tomato, broccoli

<u>Salt tolerant crops</u> – alfalfa, barley, oats, wheat, cotton, canola, asparagus

<u>Salt tolerant grasses</u> – jose tall wheatgrass, creeping wild rye, bermuda grass, alkali sacaton

<u>Halophytes</u> – plants that need salt to survive. Certain desert plants and coastal marsh plants are examples—Salt grass, iodine bush, pickelweed, cordgrass

<u>Agroforestry Trees</u> – salt tolerant, Athel (Tamarisk), Eucalyptus, Pistachio, Casuarina

<u>Treatment Options</u> – at this point reverse osmosis and selenium treatment are options available before the final disposal in solar evaporators

The main difference between the IFDM regulations and the WWD Drainage Plan is that the WWD drainage plan proposes RO and selenium treatment between the reuse areas and the solar evaporator.

It should be noted that most active IFDM systems are either in a pilot stage or have only been implemented on a small scale (~1,000 acres of drainage service). As best as we can discern at this time, there are four proposed regional systems that would address drainage for approximately 122,833 to 187,116 acres of irrigated lands. The Northerly Area is operating a reuse area of around 4,000 acres and proposes to expand that to over 6,000 acres. For WWD there would be, at a minimum, around 6,000 acres of reuse spread over 12 to 15 areas generally located close to the three treatment areas (Figure 1). These reuse areas would average from 400 to 500 acres in size. Regarding solar evaporator size, according to regulations, up to 2 percent of the drainage service acreage can be solar evaporators. However, the WWD Drainage Plan proposes to use RO and selenium treatment before the solar evaporators, thus reducing the volume of drainage going to the solar evaporators. Estimates for drainage volumes after treatment are around 6,865 acre-ft per year for the Northerly Area and WWD combined. The IFDM Manuals (Appendix D) estimate that 7.9 acres of solar evaporator are needed to handle 30 acre-ft of drainage, thus, the four solar evaporator facilities would need to average 452 acres in size. For WWD alone the volume could be 2,815 acre-ft per year and would require three solar evaporators averaging 247 acres in size.

Since the IFDM reuse and evaporation areas have high wildlife exposure potential to very elevated levels of selenium in the drainwater (H.T. Harvey, 2007; USFWS, 2006), the USFWS and others have recommended management and monitoring actions to remove, reduce, or mitigate risks associated with the drainwater to wildlife and other resources (USFWS, 2006; Appendix C, IFDM Manuals). The drainage system, as proposed, would have four regional IFDM systems that are one to two orders of magnitude larger in size compared to the current systems in place. The proposed systems have the potential to similarly increase risks to wildlife and other resources. The known risks of IFDM systems need to be monitored, and the additional unknown risks associated with the proposed scale-up of such systems may require an additional effort in scale, frequency, and contingency planning.

Figure 3 is a conceptual diagram of a drainage management system as proposed by WWD. Within WWD, each of the three regional drainage systems would have multiple reuse areas feeding into a RO and selenium treatment system and solar evaporator (Figure 1).

Regulations

Numerous federal and state laws and regulations apply to the management, discharge, and disposal of subsurface irrigation drainwater. Federal laws include: Clean Water Act (CWA), Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), National Environmental Policy Act (NEPA), Fish and Wildlife Coordination Act (FWCA), and Clean Air Act. State laws include: California Environmental Quality Act (CEQA), California Porter-Cologne Act, California Clean Air Act, and California Toxic Pits Act. These laws and regulations lay the foundation for a monitoring and compliance plan. The fundamental performance objective of the WWD Drainage Plan treatment and disposal facilities, from a fish and wildlife resources perspective, is no net take of fish and wildlife resources and no take of threatened or endangered species. However, the conceptual plan addresses all monitoring needs, not just those of the Service. Additional details on applicable laws and regulations are discussed in chapter 2 and roles and responsibilities in chapter 9.

Monitoring Needs and Resources at Risk

Because of the potential for exposure and negative impacts of the contaminants associated with subsurface drainage on the Westside of the San Joaquin Valley a monitoring plan is needed to assure protection for resources at risk. Numerous federal and state laws and regulations apply to the management, discharge, and disposal of subsurface irrigation drainwater. This Conceptual Monitoring Plan addresses all monitoring needs, not just those of the Service.

Assess Efficacy of Drainage Management System

Proper monitoring will provide a measure of success of the drainage management program itself and measure compliance with performance goals, triggers, and regulatory requirements. Monitoring will also help ensure that the means of achieving drainage benefits in one area are not contributing to adverse impacts elsewhere.

Pre-project Baseline Conditions

Baseline conditions need to be determined as a starting point for comparison with future monitoring results and to identify any immediate issues that may need to be addressed. Determining a baseline for any kind of a monitoring program is a well established methodology. A discussion of baseline is required by CEQA and typically appears as part of the "environmental setting" evaluation. Also, section 25209.13(a)(6) of the California Health and Safety Code states that before installing a solar evaporator, groundwater monitoring data that are adequate to establish baseline data for use in comparing subsequent data must be submitted. Although the final report of the San Joaquin Valley Drainage Program documented baseline conditions, those data are now almost 20 years old and are in need of updating. Where WWD or others can provide more recent or current data that fulfills the baseline needs of a monitoring program, less baseline sampling will be needed

Mass Balance

Proper monitoring will allow for calculating mass balance of key constituents in the drainage. This will help determine losses in the system, monitoring gaps, efficacy of treatment systems, and assessing overall success of the drainage plan.

Performance of Treatment Systems

Monitoring of the influent and effluent of the RO and selenium treatment systems is needed to properly operate and maintain the systems and to determine if performance goals are being met.

Waste Streams

All treatment system waste streams should be tracked, not just those exceeding 1,000 ppb selenium. Hazardous materials/hazardous wastes have their own state and federally mandated handling, tracking and reporting requirements. Since these waste streams have low potential for resource impacts this conceptual plan will not focus on them.

Groundwater Impacts

Groundwater management is the basis of the WWD Drainage Plan; therefore, appropriate groundwater monitoring is critical for assessing program success and ensuring that the means of achieving drainage benefits in one area are not contributing to adverse impacts elsewhere. Shallow groundwater high in constituent concentrations can potentially move laterally and vertically within the groundwater system. Lateral movement can potentially seep into nearby surface water features or affect vegetation growing on adjacent lands. The downward migration of groundwater and dissolved constituents can impact water quality and potential beneficial uses of deeper aquifers relied on for irrigation and drinking water supplies.

Surface Water Quality

In the semi-arid climate of the San Joaquin Valley, where over 90 percent of the wetlands have been lost, any open water—a drainage ditch, ponding in a field, evaporation pond, solar evaporator, or discharge into flowing channels—has the potential to be an attractive habitat to wildlife. Anywhere drainage water comes to the surface, either as part of the management program or as groundwater movement and seepage into natural channels or drainage systems, there is a high potential for selenium exposure to fish and wildlife. Surface water monitoring is therefore important in assessing exposure and duration.

Fish and Wildlife Impacts

Aquatic dependent birds are usually at greatest risk to selenium exposure in the San Joaquin Valley; however, other wildlife such as mammals and reptiles can be exposed through contaminated soil, invertebrates, and vegetation. Fish, especially salmonids, are at risk if the drainage reaches wetlands and flowing waters. If fish and wildlife resources are exposed to the drainage, monitoring will determine the duration of the exposure and the potential and real impacts. This information will also provide data to implement mitigation protocols.

Air Quality

Air quality is a major issue in the San Joaquin Valley. As land is retired under the drainage management program there is the potential for dust to blow off of the land and cause air quality problems. Drift from the spray solar evaporators may also be considered an air quality issue since the water droplets themselves can cause an air quality problem and as the water evaporates in the air the remaining airborne salt particles may become a potential hazard. Air quality monitoring should be done under appropriate state and federal regulations by agencies responsible for air quality control.

Soil Quality

Soil would need to be monitored to assess risk of wildlife exposure at reuse facilities and potential contamination in areas where drifting may occur.

Land Retirement

Lands are retired primarily because the shallow groundwater impacts are the greatest at those locations. If the land is to be restored to a natural habitat there is the concern of contaminant impacts. Surveys of retired land use by wildlife and potentially listed species will help in assessing potential exposure risks as well as success of restoration.

Hazardous Materials and Waste Handling

As part of an appropriate operations plan, tracking and monitoring of hazardous materials used or produced by the facilities must be done. This should be done under appropriate state and federal regulations and agencies responsible for hazardous material tracking and disposal.

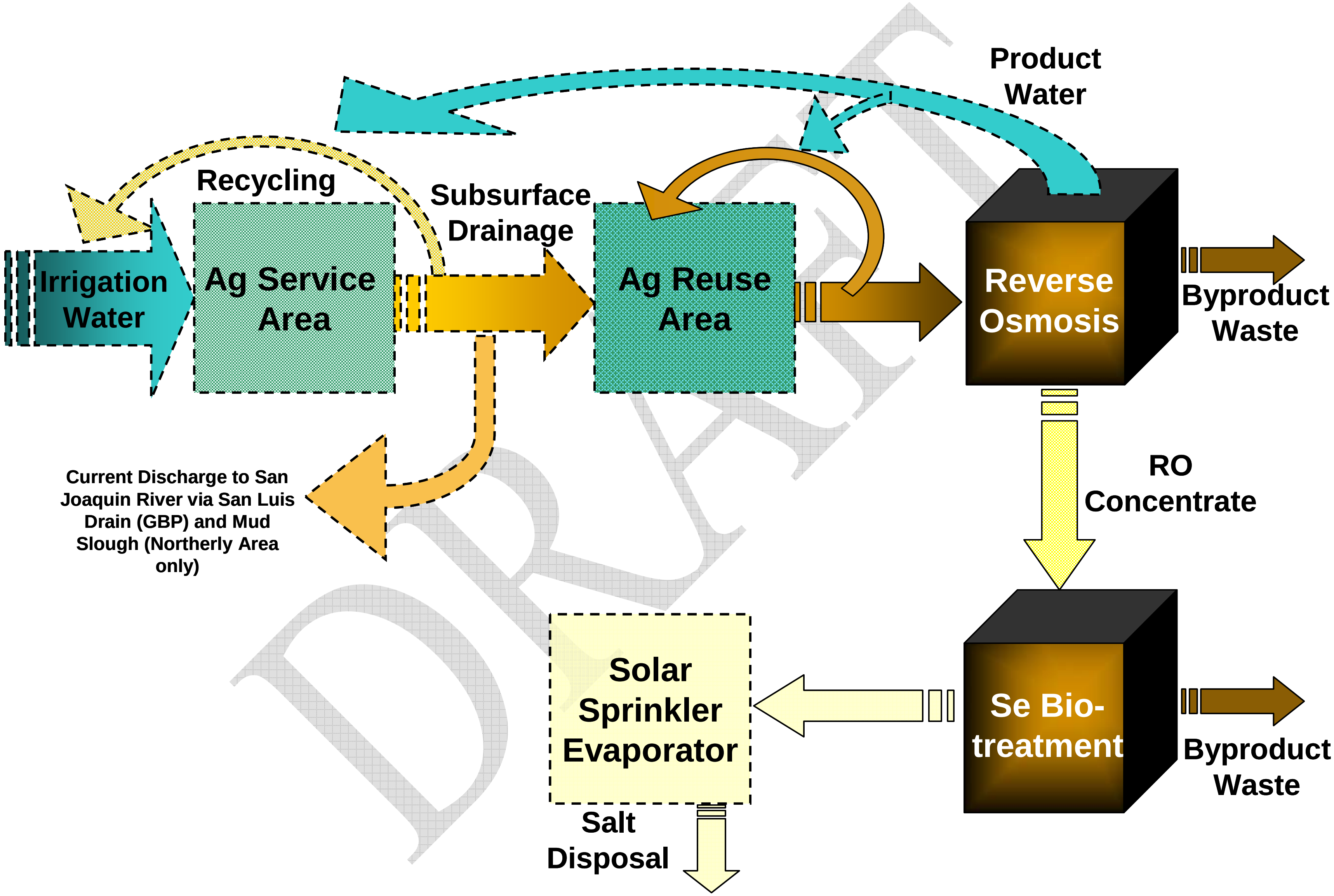
Closure Plan Monitoring

Monitoring should be done at sites after they are closed to assure there are no lingering impacts or uncontrolled releases of contaminants to adjacent lands or the deeper groundwater system.

Mitigation Monitoring

In general, Service policy regarding impacts to fish and wildlife resources is to avoid, minimize, and compensate for those impacts, in that order. The California Department of Fish and Game (CDFG) also has mitigation requirements as specified under CEQA and other state laws and regulations. A drainage management plan should identify how potential impacts will be avoided and minimized and for any remaining impacts identify compensation appropriate for the level of impacts identified. Mitigation projects need to be monitored both as a measure of success and to confirm there are no contaminant problems.

Figure 3. Conceptual Drainage Management for WWD and the Northerly Area (based primarily on WWD Nov 2007).



2. Guiding Principles and Assumptions

Since a complete project description with details on size, location, and management of facilities is not available, certain assumptions, guiding principles, and objectives must be clearly identified to develop a framework for a monitoring plan and to address the drainage issues at the source. This chapter lays out the basic assumptions and principles used by the team to develop the Conceptual Monitoring Plan. Additional chapters will describe, as best as possible at this time, project designs, regulations, guidelines, and triggers appropriate for the plan.

It is the Service's expectation that WWD would implement the drainage plan consistent with the SLDFR FEIS and ROD as well as existing state and federal laws and regulations. This includes appropriate monitoring and mitigation. The FEIS and ROD frequently refers to coordination with the Service on implementing monitoring and mitigation programs. Any recommendations by the Service will be consistent with recommendations we would provide to the BOR if they were implementing a drainage plan under the ROD.

Objectives

The primary objectives of the Conceptual Monitoring Plan are to identify:

- Potential exposure pathways to resources of concern;
- Resources most at risk;
- Appropriate monitoring needs for resources at risk along key points in the system;
- Key points in the system where performance goals and triggers are appropriate;
- An adaptive management process;
- Key points in the system where contingency plans may be appropriate;
- An oversight process; and
- Roles and responsibilities of key stakeholders.

Regulations

Numerous federal and state laws and regulations apply to the management, discharge, and disposal of subsurface irrigation drainwater. These laws and regulations lay the foundation for a monitoring and compliance plan. This Conceptual Monitoring Plan does not override those laws and regulations but attempts to bring them together in one document to address the many monitoring and compliance issues associated with drainage management. For a further summary of many of the laws and regulations pertaining to agricultural drainage reuse and disposal facilities, see Chapter 9 in A Landowner's Manual -- Managing Agricultural Irrigation Drainage Water: A guide for developing Integrated On-Farm Drainage Management systems. At the least, the following laws and regulations apply.

California Environmental Quality Act (CEQA)

The CEQA specifies that for any project involving state interests, an Environmental Impact Report (EIR) must be written if a significant environmental effect is anticipated. Before a Drainage Plan can be implemented by a State public or local agency, the Lead Agency must comply with CEQA. Among its provisions, CEQA requires a complete project description identifying the precise project location and boundaries, and addressing all phases of project planning, implementation and operation. CEQA compliance also requires discussion of the environmental setting (baseline) as well as an analysis of potential environmental effects and measures that will be adopted to mitigate those effects. By law, adequate CEQA documentation must be prepared, publically reviewed, and adopted before any proposed Drainage Plan can be implemented. Projects requiring mitigation must also include findings and a mitigation monitoring or reporting plan before the project can be approved.

National Environmental Policy Act (NEPA)

NEPA requires that environmental considerations be incorporated into the planning of any project involving federal funding or permits. If a significant effect is anticipated, an Environmental Impact Statement (EIS) must be written.

Fish and Wildlife Coordination Act (FWCA)

The FWCA requires consultation with the Fish and Wildlife Service and the fish and wildlife agencies of States where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted,. . . or otherwise controlled or modified, including navigation and drainage" by any agency under a Federal permit or license. The consultation is to prevent loss of and damage to wildlife resources. The Act recognizes the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs. It also authorizes the transfer of funds to the Fish and Wildlife Service to conduct related investigations. The Secretary of the Interior, through the Fish and Wildlife Service is authorized to make investigations to determine the effects of domestic sewage, mine, petroleum, and industrial wastes, erosion silt, and other polluting substances on wildlife and to make recommendations for alleviating dangerous and undesirable effects of such pollution.

Federal Endangered Species Act (ESA)

This act affords regulatory protection to plant and animal species federally listed as endangered, threatened, or proposed for listing. The act includes a provision (Section 9) that prohibits the unauthorized “take” of any listed species. “Take” includes significantly modifying or degrading habitat.

California Endangered Species Act (CESA)

This act applies to species (and their habitats) that are listed by the state of California as threatened or endangered, including some species that are not federally listed. CESA prohibits any state agency from approving any project that potentially jeopardizes the continued existence of a listed species when reasonable and prudent alternatives exist. A state lead agency must consult with the California Department of Fish and Game (CDFG) during the CEQA process.

Migratory Bird Treaty Act (MBTA)

This federal act implements a series of conventions with Canada, Japan, Mexico and Russia. Essentially all birds native to the United States are protected under this act. The act effectively prohibits harm to, or possession of any such bird or its nest, eggs, feathers or any other part unless permitted by regulation.

Bald Eagle Protection Act (BEPA)

This federal law provides for the protection of the bald eagle, and was later amended to include the golden eagle. The law effectively prohibits any form of harm to, or possession of these eagles, alive or dead; or any part, nest or egg of these species.

Federal Clean Water Act (CWA)

This act sets default water quality standards for all contaminants in surface waters of the United States. It charges the states with adopting standards at least as stringent as the default federal standards. It assigns to the states responsibility for establishing programs to implement those standards within each state. Section 404 of this act regulates construction, excavation and discharge into "waters of the United States" including wetlands and ephemeral streams and lakes. Under Section 401 of the CWA, a landowner that applies for a federal permit or license for an activity that could result in a discharge to "waters of the United States" must also obtain a State Water Quality Certification that the discharge meets state water quality objectives. Section 402 of this act requires that all point sources (including pipes) discharging pollutants into waters of the United States obtain a National Pollutant Discharge Elimination System Program (NPDES) permit. The Regional Water Quality Control Board regulates Section 402 permits.

Porter-Cologne Water Quality Control Act (PCA)

This California act established nine Regional Water Quality Control Boards (Regional Boards) to regulate water quality through the establishment and enforcement of Basin Plans that define water quality objectives in their respective areas. Any discharges that may degrade the quality of "waters of the state" (either surface water or groundwater) are subject to regulation. Waste disposal is regulated by issuing Waste Discharge Requirements (WDRs) that specify measures that must be taken and monitoring requirements that must be followed to assure that water quality is not degraded. IFDM solar evaporation systems are subject to new state legislation and regulations instead of WDRs.

Federal Clean Air Act (CAA)

This act sets federal standards for emission of fine particulate matter (solid or liquid droplets) less than 10 microns in diameter, such as could be emitted by a solar evaporator system. If standards are not met, contingency measures are required. Other specific major airborne emissions currently regulated under this act (hydrocarbons, carbon monoxide, photochemical oxidants, nitrogen oxides, and sulfur oxides) are probably of little relevance to agricultural drainwater treatment and disposal in the San Joaquin Valley. However, a general mandate to prevent significant deterioration of air quality may be applicable.

California Clean Air Act (CCAA) and other California air quality legislation

These California laws established a system for implementation of air quality standards that must be at least as stringent as federal standards.

Resource Conservation and Recovery Act (RCRA)

This federal statute governs management and disposal of waste. It may be applicable to salt residue from an IFDM system if the leachable selenium concentration in the solid residue (or the dissolved selenium in disposed liquid) exceeds the allowable level of 1.0 milligrams per liter (mg/L). Application of this act to salt residue from an IFDM system may be affected by regulations developed by the California State Water Resources Control Board (SWRCB).

Hazardous Waste Control Law (HWCL)

This California statute governs management and disposal of hazardous waste. California requirements are generally similar to requirements under RCRA, except that additional requirements may apply to salt waste from an IFDM system.

Toxic Pits Cleanup Act (TPCA)

This California statute regulates the cleanup of pits historically used for the disposal of liquid hazardous waste. Because drainage discharged to solar evaporators may contain selenium in excess of hazardous waste levels, certain requirements of the TPCA would be triggered but for passage of state legislation which exempts IFDM systems from this regulation. The Toxic Pits Cleanup Act of 1984 was modified in September, 2002 by Senate Bill (SB) 1372 and was revised in September, 2006 by SB 1347. The new regulations mandated by these bills contain specific definitions and requirements for design, operation and monitoring of IFDM systems and solar evaporators and have been codified in the California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950.

As a result of the changes to the Toxic Pits Cleanup Act, the SWRCB contracted with the Westside Resource Conservation District to develop a landowner's manual and a technical advisor's manual for designing and operating IFDM systems (http://www.sjd.water.ca.gov/drainage/ifdm/index.cfm)." These manuals provide a great deal of information on the design, operation, and monitoring of such facilities as regulated under state laws.

California Health and Safety Code, Section 25209.11 and Title 27, Article 9.7 Integrated On-Farm Drainage Management regulations specifically refer to coordination with state and federal resource agencies on appropriate monitoring and potential impacts to wildlife. The Regional Board was tasked to establish minimum requirements and has leeway in the kind and frequency of monitoring that may be required of an operator of an IFDM system.

Other regulations

Landfill Regulations

The disposal of non-hazardous, non-inert waste is regulated under Title 27 of the California Code of Regulations. Under these regulations, non-hazardous waste that has the potential to degrade water quality is defined as "Designated Waste," and must be disposed of in properly designed and classified surface impoundments with liners that are licensed to accept such waste.

Design, monitoring and closure requirements for hazardous waste landfills are outlined in Subtitle D of RCRA and in Titles 22 and 23 of the California Code of Regulations. The applicability of these requirements to in-situ disposal of selenium-contaminated salt residue is not clear under a resolution drafted by the SWRCB pursuant to SB 1732.

Stream Bed Alteration

California Fish and Game Code, section 1600 requires notification of CDFG by agencies and/or individuals prior to taking any action that would divert, obstruct, or change the material, flow, bed, channel, or bank of any river, stream, lake or any other waterway that may provide aquatic habitat. CDFG will propose reasonable project changes if the project has the potential to negatively affect fish and wildlife resources.

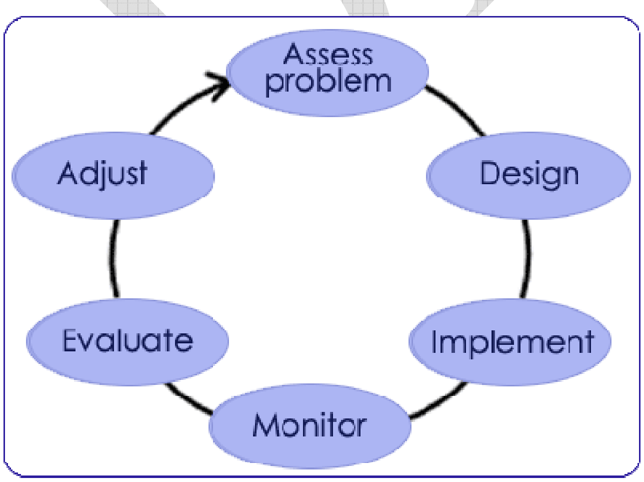
California Reclamation Board

The California Reclamation Board enforces standards to protect the public from flooding along the Sacramento and San Joaquin rivers and their tributaries. An encroachment permit application must be submitted to the Board for review if a project falls within the Board's jurisdictional area, which extends over the entire Central Valley.

Adaptive Management

The Department of the Interior (DOI) supports the use of adaptive management as a powerful tool to address natural resource problems and developed a guidance document in 2007 (Williams et al., 2007). San Luis Unit drainage issues are well suited for use of adaptive management and the monitoring itself can be adaptive in nature as new information is collected and evaluated. This is consistent with Service recommendations for evaporation ponds, integrated on-farm drainage management systems, the DOI pilot land retirement program, and the Grassland Bypass Project. Current regulatory guidelines and permitting processes can identify specific performance objectives or triggers where regulatory actions would be taken. Additional objectives or triggers can be developed within an adaptive management process to set in motion actions to avoid tripping regulatory objectives so that definitive compliance actions or penalties are not issued.

Adaptive management involves ongoing, real-time learning and knowledge creation through partnerships of managers, scientists, and other stakeholders. It helps managers maintain flexibility in their decisions, knowing that uncertainties exist and provides managers the latitude to change direction. Most importantly adaptive management is about taking action to improve progress towards desired outcomes.



From an operational point of view, adaptive management simply means learning by doing and adapting to what is learned. Adaptive management is best used when there are management choices available, there is an opportunity to apply learning, management objectives can be identified, the information value is high, uncertainty can be expressed as testable models, and a monitoring system can be established to reduce uncertainty (Figure 4).

Figure 4. A conceptual diagram of the adaptive management process (DOI 2007).

Stakeholder commitment to adaptive management for the duration of the project is critical. There is a need to identify clear, measurable, and agreed-upon objectives so that management effectiveness over time can be evaluated. A well-designed monitoring plan is needed to document the effectiveness of actions.

Adaptive management is successful when stakeholders work collaboratively in a group environment and support strategy goals and objectives, executive leadership supports changes to existing institutional culture and structures, and monitoring plans reflect a realistic assessment of monitoring capabilities and are linked to management.

Stakeholders should be those appropriate for the issue and would likely include, but not be limited to, the BOR, WWD, U.S. Geological Survey (USGS), U. S. Environmental Protection Agency (EPA), California Department of Water Resources (DWR), SWRCB, CDFG, and the Service. Executive leadership would be agency managers as high up as needed to accomplish the goals and be agreeable to all parties. The Grassland Bypass Project provides an excellent template for an oversight system that has proven successful over the past ten years of operation. Since it was designed to address monitoring and compliance for drainwater issues it has the potential to satisfy the needs of the WWD drainage plan. For example, the Grassland Bypass Oversight Committee consists of state or regional heads of the regulatory agencies with trust resources impacted by the project. Chapter 8 shows how an oversight system might be designed for this program.

Decision Analysis

Decision Analysis, as a part of adaptive management, formalizes planning and implementation decisions and analyzes their consequences on several scales (i.e., local, regional, and state) as well as different contexts including economic, scientific, and societal (Smith and von Winterfield, 2005; Coleman et al., 2006). It provides an integrated set of tools to identify and model important issues within a complex management process to support decision-making under conditions incorporating uncertainty and risk. Decision Analysis also organizes individuals and their expertise into a working group whose members are encouraged to investigate the relationships between their disciplinary boundaries in a way that makes the overall model and solution pathways more relevant and durable.

As applied to the results of data gathering, Decision Analysis involves all agencies and stakeholders in a quantitative and an analytically-focused overarching vision and understanding of the challenges at hand. In turn, an integrative scientific basis of understanding is built to further inform monitoring and compliance activities and records how each decision was reached to clearly document processes to address future questions.

Decision Analysis is tailored to the specific decision being addressed, but it generally follows five steps:

1) Frame the Problem. Identify the decision context, the decision-makers(s), and stakeholders. The purpose of this step is to develop a clear statement of the decisions being addressed, and to identify the roles, goals, and interests of the decision-makers and stakeholders in the overall process.

2) Identify Objectives, Alternatives, and Uncertainties. A fundamental feature of the Decision Analysis approach is the decomposition of any decision problem into three basic components: what the decision maker wants (*objectives*), what they can do (*alternatives*), and other factors that the decision-maker does not control but which can affect the outcome of a decision (*uncertainties*). Developing a clear identification and statement of each of these components is critical to being able to conduct a useful analysis. This step may include active participation of multiple stakeholders depending on the decision context. Stakeholders have an important role in identifying objectives and alternatives, and they may also bring technical knowledge that is useful in identifying and quantifying uncertainties.

3) Build a Decision Model. Decision Analysis modeling is a process of quantifying the relationships between the decision *alternatives* and the ability for each alternative to meet the *objectives*. Depending on the decision context, relevant *uncertainties* may include: scientific uncertainties about the state of the physical and biological processes involved; "state of the world" uncertainties (e.g. future weather patterns or climate); and policy-related uncertainties (e.g. the future regulatory environment). Building a decision model first requires specifying the relationships between the decision alternatives, uncertainties, and objectives, and then quantifying those relationships and the uncertainties. Quantification means both estimating the likelihood of various outcomes for a given uncertainty, and quantifying how well each alternative will perform against the specified objectives under each potential outcome of the uncertain factors. Decision Analysis includes a wide array of tools and processes to facilitate the model-building process.

4) Conduct Analyses and Sensitivity Analyses. Once a model is built, there are many types of analyses that can be conducted to inform the decision-makers and stakeholders. The most appropriate and useful analyses depend on the decision context. For most real-world decision contexts there are multiple parties involved, multiple objectives are relevant, and there may be varying degrees of confidence in the quantification of the uncertain factors. In those cases, more sophisticated analyses and sensitivity analyses are necessary to fully elucidate the problem. Some examples of sensitivity analyses include:

- Full quantification of the probability, variability and net benefits of each alternative (in addition to calculation of the expected value),
- "Importance analyses" which identify the inputs that have the most impact on the uncertainty in the outcomes and may point to areas of further research that would reduce the uncertainty about the outcome of a particular decision, and
- Decision policy uncertainty analyses which focus on identifying which uncertainties are "decision relevant" (i.e. where the optimal decision is different depending on the outcome of that uncertainty).

5) Decide and Execute. Ultimately, of course, the goal of Decision Analysis modeling is to support a decision or the selection of a preferred alternative. Like all models; however, Decision Analysis models are simply tools to be used by the decision-maker(s). No tool can "make a decision," but a high-quality Decision Analysis model can be used by the decision-makers to explore the implication of various choices in terms of the impact on objectives that they themselves specify based on their understanding of the science and what the future state of the world looks like.

Decision Analysis can be conducted with support from consultants who provide Decision Analysis software and guide development of site-specific Decision Analysis frameworks. Products would include conceptual models; importance, uncertainty, and sensitivity analyses; and records of how each decision is reached to clearly document and support decision-making.

Source Control

The primary source of the drainage problem on the Westside of the San Joaquin Valley is the irrigation of land that has poor drainage qualities. Drainage management must begin with source control. Implementation of various source control measures would reduce the amount of drainage that must be addressed and lead to reduced impacts to resources, smaller scale drainage management facilities, less required mitigation, more native habitat restoration opportunities, and lower management and monitoring costs in the long-term.

Land Retirement and Fallowing

The Implementation of Drainage Services, Draft Collaborative Drainage Resolution document dated July 30, 2007 states that "…Westlands initial land retirement plan would be 100,000 acres, at a minimum." It goes on to say, "The regional programs provide flexibility for Westlands to retire additional lands." Increasing land retirement or fallowing must be considered as an important management action that can be taken should the level of impacts become unacceptable. The more permanent retiring of land from irrigation can allow for dry land farming, grazing, restoration to native habitat, or other forms of development. The more temporary fallowing of land can be used to reduce drainage from key areas (e.g. lands with the highest selenium levels in drainage water) on an as needed basis.

Native Habitat Creation

If irrigated lands are used for the creation of buffer zones or native habitat corridors for upland species via soil conservation, habitat conservation, and restoration programs, this could be considered a form of land retirement, fallowing, or mitigation. Although small or linear in nature the total acreage can lead to useful reductions in drainage volumes. The CVPIA Land Retirement Program showed that restoration of retired agricultural land to upland habitat in the San Joaquin Valley is possible. The Land Retirement Program's 5 year report states "Even in the absence of widespread and successful restoration, retired agricultural lands are important to wildlife. Unquestionably, removing active agriculture and associated recurring disking and irrigating removes threats to wildlife." We see land retirement as an opportunity to improve upland habitat for many wildlife species, not just listed species. All tools available for such improvement should be considered. Mitigation credit, if appropriate, could be given according to the regulations and policies of state and federal resource agencies.

Irrigation Efficiency

Maximizing irrigation efficiency can significantly reduce drainage volumes. All drainage-impaired land that is irrigated should be utilizing irrigation efficient technologies to a maximum extent.

Recycling Drainwater

Some drainwater can be blended with primary irrigation water and used on high value crops, thus reducing drainage volume. On-farm recycling of drain water will only occur to the extent practicable and will ultimately be up to the individual farmer because the quality of applied water can dramatically affect crops.

Location of Facilities

Although it is appropriate to locate drainage management facilities in areas that allow for the most efficient movement of drainwater and effective design, an effort should be placed on locating facilities in areas that reduce and minimize impacts to groundwater, surface water, fish, wildlife, and listed species. Locating reuse areas on soils with lower water transmitting rates can reduce the vertical and lateral rate of subsurface water and constituent movement and their potential seepage to surface waters. Areas that have a high restoration potential or that can serve as movement corridors for wildlife and certain listed species should be avoided.

Breaking Exposure Pathways

The primary exposure pathway of selenium and many of the other contaminants of concern is aquatic. Selenium levels in this concentrated drainwater can be so high and pooled water so attractive that just a small ponded area a hundred square feet in size and an inch deep can be attractive to birds and other wildlife. Within days a selenium-contaminated food chain can develop that may expose this wildlife to levels of selenium that can cause reproductive impairment in birds feeding there for only a short period of time. Any drainwater exposed at the surface in drains, pooled in fields, at sumps, or in catchment basins is a potential source of exposure.

A primary goal of the drainage management plan must be to identify the weak links in the contaminant exposure pathways and to break them as quickly as possible. This can be done in the design phase, operation protocols, monitoring plans, and via day-to-day management. Current state regulations regarding the design, operation, monitoring, and closure of solar evaporators address many of these issues; however, reuse areas do not have such clearly defined regulations.

Tiered Monitoring Framework

The monitoring system should be designed to provide the stream of information needed to adaptively manage the drainage program to avoid, minimize, and compensate for adverse effects on human health, wildlife, and agriculture. To minimize the cost of the monitoring system while ensuring its effectiveness, the monitoring system itself should be adaptive and compliance-based. That is, as long as the system operates properly, as confirmed by basic monitoring of the physical functioning of the system, relatively little monitoring will be required. However, if some aspect of the system fails to meet specified design criteria in any way that could place human or wildlife health at risk, then additional monitoring may be triggered in order to ascertain the extent of that risk.

For example, the reuse areas will be designed with the objective of precluding exposure of wildlife to drainwater that openly flows or ponds long enough to develop an aquatic food chain. If basic monitoring reveals openly flowing or ponded drainwater (i.e. water could not be eliminated or kept free of wildlife), then more intensive monitoring may be triggered to determine whether the open drainwater develops a community of aquatic organisms that could be eaten by wildlife and whether any wildlife have access to the exposed drainwater. If the additional monitoring indicates that any wildlife are exposed to such aquatic food, then further monitoring may be triggered to assess whether any exposed wildlife assimilate enough contaminants to place them at risk. Results of such monitoring would lead to estimation of impacts, mitigation requirements, or regulatory penalties. It should be noted that the drainage management plan should not allow such ponding to occur for an extended period of time (days) and immediate actions should take place to stop the ponding. Current state regulations regarding the design, operation, monitoring, and closure of solar evaporators address many of these issues; however, reuse areas do not have such clearly defined regulations.

Triggers

Various triggers need to be clearly identified and used to set in motion additional monitoring, management actions, or regulatory actions as appropriate. These triggers can come in the form of current regulatory numbers such as federal or state criteria and standards, current regulatory guidance on drainwater management and discharges, regulatory requirements developed as part of the permitting process for the planned facilities, and triggers agreed upon during the development of the detailed monitoring plan.

Triggers should be identified for surface water, groundwater, influent and effluent within treatment systems, and biological components. Physical triggers such as ponding, groundwater movement, and wildlife use must also be developed. Triggers may also be defined based on established monitoring intensity.

The triggers should initiate one of several options including but not limited to more intense monitoring, appropriate adaptive management measures, mitigation requirements to compensate for effects to wildlife (or other resources), and/or regulatory actions.

Management Actions

Some triggers initiate additional monitoring while other triggers may initiate management actions to directly address a problem.

Commitment

A strong commitment by all stakeholders to the adaptive management process and to the goals of the project is critical to the success of the monitoring plan and overall drainage management.

Caution

In taking actions in the face of unknowns, especially when the consequences have the potential to be severe or irreversible, one must proceed with caution. The current regulatory process along with adaptive management and caution can work together to safely design and implement a drainage management plan and associated monitoring plan. An evaluation of the drainage management plan is needed as it is more fully developed to identify high-risk areas and uncertainties. Then management actions can be developed that address these risks and uncertainties and appropriate pilot testing, scale-up, and monitoring implemented.

Contingency Plans

Many of the risks associated with drainage management have already been identified; therefore, contingency plans must be developed to address those risks.

Mitigation

As impacts to resources are identified and addressed via management actions it is anticipated that not all impacts can be minimized or completely avoided. Mitigation may be needed to address these impacts.

The Service has developed mitigation protocols to address impacts from evaporation ponds; however, they are limited to the types of impacts associated with the larger deeper ponds and focus on shorebird impacts. An attempt to modify the protocols to address potential impacts from drainwater reuse areas and for other avian species (waterfowl) has been made for the SLDFR-EIS but they need additional work before they can be used for the proposed drainage management plan and for addressing potential impacts from the solar evaporators.

Best Management Practices (BMPs)

The IFDM manuals and regulations provide very good BMPs to protect resources related to the design, operation, and closure of solar evaporators. While some of these BMPs can be adopted for reuse areas the state regulations appear to be limited only to the solar evaporator portion of the drainage system.

Land Retirement

Increasing land retirement or fallowing must be considered as an important management action that can be taken should the level of impacts become unacceptable.

Closure Plans

As with the larger evaporation ponds, closure plans for the solar evaporators must be prepared including a funding mechanism.

Quality Assurance/Quality Control (QA/QC)

Quality Assurance/Quality Control (QA/QC) related triggers may be needed to address inaccurate or incomplete data.

Active Participation from Federal, State, Local Agencies

Although the drainage management plan, as proposed, will be implemented by the drainers rather than the federal government, active participation from federal, state, and local regulatory agencies will fully protect resources at risk through developing and enforcing monitoring and other permit conditions.

3. Facility Design, Management, and Exposure Pathways

This chapter briefly describes the drainage management and treatment system to identify potential pathways to biota and other critical points that would require monitoring. Some points in the system are not pathways to biota but would require monitoring in order to properly and safely manage and operate the system. Figure 5 identifies the key areas where an exposure pathway is likely to occur and where expected operational and maintenance monitoring would be needed.

Principal contaminants of concern in agricultural subsurface drainwater in the San Joaquin Valley include selenium, mercury and boron. These contaminants pose risks to human and wildlife health primarily through food chains. That is, these contaminants are bioaccumulated by aquatic vegetation (mainly algae), and aquatic animals (such as insects) that feed on the vegetation. These contaminants may be further concentrated in animals (such as fish) that eat the animals that eat the vegetation. Therefore, water containing concentrations of these contaminants that would be harmless to wildlife that touch or drink the water, may endanger the life or health of wildlife that eat organisms growing in the water.

The discussion in this chapter is based upon information available at the time of preparation (WWD et al., July 2007; SLDFR FEIS) and certain assumptions addressed in Chapter 2. The drainage plan is based upon the Integrated On-Farm Drainage Management (IFDM) system developed to provide affordable and effective on-farm drainage (Figures 2 and 3). California Health and Safety Code, Section 25209.11 and Title 27, Article 9.7 Integrated On-Farm Drainage Management regulations contain specific information and regulations concerning design, operation and monitoring of IFDM systems and solar evaporators. The State Water Resources Control Board contracted with the Westside Resource Conservation District to develop a landowner's manual and a technical advisor's manual for designing and operating IFDM systems (http://www.sjd.water.ca.gov/drainage/ifdm/index.cfm). These manuals provide a great deal of information on the design of such facilities as regulated under state laws. A project description containing details on the design and operation of the drainage management, treatment, and disposal systems is needed before a detailed monitoring and compliance plan can be developed.

Retired Lands

Land retirement is defined as the removal of lands from irrigated agricultural production by purchase or lease for other purposes or land uses. The SLDFR FEIS definition of land retirement included the following: "These lands could use groundwater (subject to safe yield limitations) or other purchased water to irrigate crops. They would not receive water from WWD. In 2003, approximately 25 percent of the land was irrigated." Land retirement will be utilized in WWD as an element of source control implemented to reduce the number of acres for which drainage service will be provided and thereby decreasing the volume of drainage to be managed. At a minimum, WWD will retire the approximately 60,000 acres it has already acquired as part of its land acquisition program (Sagouspe Settlement lands), in addition to the approximately 40,000 acres retired in connection with the settlement of Sumner Peck Ranch, Inc, v. United States. The regional programs provide flexibility for WWD to retire additional lands (WWD et al., July 2007).

The BOR implemented a land retirement program under the Central Valley Project Improvement Act and developed a monitoring plan for lands retired under pilot projects in the San Joaquin Valley as required under the Biological Opinion prepared for the project by the Service under section 7 of the ESA. Appendix I contains the Service's Biological Opinion, which identifies monitoring requirements and performance goals for the project. The appendix also contains the 5 year monitoring report for the land retirement pilot project. The authors note in the biota monitoring section that ". . . land retirement and the restoration of retired lands, if properly implemented, monitored, and managed, would be beneficial to wildlife, including threatened and endangered species, and would generally not pose a severe risk of selenium exposure. However, we urge that land retirement be integrated with a comprehensive selenium monitoring program to monitor exposure of wildlife to selenium on a site by site basis. Furthermore, a suite of remedial actions should be developed in the event that selenium exposure on a site is or becomes problematic."

It is outside the purview of this task to determine the resources available for land retirement or restoration.

Primary Agricultural Lands

Recycling/Blending

During at least some stages of growth, some crops may be irrigated successfully with agricultural subsurface drainwater blended with the primary water supply (recycling). This drainwater may be toxic to wildlife if the water is conveyed in open ditches or is permitted to stand in the fields long enough to develop an aquatic food chain, that is, long enough for small aquatic animals to hatch and grow. Therefore, if drainwater (pure or blended with fresh irrigation supply water) is recycled as irrigation water on primary agricultural lands, the storage, conveyance and application of this water may need to be monitored to avoid toxic exposure to wildlife. If the recycled water is applied by a spray irrigation system, then any wind-borne drift of the spray (droplets or condensed particles of salt) may be deposited beyond the irrigated field, and may pose a risk of toxicity. Recycled water can increase constituent loads to soil and groundwater, and unless removed will degrade soil and shallow groundwater quality. Contaminated groundwater can migrate laterally to adjacent land areas or seep into surface water features (ditches, sloughs, or rivers), or downwards to deeper aquifers. Therefore, monitoring may be needed for ground and surface water in the vicinity of such fields, especially downwind and downslope of the fields. An assessment of these potential risks should be done to determine if monitoring is appropriate.

Drainage System

The conveyance of subsurface drainwater from primary agricultural lands to the reuse areas may pose a risk to any wildlife exposed to foodchains that may develop in the drainwater. To minimize such exposure, the conveyance system is expected to consist of closed pipes. The integrity of this closed system needs to be verified by monitoring. Such monitoring would at a minimum include regular visual surveys but could also include accurate real-time measurements of flow at the sumps draining the fields and at the point of entry of the drainwater into the reuse area. Continuous real-time comparison of the flows at the two ends of the conveyance system would make it possible to detect leakage in the pipes.

Reuse Area

The purpose of the reuse areas is to reduce the volume of drainwater that will require treatment and disposal. The reuse areas would consist of lands that have been or are currently irrigated, and have been judged suitable for irrigation with water having a total dissolved solids (TDS) concentration of 10,000 milligrams per liter (mg/L) or less (SLDFR FEIS). A potential environmental consequence of reuse area operation may be the exposure of wildlife to the toxic constituents of the drainwater as those constituents are being concentrated by evaporation and evapotranspiration. The principal known threat to wildlife is through consumption of aquatic organisms that grow in exposed drainwater either in drains or ponded areas in the fields. An important purpose of monitoring in the reuse areas will be to ensure that drainwater does not flow or pond on the surface of the land. A secondary threat to wildlife from reuse areas is through the foodchain to upland wildlife species.

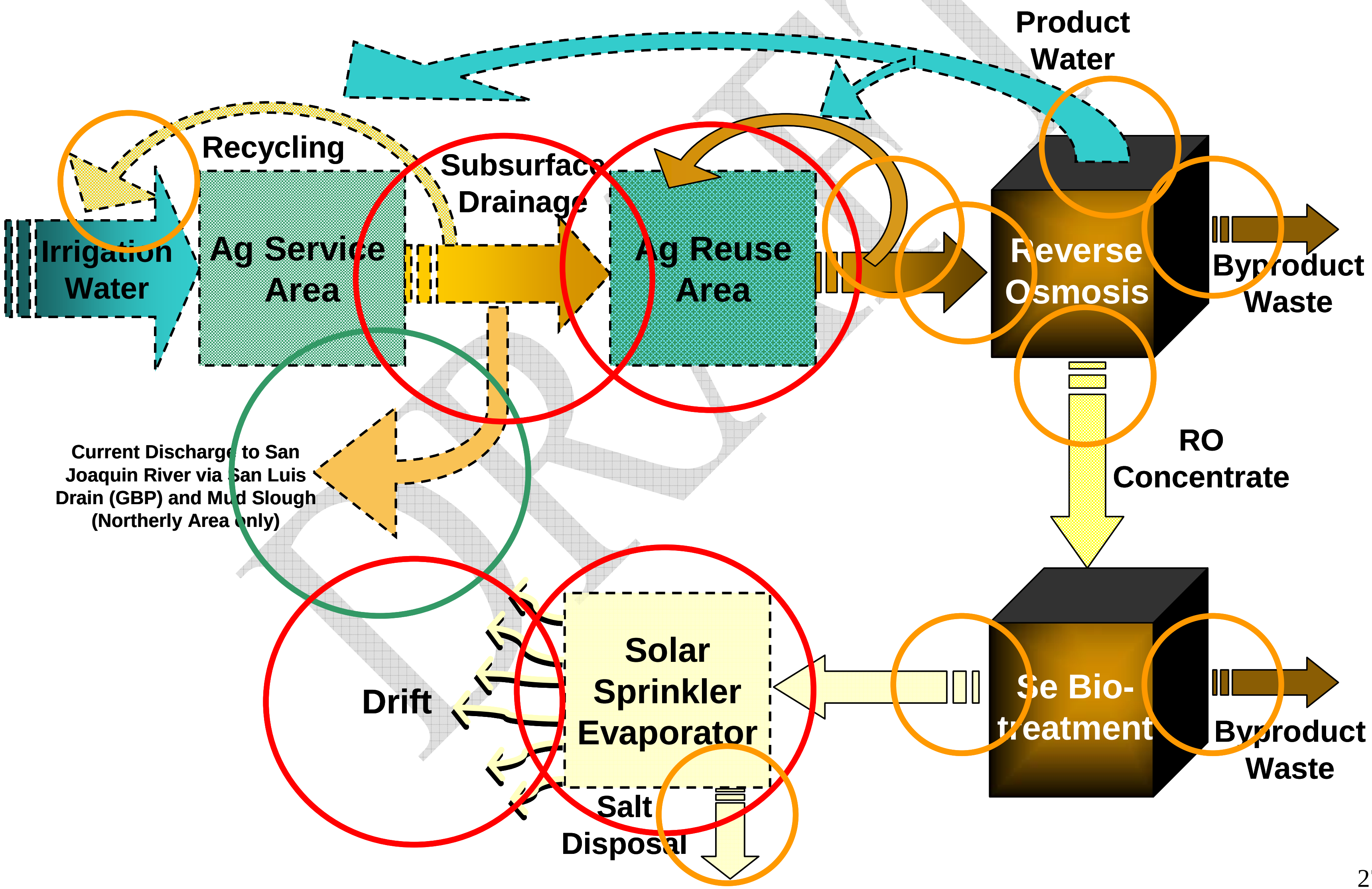
Location

Drainwater would irrigate salt-tolerant crops on lands near or surrounding up to15 regional reuse facilities (WWD et al, July 2007). Of the 14-15 reuse facilities identified in the SLDFR FEIS for the In-Valley Water Needs and In-Valley Groundwater Alternatives, respectively, one reuse area would be located in the Northerly Area with the remaining reuse areas being distributed within WWD North, Central and South (SLDFR FEIS). The Northerly Area reuse area would be located within and adjacent to the existing San Joaquin River Improvement Project (SJRIP) facility of the Grassland Bypass Project, and adjacent to the proposed Northerly Area treatment and disposal facilities (SLDFR FEIS).

Size

The total acreage anticipated of the 14-15 regional reuse facilities in WWD and the Northerly Area is projected to be 12,500 - 16,700 acres, depending on what In-Valley Alternative and acreage of land retirement is implemented. Total area needed for drainwater reuse in the Northerly Area is projected to be 8,200 acres to serve 81,000 acres of drainage impacted lands in the Grassland Drainage Area. The remaining acres of reuse would be distributed within WWD North, Central and South (SLDFR FEIS).

Figure 5. Key monitoring areas for the conceptual drainage monitoring plan. Small circles (orange) represent key points of monitoring needed for the proper operation and management of the drainage and treatment systems regardless of potential fish and wildlife exposure. Other operational monitoring is likely within the RO and Se treatment systems (biocides, coagulants, pH, salts, etc). Large circles (red) represent areas in the system where groundwater, surface water, fish, and wildlife exposure and impacts may occur and appropriate monitoring is needed. The green circle is the Grassland Bypass Project monitoring program that is not addressed in this plan.



Water Delivery and Drainage Systems

A closed collection system would be constructed to collect and convey drainwater from on-farm subsurface tile drains to the regional reuse facilities located within each of the three WWD zones. The Northerly Area would make use of the existing, open collector systems. Only newly constructed collector systems would be closed systems. The closed collection system is composed of drain sumps and pipelines. Drain sumps would be placed at the lowest corner of the quarter section of land or at some other low point on the quarter section lines. Farmers would pump drainwater from their sumps into the collector system, and pipelines would convey drainwater from sumps to the reuse areas (SLDFR FEIS). Monitoring of volumes, conductivity, and selenium would be appropriate at many of these locations to properly manage drainage flows along with salt and selenium loads. Such data can be used to determine recycling options, sources of high salt or selenium loads, and to prioritize potential land retirement options.

At the reuse facilities, subsurface tile drains would be installed to collect the reused drainwater. Each reuse facility would also be an underground regulating reservoir to control the flow of reused drainwater to downstream features. The reused drainwater would be conveyed via pipeline or canal to treatment and/or disposal facilities. No drainwater would be applied to reuse area fields until the required drains have been installed and baseline groundwater quality established. The drainage system would consist of buried drain pipes at prescribed depths and spacing. The depths and spacing would vary from one reuse area to the next based upon the hydraulic characteristics of the subsoil and the need to create storage capacity under the reuse area. The drains would be sized to handle the peak flow generated by the irrigation of the salt-tolerant crops. The reuse drainage system would be spaced to keep the water table at 4 feet, or more, below the ground surface all year.

Monitoring at the San Joaquin River Improvement Project (SJRIP) reuse area identified open water systems as being a pathway for selenium exposure to shorebirds (H.T. Harvey & Associates, 2007). To address this exposure unused drains were buried and plans are being implemented to install pipelines to transport the drainwater. In the interim open drains have been covered with netting to prevent wildlife exposure. It is our expectation that other reuse areas will utilize pipelines to transport drainwater, thus reducing exposure to wildlife.

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

Over application of irrigation water or breaks in pipelines can also create surface ponding of selenium contaminated drainwater. These occurrences can result in short-term selenium exposure risks to opportunistic shorebirds and waterfowl foraging at the temporarily inundated sites because of the high selenium concentrations in drainwater. The selenium risks can be minimized with field leveling, surface drainage management, a program of surface and groundwater monitoring, and with appropriate operating modifications to limit the occurrences or durations of the hazardous conditions.

Groundwater

The water quality of reused drainwater would initially be similar to the water quality of the shallow water table beneath the reuse facility. In general, it is expected that shallow groundwater quality would gradually decline beneath the reuse areas during long-term use, as do all aquifers underlying irrigated farmlands (SLDFR FEIS). The reuse facilities will be designed to concentrate the drain water above levels in the shallow groundwater underlying the agricultural service areas.

The drainage systems would be installed as a part of the development of each reuse area. As installation progresses, more extensive subsoil investigations would be needed to determine adequate drainage system layouts and designs. Shallow observation wells would be used to provide water table depth information for proper storage/discharge operations of the drains. Appropriate groundwater monitoring of the reuse facilities is needed to monitor potential vertical and lateral groundwater movement, potential constituent concentration changes in groundwater with depth beneath the facility, and rate of degradation if it occurs. The appropriate number of wells, their locations, and sampling frequency depend upon many factors such as soil parameters, site location, size, design, and management (See Appendix G). Figure 6 shows the proposed reuse area locations and the inferred horizontal groundwater-flow directions based on observed groundwater level data.

"Down-gradient" refers to vertical and horizontal groundwater movement. In the western San Joaquin Valley, vertical gradients and flow are primarily downward and recent irrigation recharge (irrigation recharge occurring after 1952) has percolated below agricultural lands to depths greater than 45 to 210 feet below land surface (Dubrovsky et al, 1993). Horizontal gradients and flow are generally from the southwest to the northeast (Belitz, Kenneth and Heimes, F.J., 1990). Belitz and Phillips (1995) reported average horizontal gradients of 0.002 foot/foot, and spatially horizontal gradients ranged from 0.02 foot/foot near the western margins of the valley to 0.001 foot/foot near the valley trough. Locally, vertical and horizontal groundwater flow directions can vary from these regional characteristics depending on hydrogeologic conditions and the influence of irrigation and drainage.

Figure 6 shows regional groundwater contours and generalized horizontal flow directions based on reported data from Ken Schmidt and Associates (1997) and WWD. The horizontal groundwater-flow rates are determined by these horizontal hydraulic gradients and the hydraulic conductivity of the subsurface sediments. While surface materials are primarily fine-grained, deeper materials can be coarse grained and thus facilitate greater horizontal constituent transport. For example, 20-40 feet thick deposits of predominantly coarse-grained sediment appear to underlie five of the nine proposed reuse areas (Laudon and Belitz, 1991). Estimated horizontal flow rates in the western valley range from a few feet to several tens of feet per year.

The reuse area drainage system design and operation reportedly shall maintain the water table at depths around 4 feet below land surface to maximize "storage" of drain water under the reuse areas, whereas most drainage systems in the agricultural service areas typically maintain the water table 6-10 feet below land surface. Accordingly, one would expect horizontal movement away from the local groundwater highs beneath the reuse areas and towards adjacent lands where the water table is at greater depth. Clearly, potential horizontal movement of dissolved salts and trace elements must be considered as part of plans to monitor possible off-site groundwater impacts from drainwater reuse facilities.

With few exceptions, multiple completion monitoring wells have shown the water table is not perched and the system is saturated beneath the first occurrence of groundwater (Belitz and Phillips, 1995; Belitz and Heimes, 1990). In other words, there is a continuously saturated water column from the water table downwards past the Corcoran Clay. Belitz and Phillips (1995) reported for areas underlain by fine-textured sediment, the vertical gradients in this regional aquifer ranged from 0.07 to 0.32 foot/foot, whereas in areas underlain by coarse-textured sediment the vertical gradients ranged from 0.003 to 0.07 foot/foot. Belitz and Phillips (1995) estimated average downward groundwater movement at about 0.64 foot per year. The regional aquifer is therefore at risk from contamination by the downward movement of dissolved constituents near the water table.

Crops

Reuse area crops would consist mostly of salt-tolerant perennial pasture grasses, including Bermuda grass, Jose tall wheatgrass, Rio wildrye, and alkali sacaton. Legumes, such as salt-tolerant alfalfa and narrowleaf birdsfoot trefoil, may be used in the pasture mixes in some of the less saline reuse areas. Smaller acreages of annual crops would include barley, canola, and other salt-tolerant grains or forage mixes. Tree varieties recommended by the local resource conservation district would also be used in appropriate areas (SLDFR FEIS). In the Northerly Area reuse area crops have included pasture grasses, tomatoes, grapes, alfalfa, pistachios and almonds: however, the success of some of these crops may be limited (GBP BO Status Report 2007, USBR).

Salt-tolerant grasses and grains would be harvested for hay, silage, and/or green-chopped for local livestock producers. The value of the hay and other products is expected to be significantly less than alfalfa products because the total digestible nutrient levels of these grasses are lower. Sheep grazing would also be used to harvest the grasses. Limited acreages of canola may be harvested (SLDFR FEIS). Periodic monitoring of selenium in the crops is appropriate for sale of the crops as selenium supplement forage and to understand potential selenium pathways in terrestrial biota.

Management

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

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

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

Storm Events

Ponding and Runoff

During storm events and prolonged wet periods, leaching of selenium from the unsaturated soil horizons, rising groundwater levels and increased drainflow potential, release of shallow stored drainwater and temporary ponding of rainwater and surface runoff could occur for short periods of time. Surface evaporation could concentrate selenium in the exposed water. These intermittent occurrences can result in short-term selenium exposure risks to opportunistic shorebirds and waterfowl foraging at the temporarily inundated sites because of the high selenium concentrations in drainwater. The selenium risks would be minimized with field leveling, surface drainage management, a program of surface and groundwater monitoring, and with appropriate operating modifications to limit the occurrences or durations of the hazardous conditions. Under unusual prolonged wet conditions, bypass pipelines at the reuse facilities could temporarily redirect influent drainwater, if needed, directly to the treatment plants or evaporation facilities (SLDFR FEIS).

It is anticipated that significant effects to aquatic and wetland-dependent species from operation of the reuse areas could be effectively minimized with (1) responsive operating rules including seasonal or incident-based actions directed at at-risk species, (2) implementation of a reuse area monitoring program (including surface and groundwater, soil, vegetation, bird use, dietary items, and bird eggs/tissues), and (3) adequate contingency strategies cooperatively developed by the USFWS, CDFG, and Regional Board (SLDFR FEIS).

Timeline

For Westlands, final design and construction of the proposed facilities will be initiated upon Federal and/or State authorization. The overall project is expected to be implemented in a phased manner with the intent of constructing the collector systems, reuse areas, treatment facilities, and sprinkler evaporation systems. The constructed facilities in conjunction with a planned land retirement component will provide the necessary drainage for the entire project area.

The reuse facility in the Northerly Area will process up to one-quarter of the total drainwater produced in the Grassland Drainage Area (25 percent of 52,000 acre-feet or approximately 15,000 acre/feet) and will be implemented in three phases, described below (from GBP BO Status Report 2007, USBR):

- Phase I: Purchase of land and planting of salt-tolerant crops
- Phase II: Installation of subsurface drainage and collection systems, initial treatment system
- Phase III: Complete construction of treatment removal and salt disposal systems

Wildlife Exposure Pathways

Although aquatic systems are the ones most recognized as being a risk hazard for selenium, terrestrial habitats can also be a problem especially when dealing with the high concentrations of selenium in the drainwater at reuse and treatment areas (Figure 7). Monitoring of IFDM operations documented terrestrial wildlife exposure to selenium that can put certain species at risk (USFWS, 2006).

Soil

Soils on the west side of the San Joaquin Valley are naturally elevated with selenium. Irrigation of these lands has concentrated this selenium in shallow groundwater. Irrigation of the reuse areas with this subsurface drainwater provides an ongoing supply of selenium into the soil. Prolonged evaporation from a shallow water table can also increase soluble salt and trace element concentrations in soil. This soil forms the base of the terrestrial foodchain in the reuse areas.

Crops/Vegetation

Crops and other vegetation growing in the reuse area can concentrate selenium in the root zone, in above ground tissue, and in the stubble and litter remaining after harvest.

Invertebrate

In a terrestrial environment a wide variety of invertebrates can be exposed to selenium in the soil, vegetation, and litter. Predatory invertebrates such as spiders feed on these invertebrates also. Water in ditches, sumps, and regulating basins along with ponding for a sufficient period of time (days) can develop an aquatic invertebrate population.

Amphibian

Water in ditches, sumps, and regulating basins along with ponding for a sufficient period of time (days) have the potential to attract amphibians. Some amphibians can travel long distances and could potentially utilize reuse areas.

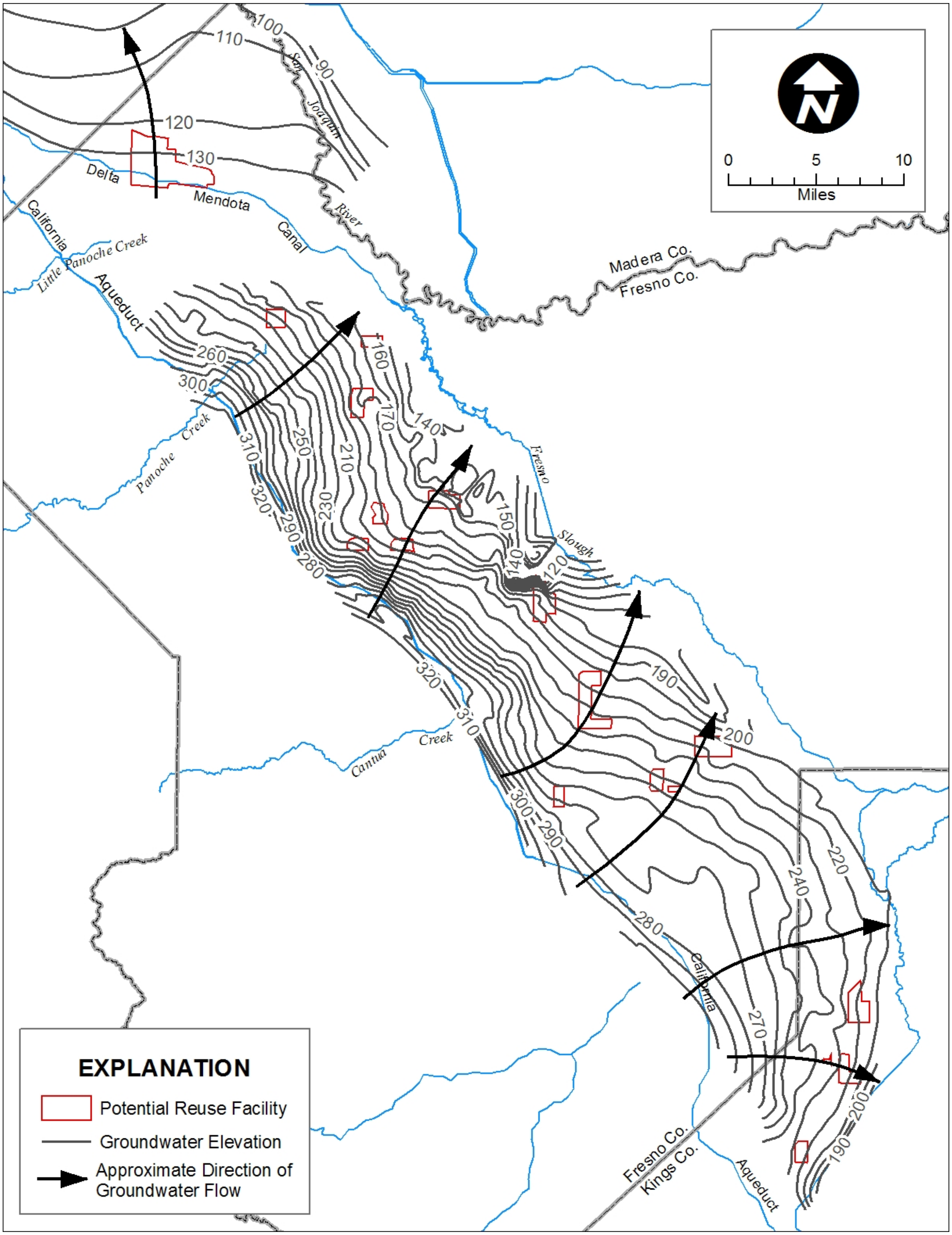


Figure 6. Groundwater contours and generalized directions of horizontal groundwater flow in the western San Joaquin Valley.

Reptile

Snakes and lizards may feed on plants, invertebrates, amphibians, fish, and mammals in the area.

Mammal

Mice and shrews can utilize reuse areas and be exposed to selenium in their diet of insects, vegetation, and seeds.

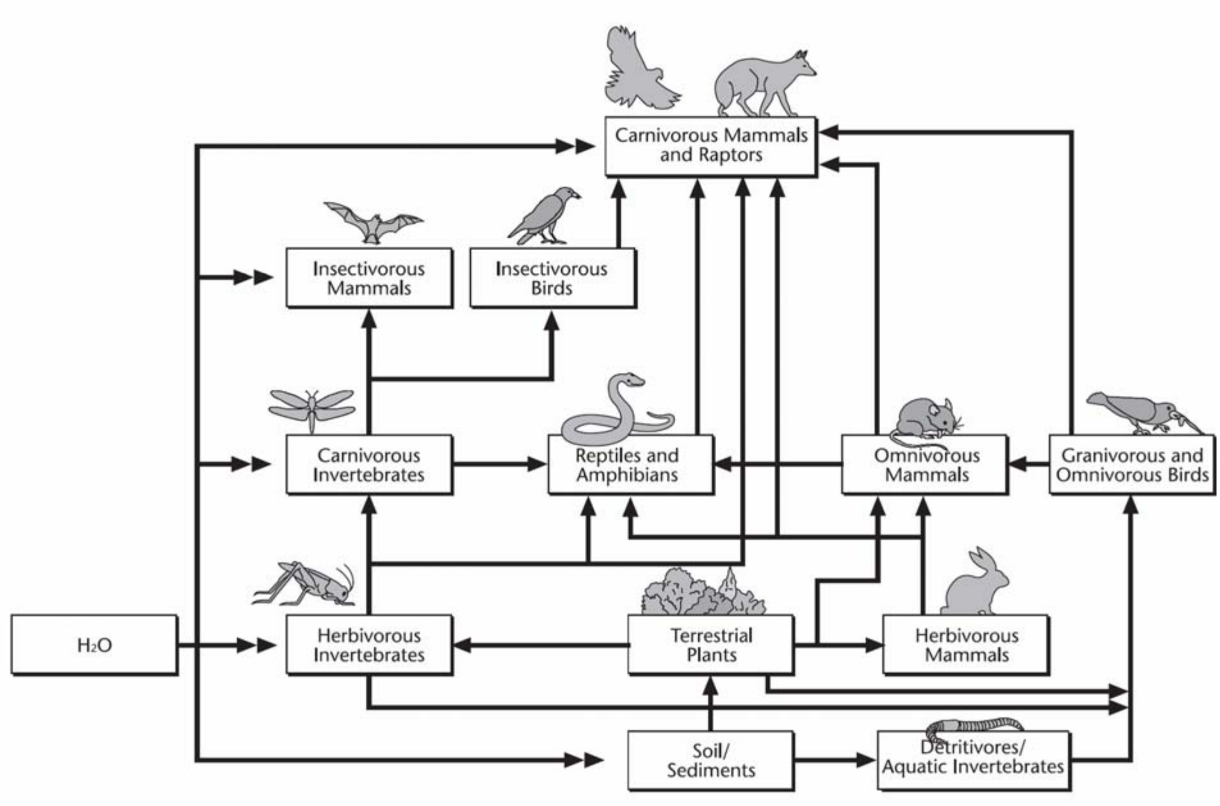


Figure 7. Selenium bioaccumulation flow-chart for wildlife from IFDM technical manual.

Avian

Often at the top of the foodchain, birds are at great risk to selenium exposure not just from the aquatic habitat but also the terrestrial habitats. Shallow ponded areas attract shorebirds and wading birds (Figure 8). Open ditches attract wading birds and dabbling waterfowl. Fields, trees and other structures can attract many bird species. Those identified at IFDM operations include red-winged blackbirds, finches, various raptors, loggerhead shrikes, and western kingbirds. Selenium monitoring at IFDM sites (USFWS, 2006) revealed that habitat features favoring seed-eating passerine birds over shorebirds, aerial insectivores, or litter foraging species tend to present a significantly reduced risk of selenium poisoning.

Figure 8. Any ponding of drainwater at an IFDM site can attract wildlife such as these black-necked stilts in a very short period of time.

Groundwater Pumping Program

Any groundwater pumping program directly or indirectly associated with the drainwater management system (e.g. pumped groundwater sold to support costs of the system or to manage drainage) should be monitored to ensure that the pumping program does not adversely affect the quality and quantity of water in the aquifer from which the water is pumped, to ensure that the pumping program does not cause unacceptable land subsidence, and to ensure that the pumped water remains of sufficient quality for the purposes for which it is delivered.

Since the irrigation, water transfers, and drainage issues on the Westside of the San Joaquin Valley are so intertwined across the landscape and considering the fact that the Northerly Area was included in the SLDFR-FEIS and WWD Draft Collaborative Drainage Resolution, we include a discussion of monitoring needs associated with the San Joaquin Exchange Contractors' Groundwater Pumping/Transfer-Exchange Project located in the Northerly Area.

The San Joaquin Exchange Contractors (Exchange Contractors) propose to implement a Groundwater Pumping/Transfer-Exchange Project for a period of 25-Years (GW/Transfer Project). The project as proposed would involve development of up to 20,000 AFY by means of the following: a maximum of 15,000 AFY developed from groundwater pumping of the upper aquifer above a depth of 350 feet (above the Corcoran clay) but below the drainage impacted area of Firebaugh Canal WD and Central California Irrigation District, and up to 5,000 AFY of water developed from conservation and/or rotational land fallowing. Conservation measures employed would include canal lining and drip irrigation techniques; no tailwater recovery would occur for this project. Rotational land fallowing would be in addition to normal crop rotation practices. The Proposed Action of the GW/Transfer Project EA/IS would free up a commensurate quantity of water of the Exchange Contractors contract supply equivalent to the quantity developed by this project (up to 20,000 AFY) for transfer to San Luis Unit contractors and Santa Clara Valley Water District. The purpose of the project is to 1) supplement water supply deficiencies or provide additional water for Central Valley Project (CVP) contractors, 2) provide subsurface drainwater management, and, 3) provide capital improvement funding to control drainage water production in areas affected by shallow groundwater in the Northerly Area (USBR/SJEC GW/Transfer Project EA/IS 2007).

Location

The well field that would develop the water for transfer (28,000 acres within the Grassland Drainage Area) is located within the drainage-impacted areas of Central California Irrigation District, including the Camp 13 Drainage Area, and Firebaugh Canal Water District. The well field is adjacent to and downslope of the existing SJRIP reuse area, and would be located between the Delta Mendota Canal and the Main Canal.

Scale

A maximum of 15,000 AFY would be developed from groundwater pumping below the drainage impacted lands of the Exchange Contractors, and up to 5,000 AFY of water developed from conservation and/or land fallowing.

Water Use

The Proposed Action would allow for delivery of up to 20,000 acre-feet per year (AFY) to any or all of the following users:

- CVP San Luis Unit agriculture service contractors, up to 20,000 AFY;
- Local CVP M&I uses in Santa Clara Valley Water District (up to 2,000 AFY);
- And/or CVP M&I uses in San Luis Water District (up to 5,000 AFY) of which 3,000 AFY would be allocated specifically to serve a new proposed development (the Villages).

Potential Effects

Potential effects associated with this project that would be expected to need monitoring include:

- Groundwater degradation of the well field (i.e., increasing salt, selenium, and potentially mercury concentrations over the life of the project);
- Accelerated subsidence in the area of the well field;
- Degradation of downstream water supplies including Grassland Area wetland water supplies (as a result of pumping lower quality groundwater into the water supply conveyance canals).

Reverse Osmosis

Reused drainwater from the Northerly Area and the 12-15 potential reuse areas in WWD would be conveyed to four areas for reverse osmosis (RO) treatment to produce high quality product water that could be blended with other water for irrigation. Each RO system would consist of a single-stage, single-pass array with appropriate pretreatment to achieve 50 percent recovery

(SLDFR FEIS; WWD et al., July 2007).

Location/Size

RO treatment plants will be located near each of four solar evaporation units, one in the Northerly Area, three in Westlands (North, Central and South). Each RO facility will occupy about 12 acres (WWD et al., July 2007).

Inflow Quality and Volumes

Initial average selenium concentration of reused drainwater is projected to be 120 ppb. The final average selenium concentration of reused drainwater is projected to be 270 ppb. The combined inflow volume for the Northerly Area and WWD is projected to be 13,730 AFY – 18,458 AFY depending on which In-Valley Alternative and acreage of land retirement is implemented (SLDFR FEIS). Numerous water quality parameters are expected to be monitoring as a regular operational need of the system.

Product Water Quality and Volume

Each RO treatment plant is anticipated to produce product water that would be of adequate quality to be blended with CVP water for irrigation (SLDFR FEIS). To confirm this, appropriate monitoring is expected to be an operational need.

Effluent Quality and Volume

The flow weighted average concentrations of selenium and total dissolved solids (TDS) after reuse and RO treatment are estimated to be 534 µg/L and 32,520 mg/L, respectively (SLDFR FEIS and WWD et al., July 2007). The combined outflow volume for the Northerly Area and WWD is projected to be 6,865 AFY – 9,229 AFY depending on which In-Valley Alternative and acreage of land retirement is implemented (SLDFR FEIS). Monitoring of this output is an operational need to document proper operation and efficacy of the RO system and for operational needs of the following selenium treatment system.

Selenium Biotreatment

The concentrate reject stream from each of the four RO facilities would be conveyed to four selenium biotreatment facilities. As currently envisioned, the effluent from the selenium biotreatment plants will be discharged to solar evaporation units in each of the four drainage areas (Northerly; WWD North, Central and South) (WWD et al., July 2007).

Location

Based on the SLDFR FEIS, there would be four selenium biotreatment plants, one for each of the drainage areas (Northerly; WWD North, Central, and South). The effluent from the biotreatment plants would be discharged to sprinkler evaporators in Westlands and solar evaporators or dehumidifiers in the Northerly Area (WWD et al., July 2007).

Inflow Quality and Volumes

The flow weighted average concentrations of selenium and TDS after reuse and RO treatment are estimated to be 534 µg/L and 32,520 mg/L, respectively (SLDFR FEIS and WWD et al., July 2007).

The flow rate to the biotreatment plant for the Northerly Area would be approximately 4,050 AFY, while the flow rates for the combined WWD North, Central, and South areas would be 2,815 - 5,179 AFY depending on what In-Valley Alternative and acreage of land retirement is implemented. These flows are based on the assumption that the drainage rate from the reuse area would be maintained at a fairly constant level throughout the year.

Monitoring of this input is an operational need to document proper operation and efficacy of the selenium treatment system. Assuming RO treatment is implemented the RO effluent monitoring should suffice for the input monitoring to the selenium treatment system.

Effluent Quality and Volumes

The biotreatment plants will be designed, operated, and maintained to remove selenium to a monthly average concentration of 10 µg/L or less in the treated effluent. In addition, an oxidation process will be used to convert the form of selenium in the effluent to predominately selenate (a less toxic, bioavailable form of selenium) prior to discharge into the solar evaporation units. The WWD included the oxidation step in its proposal, the BOR included the oxidation step in the treatment process in the SLDFR-FEIS, and this step was evaluated under the FWCA and ESA consultations. It is not clear whether more recent treatment pilot studies have attempted to address the oxidation issue. Whether this step is needed if the effluent is discharged to a sprinkler solar evaporator must still be evaluated as the exposure risks are different than for evaporation ponds.

The predicted 10 µg/L was never achieved in a combined RO and selenium treatment system pilot test and the final oxidation step described in the SLDFR FEIS and WWD et al. 2007 has not been field verified (USBR and Applied Biosciences Corporation, 2004; USBR, 2006; USBR, 2007; PCI Membrane Systems, 2007). After many problems, only the phase 3 pilot treatment project reached a stable operation at <10 ppb selenium in the effluent; however, that pilot project involved treatment of raw drainwater, not the treatment of RO effluent that is the proposed drainwater treatment process (USBR, 2007). The pilot projects for RO treatment were very mixed and did not operate for more than a week at a time (PCI Membrane Systems, 2007). Therefore, it still remains to be seen whether a combined RO and selenium treatment system will produce effluent that is consistently below 10 ppb selenium, especially at the scaled-up version needed to treat the expected volume of drainwater.

Since this effluent will be disposed of in an open system which poses an exposure risk to wildlife, careful monitoring is needed. Monitoring results may dictate design and operation of the sprinkler evaporation systems.

Reverse Osmosis and Selenium Treatment Byproduct Wastes

The selenium, biomass sludge, RO wastes, and other byproducts or wastes would be collected and disposed of in accordance with applicable regulations (SLDFR FEIS, WWD et al, 2007). Disposal facilities will likely require documentation of the concentrations of potentially hazardous constituents, thus monitoring of the wastes is expected as an operational/disposal need. The following (not inclusive) potential effluents and byproducts were identified from review of the RO and Se treatment pilot reports: Brine (permeate, blowdown, overflow)—the highly saline RO concentrate reject water which goes to the selenium treatment system; Backwash solids—solids remaining in the selenium treatment bioreactor backwash settling tanks; Hydrocyclone solids—the gypsum recovered in the hydrocyclone process. Other wastes may include coagulation and anti-scalant waste, cleaning fluids, pump lubricants, etc. Since a final design of the RO and selenium treatment systems has not yet been determined we did not attempt to identify each potential waste. It is our expectation that these wastes will be properly tracked, monitored, and disposed of according to state and federal hazardous materials/wastes regulations.

Solar Evaporator

Location

Based on the disposal facilities described in the SLDFR FEIS there would be four drainage disposal facilities located in the vicinity of each of the four regional treatment plants (e.g., Northerly Area, Westlands North, Central, South). In the Northerly Area, the proposed site of the drainage disposal facility would be contiguous to the existing SJRIP reuse area and adjacent to a wildlife refuge area north of the Grassland Drainage Area land. For WWD North the proposed site of the drainage disposal facility would be located about 3 miles south of the town of Mendota and would be adjacent to reuse areas (the location was selected to utilize retired lands as much as possible) and near the Mendota Wildlife Area and Fresno Slough. For WWD Central the proposed site of the drainage disposal facility would be near reuse area G (in the SLDFR FEIS) and would be partially encircled by an approximate ½-mile-wide reuse area. For WWD South, the proposed site of the drainage disposal facility would be adjacent to the southern boundary of the district within Kings County and would be partially surrounded by a ½-mile-wide reuse area.

Size

A total of three evaporation facilities are planned for the WWD. About 330 total acres of sprinkler evaporators has been proposed to evaporate up to 5,500 acre-feet of drainage annually. The evaporators will be divided between three areas in the WWD, so each evaporator could be about 110 acres (WWD Nov 2007). In the Northerly Area, drainage disposal will be accomplished through sprinkler technology and solar evaporation units, or other emerging technologies such as dehumidifiers. The size of the Northerly Area facility(s) is presently not known but could be similar in size to the WWD facilities.

Design

The solar evaporator will consist of a shallowly graded and lined basin filled with gravel. Additionally an interceptor tile would be located in the low point to recover and re-circulate any water that was not converted to vapor. Sprinklers placed on the gravel bed, spaced at about 15 feet and set at about 2 feet will serve as the primary means to evaporate. Salts will accumulate on the gravel over time and could then be recovered for sale to processors and/or encapsulated with low permeability clay (WWD et al., July 2007). The design, operation, and closure of the facility must meet the requirements set forth in California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950.

The WWD will regulate the timing and volume of water that may be input into the system from the on-farm collection. The solar evaporators will be built to the appropriate depth to contain the water without ponding above the surface of the aggregate. The aggregate will be 2 inch, coarse. Each evaporator will be lined with an impermeable liner similar to a product known as Pondguard and marketed by Firestone. These liners come in a variety of thicknesses and are suitable for either municipal or agricultural waste containment (WWD Nov 2007). The specific design of the disposal facilities in the Northerly Area is currently not known.

Storm Events

Ponding

The systems will be designed and managed to operate under all climatic conditions, and prevent ponding of water (WWD et al., July 2007). Monitoring of the system to assure no ponding occurs is appropriate and is an operational requirement.

Runoff/Facility Overflow

The evaporators will be designed to each hold enough water to accommodate runoff from a 100 year storm (30 AF) and a buffer of 15 AF. However the evaporator will be designed so it can be isolated from the collection system during periods of rain (WWD Nov 2007).

As described in the SWRCB IFDM Landowner Manual, available at http://www.sjd.water.ca.gov/drainage/land_manual/index.cfm: a water catchment basin may be constructed as part of the solar evaporator in order to contain standing water that might otherwise occur in the solar evaporator. A water catchment basin is an area within the boundaries of a solar evaporator designed to receive and hold any water that might otherwise become standing water within the solar evaporator under reasonably foreseeable operating conditions. The entire area of the water catchment basin needs to be permanently covered with netting or otherwise constructed to ensure protection of avian wildlife."

Netting may be problematic within the sprinkler solar evaporator. The potential area needing netting may be too large to properly install the netting. Also the salt buildup on the netting over time could make it difficult to maintain. Operationally it is expected that any netting used at evaporation systems will be monitored to assure its proper maintenance and effectiveness.

"Reasonably foreseeable operating conditions" were stated by the State Legislature as defining the regulatory limits for the design of a solar evaporator, but were not quantified. The SWRCB has quantified these conditions as follows:

- the local 25-year, 24-hour maximum precipitation event,
- floods with a 100-year return period.

This means that the solar evaporator must be designed to not have standing water in the event of a 25-year, 24-hour precipitation amount, or that the water catchment basin must have sufficient volume to hold that amount of water accumulating in the solar evaporator. If a storm event occurs exceeding that amount, any associated occurrence of standing water within the solar evaporator will not be considered a violation of the regulations. In an analogous manner, inundation of the solar evaporator by a flood event exceeding the 100-year return period will also not be considered a violation of the regulations.

Events that do cause overflow or inundation will create an exposure pathway to wildlife that needs to be addressed immediately. The longer the situation posses an exposure pathway, the greater the risk of negative impacts to wildlife and other resources; therefore, monitoring of such situations is important.

Inflow Quality and Volumes

Based on information provided in the SLDFR Plan Formulation Report Addendum (2004) the flow rates to the drainage disposal facilities would be the same as the volumes conveyed to the selenium biotreatment facilities. For the Northerly Area the flow volume is projected to be 4,050 AFY, while the flow rates for the combined WWD North, Central, and South areas would be 2,815 - 5,179 AFY depending on what In-Valley Alternative and acreage of land retirement is implemented. In their response to FWS questions, WWD projected their volume of inflow into the disposal facilities to be 5,500 AFY (WWD Nov 2007).

Quality of inflow into the disposal facilities is assumed to be a monthly average selenium concentration of 10 µg/L or less, predominantly in the form of selenate, although pilot treatment studies to date have failed to meet this assumption (See previous inflow quality discussion under selenium treatment above). Effluent monitoring from the selenium treatment system should suffice for solar evaporation system monitoring of inflows as long as that monitoring includes selenium speciation.

Groundwater

Westlands will install monitoring wells down gradient from the evaporators at intervals that are recommended / ordered during permitting by the RWQCB. The frequency of monitoring and reporting will be determined by the RWQCB as part of the permitting process. However, the WWD anticipates a monthly monitoring requirement (WWD Nov 2007).

Management

The management and handling of water with high selenium concentrations will be consistent with applicable state and Federal laws. The operation and design of the solar evaporators will be subject to the jurisdiction of the Regional Board as required under current laws and regulations. Detailed procedures to handle high selenium concentrations will be developed as part of the future design criteria for specific facilities. If the salts cannot be immediately marketed, they will be encapsulated in a lined facility and capped with impermeable clay, a method approved by the Regional Board. The Regional Board will oversee management of the lined facility (WWD et al., July 2007)

Timeline

The lifespan of the facilities is expected to be 50 years. Final design and construction of the proposed facilities will be initiated upon Federal authorization. The overall project is expected to be implemented in a phased manner with the intent of constructing the collector systems, re-use areas, treatment facilities, and sprinkler evaporation systems.

Drift

During pilot testing by the Department of Water Resources (Appendix E) at a 30 meter by 30 meter sprinkler solar evaporator, significant drift occurred off site. Anywhere from 0.6 to 5.3 percent of the spray concentrate drifted beyond the edge of the spray field for several hundred feet. Drift barriers such as high fencing or trees along with prevailing wind directional design options have been proposed to minimize the drift; however, even a small percentage of drift can add up to significant off site contamination and exposure to wildlife over time. A vegetated drift barrier would be an attractive hazard for wildlife.

The design of large scale sprinkler solar evaporators is critical if wildlife exposures and other potential impacts are to be addressed. There is reason for concern that the problems of drift may be intensified as solar evaporators are scaled up to the sizes that will be needed for the proposed drainage management plan. The solar evaporator drift report (Krauter 2005) suggested constructing elongated evaporators and orienting them parallel to prevailing winds so that drift would fall within the evaporator. This would only minimize drift, not eliminate it, and any time the wind is blowing perpendicular to the facility drift could be worse because of the elongated shape. Vegetation has also been suggested as a drift barrier. We do not believe that shrubs or trees used as drift barriers are wildlife safe, but rather, would likely increase wildlife exposure. Adding vegetation as a drift barrier in this agricultural landscape would make solar evaporator facilities more attractive to wildlife. Fifteen species of migratory birds were documented to nest at IFDM study sites (USFWS 2006). Avian nests were located in every habitat component of IFDM plots, including agroforestry trees, indicating that these sites are capable of attracting both foraging and nesting birds.

Closure Requirements

Facility closure plans should be in place once the design lifetime or system capacity has been exhausted. It is anticipated that procedures for closure will be similar to those of drainwater evaporation ponds (WWD Nov, 2007) but would likely be developed under regulatory guidance and oversight by the Regional Board under California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950.

Wildlife Exposure Pathways

Exposure pathways are somewhat similar to those described in the reuse section above; however, they may not be as complex. Although regulated operating conditions are supposed to prevent standing water, the uncertainties associated with scaling the solar evaporator technology to the size needed to evaporate the expected volume of drainwater warrant careful monitoring and regulatory enforcement. Title 27 defines solar evaporator "standing water" as water occurring under all of the following conditions: (1) to a depth greater than one centimeter, (2) for a continuous duration in excess of 48 hours, (3) as a body of any areal extent, not an average depth, and (4) under reasonably foreseeable operating conditions. Under this definition an exposure risk to birds is possible.

Even within the sprinkler solar evaporator, invertebrates such as brine flies may survive which can attract various bird species. Salt encrustation may occur on the feathers and legs of birds that may land in salt-saturated waters within solar evaporators. Also, birds are generally known to fly through or land under water sprinklers for bathing—hundreds of acres of solar evaporators provide such an opportunity. Drift from the site will deposit salt and selenium on nearby soils and vegetation potentially exposing other wildlife. This may be of particular concern if vegetated wind breaks are incorporated into the design to stop drifting. This will simply create habitat that will collect salt and selenium which will enter the foodchain. The drifting salt itself may coat bird feathers and mammal fur causing encrustation problems and health risks from exposure to the weather.

Grassland Bypass Project

The Grassland Bypass Project has been thoroughly documented in other documents and venues and does not require a detailed discussion here. Appendix B contains the current monitoring plan for the project in particular for discharges to the San Joaquin River. As their drainage management plan is further implemented the monitoring described in this document would likely apply.

In the Northerly Area, tile drains and collection systems have already been installed on most land requiring drainage service. The Grassland Bypass Project includes an agreement between the entities in the Northerly Area and BOR that authorizes the entities to use a portion of the San Luis Drain subject to existing discharge permits issued by the Regional Board. The Use Agreement will expire in 2009; the dischargers anticipate a need to continue discharging for up to ten years while they pursue long-term drainage service through completion of the In-Valley treatment and disposal elements included in the drainage settlement proposal. The drainers have initiated a stakeholder process to negotiate with BOR a new Use Agreement and to complete appropriate environmental review and regulatory compliance requirements, including obtaining a new discharge permit from the Regional Board. The Parties to the Drainage Settlement MOU intend to support these processes to supplement diligent efforts by the Northerly Area Districts to implement the drainage service described in the settlement proposal, including continued reduction in drainage water quantity as a result of ongoing source control and reuse programs (WWD et al., July 2007).

Location/Size

Drain water is currently being discharged to the San Joaquin River through the Grassland Bypass Project, which serves approximately 90,000 acres in portions of San Luis, Panoche and Pacheco Water Districts, Central California Irrigation District, and Firebaugh Canal Water District.

Mitigation Areas

Mitigation areas may need to be created to address unavoidable impacts to resources. Unavoidable impacts are those impacts, expected or unanticipated, to any trust resource that could not be avoided or otherwise minimized through design, construction, and implementation of best management practices. The location, size, and design of mitigation areas are unknown at this time. These areas would need to be monitored to assure that good quality water is being used (if needed), that they are providing an appropriate level of habitat and wildlife use to fully compensate for impacts, and that wildlife using the mitigation sites are not using contaminated sites to an excessive or detrimental amount.

Mitigation habitat will be provided on an as-needed basis. This should be determined by the results of the monitoring, and the ultimate performance of the adaptive management process. Service policy favors a three-tiered approach to mitigation. This includes, first, avoidance; second, minimization; and finally, compensation. It is possible that a suite of potential remedies may be applied to ameliorate or resolve a particular undesirable outcome, and some of these may be employed to successfully eliminate wildlife impacts. In the event that best management practices operating at the reuse and disposal facilities are insufficient to preclude risk to area fish and wildlife resources, certain contingency measures are triggered (one among these being the provision of mitigation habitat to compensate for losses).

The type of habitat provided is dependent on the nature of the risk (what endpoint is being affected, and when). It is likely that mitigation habitat (if needed) would be seasonally operated. The mitigation prescription would be based on the endpoint being compensated. The contingency “triggers” that would prescribe provision of mitigation habitat are defined in Chapter 6, below.

Location

Current Service mitigation protocols for the Tulare Basin evaporation ponds may be modified to identify mitigation needs. The protocols include construction and operation of “alternative habitat” to effectively dilute contaminant exposure at evaporation facilities. This approach works on the premise that the provision of clean habitat near already attractive (yet contaminated) habitats can serve to draw birds away from exposure and contaminant risk as long as the contaminated site is also made to be less attractive. Additionally, a compensation habitat protocol has been developed to mitigate for wildlife losses that could not be eliminated via practical avoidance or minimization measures (i.e., losses that accrue despite the provision of alternative habitat). A combination of these two approaches was proposed in the SLDFR EIS and ROD for several at-risk species and can be modified to address needs at IFDM sites.

Presumably, habitat attractiveness to aquatic birds of the sites in question is already significantly reduced due to lack of extensive surface ponding. Therefore, for purposes of mitigating potential harmful effects from wildlife contaminant exposure at reuse and drainwater disposal facilities as part of the proposed drainage plan, we believe initial mitigation provisions should be based on a modified “compensation” model, with facilities located remotely from drainwater treatment and disposal sites. Specifics of location are then more dependent upon practical considerations of availability and accessibility for conveyance of necessary volumes of clean, fresh water to these sites, considerations related to the existing groundwater quality, and amenable soil properties.

Size

Facilities should be sized according to compensatory ratios defined by appropriate mitigation protocols or adaptations from these existing protocols (see appendices). These are based upon the degree of contamination and extent of wildlife exposure. For purposes of planning and management efficiency, BOR designed their mitigation habitat within the SLDFR Feasibility Analysis into 80 acre management units. Final mitigation acreages were then projected such that prescribed mitigation acreages would be provided in the lowest multiple of 80 acre that included the necessary acreage prescription. For example, if 212 acres of habitat were prescribed by the risk models, 240 acres (3 management unit blocks) of mitigation habitat would be constructed and maintained.

Design and Management

Mitigation habitats should be designed to maximize attractiveness and utility (habitat quality) for impacted species. For aquatic bird species, this typically requires appropriate grading to create habitat features that maintain productivity and suitability as substrate for foraging, nesting, and roosting. In addition, maintenance of these sites generally entails vegetation management (enhancing desirable vegetation and minimizing or eradicating invasives) through appropriate means. In the circumstance that unintended negative effects are documented in taxa other than aquatic birds, appropriate mitigation habitat for these species would have to be designed and constructed. Alternatively, certain species may be compensated through existing mitigation banks, and this avenue of remedy is also open for consideration in such circumstances.

Influent Quality and Volume

Ponded water used for mitigation cannot exceed 2 parts per billion selenium concentration. This is consistent with guidelines for Refuge water supply, and for evaporation pond mitigation habitats. Waterborne selenium concentrations in excess of this value would create habitat with its own attendant risk, and would therefore not be fully adequate as compensatory mitigation. This water quality requirement may have bearing on locations available for mitigation facilities.

4. Monitoring At Each Facility

Tiered Design

The monitoring system is designed to provide the stream of information needed to adaptively manage the drainage program to avoid, minimize, and mitigate for adverse effects on human health, wildlife, and agriculture.

Compliance Based

Clear regulatory and goal based targets will be used to identify and focus monitoring needs. These targets can also function as triggers for additional monitoring such as effects of contaminants on specific resources that are documented as being at increased risk.

Adaptive Monitoring Based on Results over Time

To minimize the cost of the monitoring system while ensuring its effectiveness, the monitoring system itself should be adaptive and compliance-based. That is, as long as the system operates properly, as confirmed by basic monitoring of the physical functioning of the system, relatively little monitoring will be required. However, if some aspect of the system fails to meet specified design criteria in any way that could place human or wildlife health at risk, then additional monitoring may be triggered in order to ascertain the extent of that risk. For example, the system will be designed with the objective of precluding exposure of wildlife to drainwater that openly flows or ponds long enough to develop an aquatic food chain, as per current laws and regulations. If basic monitoring reveals openly flowing or ponded drainwater, then more intensive monitoring may be triggered to determine whether the open drainwater develops a community of aquatic organisms that could be eaten by wildlife and whether any wildlife have access to the exposed drainwater. If the additional monitoring indicates that any wildlife are exposed to such aquatic food, then further monitoring should be triggered to assess whether any exposed wildlife assimilates enough contaminants to place them at risk.

Clear Implementation Schedule

A clear implementation schedule for each component of the drainage project is needed to design and implement appropriate monitoring. Although basic monitoring needs will be similar across many of the components (e.g. drift monitoring at solar evaporators) some site specific conditions may require monitoring at greater frequency or on a larger scale. Also, monitoring must be initiated before operation to establish baseline conditions (for example, soil and groundwater). The monitoring schedule itself must be clearly identified to avoid confusion and to assure that the data collected is useful for the purposes intended.

Parameters to Monitor

Flow

Flows of drainwater at various stages of the drainage management program should be monitored to track the physical functioning of the system and for management efficiency. Comparison of flow measurements at input and output may be used to detect leaks in drainwater conveyance systems. Flow measurements are also vital for tracking loads of contaminants at various stages in the system. Drainwater that is unaccounted for may indicate an unexpected loss of contaminants to the environment.

Selenium

Selenium is a primary contaminant of concern in agricultural drainwater in the west side of the San Joaquin Valley. While small amounts of selenium are essential to animals, higher dietary intakes of selenium are toxic. Concentrations of selenium in subsurface agricultural drainwater in the San Joaquin Valley may be high enough to cause immunosuppression, spinal malformations, impaired growth, and death in fish; loss of feathers in adult birds; and embryonic malformations and failure to hatch in developing birds.

Salt/Total Dissolved Solids (TDS)

The “salt” or “salinity” in subsurface agricultural drainwater is not entirely, nor even principally, the familiar form of salt (sodium chloride) that is the principal ingredient of common table salt. Rather, it is a mixture of ions, including those of calcium, magnesium, bicarbonate, sulfate, and selenate. Total dissolved solids (TDS) is a comprehensive measure of all the constituents dissolved in a water sample. Salt in groundwater seepage or deposited as drift from the spray of solar evaporators may accumulate and raise the salinity of surface waters above the levels that can be tolerated by sensitive vegetation and wildlife that are adapted to less saline conditions. Visible salt encrustation problems with wildlife may require monitoring.

Boron

Agricultural subsurface drainwater from the serviced agricultural lands is characterized by elevated concentrations of boron, which at sufficiently high levels can be toxic to wildlife as well as to agricultural crops.

Mercury

Natural sources of mercury occur in the Coastal Range of California. Much of the agricultural land to be served by the proposed drainage management system lies in the "Panoche fan," a region of alluvium deposited by Panoche Creek. The New Idria mercury mine, operated in the Panoche Creek watershed until 1972, has resulted in mercury contamination of the soils of the Panoche fan, and is possibly the root source of elevated mercury levels in water and fish sampled in Mud Slough and the San Joaquin River. The San Joaquin Valley Drainage Program identified mercury as a substance of concern that warrants further attention (Moore et al., 1990). Elevated concentrations of vanadium, chromium, and mercury have also been observed in the shallow groundwater in the San Luis Unit (Deverel et al. 1984 cited in USBR 2005). Water quality sampling of the Delta Mendota Canal (DMC) sumps (along the Delta Mendota Canal in the Firebaugh Canal Water District) from 2002 through 2007 by BOR for total mercury has documented significantly elevated concentrations of total mercury (range 200 ng/L to 3,000 ng/L) in the sump water currently being pumped into the Delta Mendota Canal (USBR, April 2007).

Molybdenum

Subsurface agricultural drainwater in the service area has high levels of molybdenum, which is recognized as a contaminant of concern and regulated by the Regional Board.

Minerals

The constituents listed above are known to be present in subsurface drainwater in the service area at concentrations elevated to the point that wildlife are potentially at risk. While no such risk is currently known due to other minerals, the unprecedented concentration of large quantities of drainwater in this management system may elevate the levels of other metals above thresholds of significant risk. Therefore a comprehensive monitoring program should include testing for a suite of metals and trace elements in addition to selenium, mercury, boron, and molybdenum.

Electrical Conductivity

The electrical conductivity (EC) of water is directly proportional to the concentration of ions in the water, that is, the TDS, or salinity of the water. If the relative proportions of drainwater constituents are known and are demonstrated to remain approximately constant, then monitoring EC may provide a quick, inexpensive, and convenient way to estimate the concentration of each of these constituents as well as a means of measuring the salinity or TDS of the water.

Others

A large number of chemicals used in agriculture could contaminate subsurface drainwater. These include fertilizers, herbicides and other pesticides. Three-species toxicity testing of subsurface agricultural drainwater in the northerly portion of the service area (Grassland Bypass Project) has revealed frequent instances of unexplained toxicity not attributable to selenium, boron, or mercury. These toxic episodes may be caused by agricultural chemicals applied to the fields and seeping into drainwater. Therefore a comprehensive monitoring program should include toxicity testing of any subsurface drainwater that reaches the surface in an uncontrolled manner and poses a risk to humans or wildlife.

Matrixes to Monitor

Surface Water

Any water that is flowing or is ponding on the surface of the land may quickly develop an aquatic ecosystem and has the potential to assimilate contaminants in the water and pass those contaminants on to terrestrial wildlife that eat aquatic organisms. Therefore, surface water, in its various forms (e.g. field ponding, open drains, sheet flow, holding basins, seepage) associated with the drainage system is a key matrix to monitor.

Groundwater

Groundwater represents an important potential route of escape of concentrated drainwater from the drainage management system. Plans call for using the shallow groundwater system beneath each reuse area as a reservoir for storage of concentrated drainwater (USBR 2006 p. 2-11). The downward and lateral movement of concentrated shallow groundwater and leaching of soil salts and associated trace elements such as selenium, molybdenum and boron has caused deterioration of groundwater quality throughout the western San Joaquin Valley (e.g. Dubrovsky et al, 1993; Deverel and Fio, 1991). The depth of the affected groundwater is variable and dependent primarily on the ability of subsurface sediment deposits to store and transmit water and drainage and irrigation practices. Shallow groundwater and drainwater stored beneath the reuse facilities can potentially move laterally and vertically within the groundwater system. Lateral movement can potentially seep into nearby surface water features or affect vegetation growing on adjacent lands. The downward migration of groundwater and dissolved constituents can impact water quality and potential beneficial uses of deeper aquifers relied on for irrigation and drinking water supplies. Monitoring will also identify when an existing or potential beneficial use impairment is imminent. A conceptual groundwater monitoring plan is found in Appendix G.

Drainage Water

To alert managers to malfunctions, leaks, and other releases of drainwater to the environment, drainwater should be monitored in real time as it passes through the drainwater management system.

Product Water

Relatively high-quality product water that passes through the reverse osmosis (RO) treatment system must be tested regularly to monitor the integrity of the RO system and confirm the suitability of the water for irrigation. In addition to residual drainwater contaminants, product water could contain residues of various chemicals added to the drainwater stream (anticoagulants, antiscalants, biocides).

Brine

The stream of concentrate (brine) from the RO system should be monitored to track contaminants of concern, especially selenium, through the system as part of normal operations and per current laws and regulations.

Treatment Sludge

Particles removed from the drainwater stream by the RO pretreatment filtration and flushing sludge removed during the selenium biotreatment should be tested before disposal in a suitable site as per current laws and regulations.

Crops/Vegetation

Vegetation and crops may be adversely affected by some of the constituents of subsurface agricultural drainwater (such as boron), and they are also at the base of the food webs that concentrate and pass on contaminants to higher trophic levels (animals that eat the vegetation, animals that eat the herbivorous animals, etc.).

The consumption of vegetation and crops by humans, livestock, or wildlife is not known to be an important route of exposure to the toxic constituents of drainwater; however, there is no precedent for the use of concentrated drainwater for cultivation of crops and forage on the scale of this drainwater management program. There may be unanticipated risks to animals (including humans) that eat these crops and vegetation; therefore, periodic monitoring of contaminant concentrations (primarily selenium) in vegetation and crops would be appropriate. In the Service's biological opinion for the Grassland Bypass Project (the operation of the reuse area) and the CVPIA Land Retirement Program we recommended vegetation monitoring as an appropriate first tier monitoring effort.

Sediment

Any sediment that accumulates in drainwater conveyances, reuse, or treatment units within the system should be monitored to determine suitability for retention on site or transport to an appropriate off-site disposal location.

Soil

Soil should be tested periodically in the serviced agricultural fields, the reuse areas, and in the lands surrounding the solar evaporators to ensure that soils are not degraded unacceptably by the drainwater management system.

Salt Crust

The salt crust that accumulates in the solar evaporators should be tested periodically to monitor the fates of salts, selenium, and other contaminants in the drainwater stream. In addition the salt crust should be checked for the presence of salt tolerant organisms that could feed into a local wildlife foodchain (Figure 9).

Figure 9. Brine fly pupae under salt crust at a solar evaporator provide a toxic food source for shorebirds. (Photo by A. Toto, CVRWQCB)

Air

Air downwind of the solar evaporators should be tested for appropriate constituents of concern to ensure compliance with applicable air quality standards under regulatory guidance from air quality agencies.

Invertebrates

Some sensitive invertebrates may be harmed by direct exposure to the constituents of agricultural subsurface drainwater, or by feeding on plant material that grows in the drainwater. Other, more tolerant invertebrates may themselves survive assimilation of high levels of contaminants from agricultural drainwater, but may serve as conduits or pathways of contaminant exposure for any wildlife that feeds on the invertebrates. Invertebrate monitoring is an appropriate first tier monitoring effort.

Reptiles and Amphibians

The effects of subsurface agricultural drainwater on reptiles and amphibians are largely unknown. However, birds, as closely related descendents of reptiles (and ultimately descendents of amphibians), are among the wildlife most sensitive to some of the constituents (such as selenium) of drainwater. Therefore, reptiles and amphibians may be vulnerable to the contaminants in drainwater. Amphibians may be particularly vulnerable because they can absorb these contaminants through their skin in addition to assimilating them from the food they eat. The service area of this project constitutes a sizeable portion of the last remaining range of an endangered reptile, the blunt-nosed leopard lizard. Given the very high concentrations of contaminants in the drainage and the size of the facilities, potential presence of reptiles and amphibians at the facilities should warrant including them as part of a tiered monitoring effort.

Mammals

Any mammal may be at risk if it feeds on aquatic or terrestrial food webs that become contaminated as a result of releases of drainwater into the environment at any stage of the drainage treatment and disposal system. Mammal presence at the facilities should warrant including them as part of a tiered monitoring effort as appropriate.

Birds

Birds are known to be particularly vulnerable to adverse effects of some components of subsurface agricultural drainwater in the western San Joaquin Valley, in particular selenium. Standing water in the semi-arid climate of the San Joaquin Valley is very attractive to shorebirds, thus putting them at high risk of exposure should there be ponding of drainwater. Shorebirds and wading birds also utilize open drainage and delivery systems. Although very narrow, the length of these systems (potentially hundreds of miles) provides a large amount of habitat. Birds are also attracted to the upland and forestry components of the drainage management system (Figure 10).

Figure 10. Black-necked stilt nest in salt tolerant grass on an IFDM site. (Photo by J. Vance)

Primary Agricultural Lands

Subsurface Drainwater Quantity and Quality

As a tool for managing drainwater and to monitor the integrity of the closed conveyance system, the quantity and quality (constituents) of subsurface drainwater must be systematically measured on the farms at the points where the drainwater enters the system that conveys it to the reuse areas. Shallow groundwater levels would also be useful to predict changes in the timing and volume of drainage ultimately requiring treatment.

Reuse Areas

Influent

Systematic measurement of flow and concentrations of constituents in the drainwater entering the reuse areas is important for managing the drainwater, monitoring the integrity of the closed drainwater conveyance system, for assessing the efficiency of the reuse areas, and for tracking loads of key constituents such as salt, selenium and mercury. This will ensure that these contaminants do not escape into the environment in ways and in quantities that could put humans or wildlife at unacceptable levels of risk.

Groundwater

The likelihood of infiltration of concentrated drainwater into local and regional groundwater is great enough to warrant careful monitoring and regulatory enforcement, especially given the uncertainties associated with scaling the reuse areas and the solar evaporator technology to the size needed to evaporate the expected volume of drainwater. Groundwater monitoring is necessary to insure that such infiltration does not degrade groundwater to an extent that would cause harm to humans, wildlife, or crops on adjacent lands. These data are also needed for overall drainwater management in the reuse system. A conceptual groundwater monitoring plan is found in Appendix G.

Downward rates of movement vary spatially depending on land use, water management practices and the ability of subsurface sediment deposits to store and transmit water. Belitz and Phillips (1995) estimated average downward movement at about 0.64 foot per year in the western Valley. Horizontal rates of movement range from a few feet to several tens of feet per year. The altitude of the shallow water table within drainage impaired areas is influenced by upslope recharge and groundwater pumping from above and below the Corcoran Clay (Belitz and Phillips, 1995). Because horizontal and vertical groundwater velocities are small (on the order of 1 foot to several 10's of feet per year), concentration changes due to operation of the reuse and evaporation facilities may be observed years or even decades after the initiation of operations. To characterize these changes, continuous monitoring with sufficient wells to effectively represent the spatial variability and additional information is required to provide indication of the arrival of water from the facilities at the well. Additional information can include isotopes of oxygen and hydrogen and groundwater age dating to provide information about the source and timing of groundwater recharge and time-of-travel between monitoring locations. Also physical measurements of hydraulic gradients and subsurface transmissivity can provide additional physical support for the chemical observations.

Surface Ponding

At the reuse facilities the highly concentrated subsurface agricultural drainwater poses a particularly acute threat to wildlife when the water is exposed on the surface of the land, either as flowing or ponded water. Such exposed water quickly develops a population of aquatic life that assimilates and concentrates toxic contaminants and serves as an attractive food source for birds and other terrestrial animals, which may be adversely affected.

Soil

The reuse areas of this project comprise by far the world's largest and most intensive experiment in applying concentrated subsurface drainwater to surface soil. The toxicological consequences are unknown, but food chains based on soil organisms could be at risk. For example, American robins (*Turdus migratorious*) feed to a large extent on soil-dwelling worms. Any worms that may survive in the saline soils of the reuse area may concentrate selenium, mercury or other contaminants to levels that could adversely affect reproductive success in local breeding robin populations or the ability of wintering robins to complete their migration to breeding grounds, or adversely affect their reproduction once robins reach their breeding grounds. Soils and soil-dwelling organisms should be included in a tiered monitoring effort to determine concentrations of these contaminants.

Wildlife Use

Wildlife may be adversely affected by contaminants in the reuse areas only to the extent that wildlife actually uses these areas. Such use may involve living and breeding in the reuse areas, or visiting these areas to forage for food and water as transients or on migration. Monitoring the presence of wildlife in the reuse areas is an important component of a tiered, adaptive monitoring program. Once the presence of wildlife has been ascertained, it must be assumed that the wildlife are at risk of exposure to drainwater contaminants unless subsequent monitoring conclusively demonstrates otherwise. Wildlife exposure triggers either direct or indirect assessment of the extent of adverse effects on the wildlife.

Wildlife Impacts

Monitoring and eliminating or minimizing adverse effects on wildlife is a condition for acceptability of the drainage management system. Directly measuring all the potential adverse effects of each contaminant on all wildlife that use the reuse areas would be difficult, expensive, and probably not practical. In the tiered monitoring program wildlife impacts would be monitored if previous water, food chain, and wildlife use results identify a high risk of exposure. Monitoring of wildlife impacts can include tissue sampling (eggs, blood, liver), measuring reproductive success, or evaluating more subtle effects such as predator avoidance or courtship behavior. To the extent that direct measurements of these effects are not practical, then measurements can be made of the contaminant concentrations in the tissues of the wildlife, and estimates can be made of the risk of likely effects, based on available toxicity data.

Crops/Vegetation

As noted above, measurement of contaminant levels in the crops and other vegetation grown in the reuse areas is appropriate to assess the risks posed by use of the crops for human consumption or as livestock fodder, and the risks to wildlife that may feed within these crops or reuse areas.

Groundwater Pumping Program

Any groundwater pumping program directly or indirectly associated with the drainwater management system (e.g. pumped groundwater sold to support costs of the system or to manage drainage) should be monitored to ensure that the pumping program does not adversely affect the quality and quantity of water in the aquifer from which the water is pumped, to ensure that the pumping program does not cause unacceptable land subsidence, and to ensure that the pumped water remains of sufficient quality for the purposes for which it is delivered.

A groundwater pumping program has been proposed in the Northerly Area as discussed previously. Monitoring of groundwater quality and quantity is important for the assessment of potential impacts to the deeper aquifer in the Northerly Area and the quality and quantity of water in the Main Canal and Grassland Area channels where the pumped groundwater will be discharged.

Reverse Osmosis

To monitor the effectiveness of the reverse osmosis process, the quantity and quality of the influent and effluent streams must be systematically measured. The effluent will comprise separate streams of filtered product water and concentrate; both effluent streams should be monitored. Other chemicals used in the RO process may need to be tracked and properly disposed of as part of a sound hazardous material handling program.

Selenium Biotreatment

To monitor the effectiveness of selenium biotreatment, the quantity and quality of the influent and effluent streams must be systematically measured. Because there are indications that selenium biotreatment, while reducing total selenium, may effectively convert the remaining selenium to a more bioavailable form that is more dangerous to wildlife, speciation of selenium (the different forms of selenium) must be monitored in the influent and effluent streams. Selenium speciation should be monitored if an oxidation process is added to convert the selenium to a less bioavailable form. Similarly, at least initially it may be necessary to monitor methylmercury as well as total mercury in the influent and effluent streams, to test whether mercury may be methylated (converted into the more biologically available and dangerous methylmercury form) by the biotreatment process. Other chemicals used in the RO process may need to be tracked and properly disposed of as part of a sound hazardous material handling program.

Solar Evaporators

Groundwater

The drainwater circulating in solar evaporators will be extremely concentrated with respect to potentially toxic constituents. Any lining underlying the evaporators may develop leaks, and any subsurface drainage system may not be entirely effective at intercepting concentrated drainwater before it reaches the water table. As previously discussed in Chapter 3, there is a continuously saturated water column from the water table downwards past the Corcoran Clay. Although the Corcoran layer has relatively low permeability to water, this geological feature does not completely isolate deeper high quality groundwater from lower quality “perched” groundwater. Proposed drainwater management may concentrate and transfer groundwater contamination to down-slope locations that are closer to sensitive wetlands and closer to river courses. Therefore, both perched and deeper groundwater are potentially at risk of degradation, although, it is noted that the deeper sub Corcoran groundwater is at lower risk.

The design, operation, and closure of the facility must meet the requirements set forth in California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950. These regulations require groundwater monitoring (including preproject baseline) in the vicinity of the solar evaporators to ensure that unacceptable amounts of drainwater do not contaminate regional groundwater resources.

Surface Water/Ponding

As previously noted, current laws and regulations allow for some standing water (1 cm for up to 48 hours) within solar evaporators. As salt builds up in the solar evaporators, it may prove more difficult to keep the constantly accumulating salt covered with gravel and avoid pooling. If the rain of sprayed concentrated drainwater (or natural rain itself) erodes the layers of salt to form puddles on the surface of the crystallized salt, wildlife may be endangered. In addition, as per current regulations, any trough or storage structure used for collecting and recirculating the spray runoff must be covered, netted, or enclosed to ensure that birds are not exposed to the water.

Salt Crust

There are several reasons why salt crust should be monitored. Although the surface of a solar evaporator may appear devoid of life some invertebrates such as brine flies can survive under the crust in moist conditions. This can be an attractive food source to many bird species. Therefore, the salt crust must be periodically monitored for any potential food sources.

Salt samples should be taken to determine concentrations and mass of salts to determine the mass balance of key constituents, evaluate applicability of alternative uses for the salt, or to assess potential hazards for disposal. This may also help in assessing drift.

The salt crust itself may prove to be an attractive hazard to some wildlife. Various species of wildlife, including ungulates and some birds, are attracted to crystalline salt as a dietary supplement under some circumstances. While such behavior is less likely in the salt-rich western San Joaquin Valley than it is in areas that are deficient in certain essential minerals, the possibility of such wildlife exposure suggests that periodic monitoring of the constituents of the salt crust to be appropriate.

Drift

Wind-carried drift of mist from solar evaporators potentially represents a major pathway of escape of concentrated drainwater contaminants into the environment (see previous discussion in Chapter 3). Although barriers can be used to reduce the amount of drift, a full scale system has yet to be designed and tested. Over time, even a small percentage drift can lead to large volumes of salts and contaminants building up off-site making them available to soil organisms, surface ponding in the winter or during irrigation of crops, surface runoff, and groundwater contamination. This drift should be carefully monitored.

The total estimated deposit within and outside of the evaporators can be compared with the evaporator influent load to provide a check and calibration of the sampling and modeling method. Although the influent and deposited loads of salt are expected to be closely in balance, if selenium volatilizes appreciably, then selenium loads will not be similarly in balance. Therefore, the samples of drift deposit should be analyzed for selenium, and the proportion of selenium in the captured drift can be compared to that in the influent drainwater to calculate the amount of selenium that is volatilized.

Wildlife Use

In generally arid areas, such as the west side of the San Joaquin Valley, wildlife (especially birds) tend to be attracted to water, even sprayed water. Brine flies surviving under the salt crust may also attract wildlife. Living drift barriers such as shrubs and trees will attract wildlife thus exposing them to high salt and selenium concentrations. Wildlife use of the solar evaporators (including drift barriers) must be minimized, and the solar evaporators must be regularly checked for the presence of wildlife to monitor the effectiveness of the exclusion measures and to assess exposure risks.

Wildlife Impacts

To the extent that wildlife are found to frequent the solar evaporators and the surrounding region that experiences appreciable fallout of salt from spray drift, wildlife must be monitored for the potential effects of exposure to the contaminants of concern. These effects may include mortality, as well as impairment of reproduction, development, predator avoidance, foraging ability, body condition, and health. To the extent that direct measurements of these effects are not practical, then measurements should be made of the contaminant concentrations in the tissues of the wildlife, and estimates can be made of the risk of likely effects, based on available toxicity data.

Storm Events

During storm events it is appropriate to monitor ponding, runoff, and potential facility overflow or inundation to avoid exposure to wildlife or release of contaminated water from the site. Overland storm flows may pose a particularly acute danger to wildlife if those flows inundate and overflow reuse areas and evaporation facilities. Therefore these facilities must be closely monitored during and after storm events to ensure that such overflow does not occur. If overflow does occur, the overflow water should be closely tracked and tested for contaminant concentrations for the purpose of enabling immediate corrective action and prompt compensatory management. The extent of ponding or overflow as well as duration needs to be documented. Wildlife use of ponded areas, drains, sumps, or overflow areas should be monitored to assess potential exposure. Actions to minimize impacts to wildlife must be implemented. Depending on severity, duration, and level of wildlife use, additional monitoring for potential effects to wildlife may be needed.

San Joaquin River and Fresno Slough

The San Joaquin River flows along the northeast edge of the project area while Fresno Slough flows northward along the eastern boundary of the project area and connects to the river at Mendota, CA. Although the Northerly Area discharges and drainage management facilities are most likely to affect water quality in the river, the WWD northern treatment facility is located close to Fresno Slough. Concentrated subsurface drainwater may escape from these facilities via seepage into, and lateral down gradient movement of, groundwater; overland flow of storm water; and wind-carried drift of spray from the solar evaporators. This escaped drainwater may be discharged or deposited directly into the San Joaquin River or into the watershed of the River from where it may be subsequently washed into the River. The San Joaquin River is already impaired with respect to constituents of subsurface drainwater, including selenium, salt, and boron. Further degradation of the river would be a violation of the Clean Water Act (CWA). Compliance with the CWA will become increasingly important as the San Joaquin River is restored and contaminant-sensitive salmonids are reintroduced to the river. The most cost effective way to ensure compliance with the CWA would be to monitor loads of regulated contaminants (selenium, salt, and boron) in the San Joaquin River just upstream and downstream of the reach of the river that passes by the agricultural area serviced by this drainage management plan. Such monitoring is likely already performed by the Regional Board or other entities as part of a regional water quality program or irrigated lands waiver monitoring program.

Grassland Bypass

The Northerly Area currently has an extensive drainage monitoring program. The Grassland Bypass Project has been monitoring water, sediment, invertebrates, fish, and bird eggs for over 10 years at key locations in the drainage system, Mud Slough, Salt Slough, and the San Joaquin River. We do not propose any changes to this particular monitoring program; however, this proposed monitoring plan could cover any additional treatment or drainage management systems that may be added to the Northerly Area. The details of the Grassland Bypass Project monitoring program are found in Appendix B.

Mitigation

Where wildlife impacts can not be fully avoided mitigation may be appropriate. Mitigation habitat should be free of selenium and other contaminants, attractive to wildlife, and fully meet mitigation protocols and expectations. Therefore, monitoring of mitigation habitat is appropriate. As with other monitoring, a tiered process can be used. If initial monitoring results are favorable no additional monitoring (e.g. effects) is needed and the level of monitoring may be reduced.

Influent Quality and Volumes

Systematic measurement of flow and concentrations of constituents in the supply water to mitigation sites is important for assessing the quality of the habitat provided.

Fish and Wildlife Use

Documentation of wildlife use is important for confirming the success of mitigation and whether the habitat fully meets requirements under mitigation protocols or other identified goals.

Fish and Wildlife Impacts

Although wildlife may be using clean mitigation habitat they may still be using reuse, drift, or other areas where they may be exposed to selenium or other contaminants. Initial monitoring of contaminants in wildlife such as birds is appropriate to assure the mitigation habitat is fully meeting the requirements under mitigation protocols or other identified goals.

5. Reporting

Regulatory Compliance Documentation

Regulatory reporting should be done as required under current laws and regulations by the regulatory agencies. These reports can be used or incorporated via use of appendices into quarterly or final reports for the drainage monitoring and compliance plan.

Annual Reports

Annual reports on all monitoring results for the calendar year should include an introduction, as well as individual chapters containing methods, results and discussion for each monitoring component (surface water, sediment, reuse areas, treatment facilities, solar evaporators). The Grassland Bypass Project annual reports provide an excellent example of such a report format (http://www.sfei.org/grassland/reports/gbppdfs.htm). Important in the discussion are significant results such as triggers or goals reached, changes from the norm, problems encountered, how those problems were/should be addressed, recommendations for changes in monitoring, and recommendations for management actions that could be taken to address issues identified.

Quarterly Reports

Quarterly reports should be provided for those things being monitored on a more frequent basis, such as surface water, drainwater, influent/effluent water, and wildlife use.

Emergency Situations

Should monitoring show significant changes or elevated levels of contaminants that pose an immediate risk to humans or wildlife, an emergency reporting system will alert key stakeholders so that appropriate actions can be taken. Problems arising from storm events, operator error, or equipment malfunction must be reported in a timely fashion so that response actions can be quickly evaluated and implemented. Contingency plans should address these emergency alert situations.

Real-Time Data on Website

It may be appropriate to develop a real-time data recording and dissemination system that would be available to stakeholders on-line. As the monitoring and contingency plan is developed those data that are appropriate and can be provided in a cost efficient manner can be evaluated for a real-time program.

6. Performance Goals and Triggers

Compliance should be based on agreed upon goals and triggers and requirements of existing laws and regulations. Current regulatory guidelines and permitting processes will identify specific performance goals or triggers where mandatory regulatory actions would be taken. In general, the adaptive management process would be utilized to prevent reaching these more definitive regulatory penalties mandated by law. Additional goals or triggers can be developed within an adaptive management process to set in motion actions to avoid tripping the regulatory objectives so that mandatory compliance actions or penalties are not issued.

Performance goals constitute standards by which best management practices at treatment and disposal facilities shall be evaluated. To the greatest practical extent, these should be explicit, tangible quantitative standards. They will likely be a combination of current regulatory standards and other goals developed through time as the drainage management and monitoring plans are fully developed. These goals must be based on sound science and a clearly articulated rationale. Examples of some of these goals are: zero incidences of standing water; no redistribution and resuspension of contaminants beyond controlled and isolated facilities; removal and containment of selenium from waste stream through pretreatment to yield 10 ppb or less as selenate; proper disposal of solid waste; and wildlife exposure at the facilities not exceeding background. The fundamental performance objective of the WWD Drainage Plan treatment and disposal facilities from a fish and wildlife resources perspective is no net take of fish and wildlife resources, and no take of threatened or endangered species.

As previously mentioned, this monitoring and compliance plan is based on a tiered approach. There are certain thresholds representing key decision points from which certain management or regulatory actions are prescribed—these are performance "*triggers*." These triggers will be based on sound science and a clearly articulated rationale. When monitoring indicates suboptimal system performance compared against predetermined triggers, one or more contingencies within the adaptive management process should be set in motion. Depending on the trigger, these contingencies may include mandatory regulatory penalties, adaptive measures in order to mitigate the problem at hand, additional monitoring to adequately assess the severity of the problem, and/or compensatory mitigation through provision of clean habitat. See Chapter 8 for a recommended oversight process.

Within an adaptive management context, some of these triggers may be compound, or flexible—as one event itself in a chain of causality does not necessarily lead to measurable (biologically significant) subsequent events. Triggers would be based on established monitoring intensity. These, in turn, would initiate one of three options (not exclusive): more intense monitoring, appropriate adaptive management measures, and/or mitigation requirements to compensate for effects to wildlife or other resources.

A three strikes concept could be considered as a final factor in an ultimate decision to apply the most restrictive actions such as increased land retirement, sump closure, facility closure, or to consider breach of the associated settlement contract. However, compliance with regulatory requirements is mandatory and enforcement action can be taken at any time the facility is determined to be out of compliance by the appropriate regulatory agency.

Under a three strikes concept, in the event that defined triggers are tripped (regulatory or otherwise), additional monitoring confirms wildlife risk, exposure, or effects, and adaptive management measures prove unsuccessful, the treatment and disposal facility can be found to be out of compliance. If a facility is found to be out of compliance for an appropriate period of time such as three of five consecutive years, this would constitute unsatisfactory performance and the facility must execute closure plans. This contingency for closure should include provisions and measures consistent with the overall site closure plans and regulations (see Chapter 7). Failure to close a given site after three strikes against compliance as determined by the oversight committee could represent an action constituting breach of the associated settlement contract.

Adaptive Management Actions

The adaptive management process as described in Chapter 2 allows flexibility in operations and management to reach environmental and other compliance goals. For selenium and many other contaminants not every exposure pathway is complete, not every exposure creates negative effects, many site variables impact the level of risk, and there are many unknowns with regard to scaling up many of the management and treatment systems; thus, a tiered monitoring effort and adaptive management is appropriate. For example, if ponded water with high selenium concentrations occurs, there are several actions that can be taken to remediate the problem. Depending on the situation these may include: improved treatment performance, additional disposal basins or associated tiling and catchments, reduced source loading through land retirement, and additional mitigation to compensate for effects of the ponding. Contingency plans can address many of the anticipate problems and the interagency technical advisory team can offer suggestions to the facility managers to best address the issue of compliance. The specific remedy to an observed problem is probably best approached on a case-by-case basis.

Within the adaptive management framework, current regulatory guidelines and permitting processes will identify specific performance goals or triggers where mandatory regulatory actions would be taken. In the eventual circumstance that remedies and regulatory actions cannot be employed to avoid wildlife exposure to elevated concentrations of drainwater contaminants, including in the event that compensatory mitigation is not or cannot be provided in an appropriate ratio to balance net demographic impacts of the operation of the treatment and disposal facilities, the facility could be found to be out of compliance for that particular annual cycle and could constitute a breach of the associated settlement contract.

Groundwater

Primary concerns for groundwater center around the issue of transport of seleniferous groundwater and potential contamination of local waterways and deeper aquifers. High groundwater levels can also result in downslope ponding of shallow groundwater and surface pooling of contaminated drainwater that can increase exposure to wildlife. Compliance triggers for groundwater are tripped in the event that facilities directly contribute to surface ponding (on or off-site) or elevated concentrations of constituents of concern in local waterways. Significant impacts to groundwater could constitute a strike against annual compliance. Current solar evaporator regulations require baseline and ongoing groundwater monitoring with Regional Board oversight.

Surface Water

The performance goal for treatment and disposal facilities with respect to surface water should be related to incidences of standing water for certain periods of time depending upon selenium concentrations. The concern in these instances is that such ponding or runoff leads to invertebrate, fish and other aquatic vertebrate exposure and effects. These criteria would apply to inadvertent pooling, as well as conveyance infrastructure (we are presuming that pipelines, not ditches, will be used to transport drainwater between facilities). Surface exposure through furrow irrigation would constitute a risk to aquatic birds and other wildlife and alternative irrigation methods should be considered.

Certain regulations apply to standing water in solar evaporators where mandatory regulatory actions would be taken. Regulations also require solar evaporator catchment basins to include some form of effective exclosure technology to preclude access by wildlife, as per current regulations.

Tiered monitoring triggers for surface water ponding may include: detailed monitoring to ascertain wildlife exposure. In effect, this monitoring would represent episodic, site-specific monitoring additional to the existing monitoring that would be in effect to establish ongoing wildlife exposure at the treatment and disposal facilities.

Chronic ponding and wildlife exposure problems could lead to a strike against annual compliance. "Chronic ponding" is ponding that occurs for a period longer than regulatory limits and/or occurs for a period of time sufficient for an aquatic food chain to develop that exposes wildlife to elevated levels of selenium or other hazards (e.g. salt encrustation). This may be one ponding event or multiple events over time.

Fish and Wildlife

Based upon the documented use of wildlife at IFDM sites and the proposed scale-up of these facilities (volumes of drainage and size of reuse areas and evaporators), the utilization of drainage treatment and disposal facilities by wildlife is probably inevitable. Anytime subsurface drain water comes to the surface there is the potential for wildlife exposure. The risks to wildlife from this potential exposure need to be evaluated to decide if any monitoring is appropriate. The degree of exposure to high selenium concentrations determines the risk each site poses to area wildlife, and consequently the need and/or urgency of applying appropriate mitigation measures through the adaptive management process. In general, exposure and effects can be estimated through direct measurement of the constituent of concern in fish and wildlife tissue. Exposure to elevated dietary selenium is an effect that will have to be mitigated through appropriate means.

The tiered monitoring triggers should include:

- more intensive monitoring of the extent of exposure through censuses or nest surveys when baseline monitoring reveals selenium concentrations in potential dietary items greater than levels considered to be harmful,
- effects monitoring if wildlife exposure is confirmed,
- and provision of mitigation habitat (via appropriate protocols) if and when food web concentrations exceed harmful levels and the extent of exposure is determined to be frequent or for long durations.

The various tiered monitoring and compliance triggers within the adaptive management framework of the Conceptual Monitoring Plan are presented in Figure 11. Details of specific goals, concern levels, and triggers will be identified as a detailed drainage plan is proposed and a detailed monitoring and compliance plan is developed. Chronic or significant wildlife exposure and effect problems could lead to a strike against annual compliance.

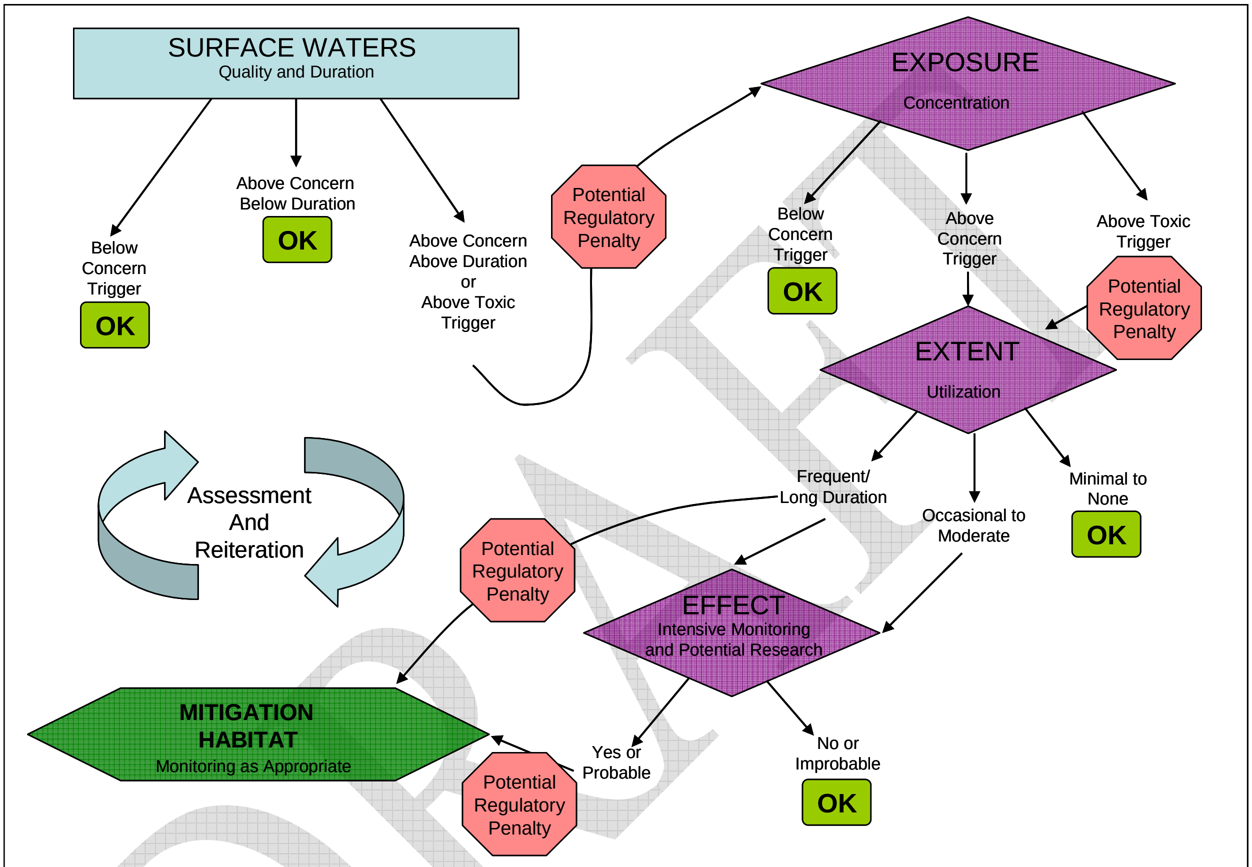


Figure 11. A conceptual decision tree for an adaptive management process addressing surface waters and wildlife exposure in general. Surface waters may include drains, sumps, ponding, catchment basins, runoff, overflows, sloughs, and rivers.

In the event that exposure to elevated concentrations of dietary selenium is documented in ranges known or suspected to be detrimental to wildlife resources, mitigation measures are initiated. These may include adjustments to system operation to minimize or avoid the risk, but will at the same time include compensatory mitigation in the amount determined through application of the modified Service mitigation protocols (where applicable), or in newly derived risk assessment models completed to address detrimental effects to species not currently covered by existing protocols (i.e., everything but aquatic birds). Compensatory mitigation should be implemented the immediate year following the documented exposure, and should remain in effect until other adaptive management measures ameliorate the exposure risk.

Endangered Species

The regulatory threshold for protection of threatened and endangered species is necessarily stricter. In these circumstances, mere presence forms presumption of use and exposure until proven otherwise. The initial trigger, beyond confirmation of presence, is greater intensity of observation. If presence persists, a contingency such as exclusion is prescribed where practical. Depending on the species under observation, perhaps a more detailed and thorough assessment of exposure can be conducted. In regards to compliance, documented exposure by an endangered species to selenium concentrations known to be hazardous to wildlife could constitute a strike against annual compliance in a three strike compliance system. An additional regulatory oversight comes into play with threatened and endangered species, and other measures, terms and conditions may be attached to this plan as incorporated through habitat conservation plans, safe harbor agreements, or biological opinions completed for each particular treatment and disposal site during the permitting phase.

Drift

A performance goal for drift of effluent from the selenium pre-treatment as it is disposed into solar evaporators is needed, but at this time do not have sufficient information to determine how best to define such a goal. The concern for this pathway is the creation of an air borne hazard (particulates), resuspension of drainwater contaminants, the potential re-ponding and exposure to aquatic birds, and exposure to upland habitat or that such upland habitat could serve as a depot for sheet runoff and contamination of local waterways during flood events. The consideration of a vegetated drift barrier creates an attractive habitat that will lead to wildlife exposure to the contaminants. Considering the high levels of salts, selenium, and boron as well as the volume of treatment water and the size of the facility, a “minimal” 1 percent drift offsite may lead to contamination of cropland, uplands, vegetation, and wildlife over time. Drift above the performance goal or wildlife effect trigger could constitute a strike against annual compliance.

Mitigation

Compensatory mitigation (as defined in USFWS protocols) has the objective of balancing the net demographic effect of a documented exposure/response with a benefit through provision of optimal (clean) habitat. The USFWS Compensation Habitat Protocol for evaporation basins is in Appendix H. The calculations within the protocols are explicit, and therefore compliance can be gauged quantitatively on an inter-annual basis, in a clear-cut fashion. Failure to provide adequate quantity and quality of mitigation habitats for documented losses at the reuse, treatment, and disposal facilities could constitute a strike against annual compliance.

7. Contingency Plans

Many problems associated with the operation and maintenance of an IFDM system can be predicted based on past experience form the many pilot programs conducted over the years. Key exposure pathways have been identified above, which if created or opened, represent events that require an action to resolve the problem. To the extent that these problems can be identified, appropriate contingency plans can be developed to provide drainage managers response options and guidance. With clear contingency plans response efforts can be more quickly implemented.

Regulatory Compliance

Contingency plans may be required as part of a regulatory compliance program as appropriate.

Resource Impacts

Contingency plans could be developed for individual resources that may be impacted. These include: endangered species, other fish and wildlife, groundwater, surface water, air resources, crops, and soil resources.

Ponding

A contingency plan for ponding resulting from regular operations of the facilities can be developed for each facility as site-specific consideration may be needed.

Storm Events

A contingency plan for ponding, runoff, and overflow resulting from storm events can be developed for each facility as site-specific consideration may be needed.

Mitigation

Contingency plans for mitigation sites may be needed.

Land Retirement

Contingency plans for lands being retired would be appropriate to address issues such as which lands are retired and when, dust control, and invasive species.

Closure Plans

Facility closure plans should be in place once the design lifetime or system capacity has been exhausted. It is anticipated that procedures for closure will be similar to those of drainwater evaporation ponds (WWD Nov, 2007) but would likely be developed under regulatory guidance and oversight by the Regional Board under California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950.

8. Oversight

The Grassland Bypass Project provides an excellent template for an oversight system that has proven successful over the past ten years of operation. Since it was designed to address monitoring and compliance for drainwater issues it has the potential to satisfy the needs of the WWD Drainage Plan. Lessons learned from the Grassland Bypass Project process should be incorporated into this new effort. A Memorandum of Agreement between the regulatory agencies and stakeholders should be developed to govern the implementation of the monitoring and compliance plan. Figure 12 shows how an oversight system might be designed for this program. The key components of the oversight program are described below.

Interagency Technical Advisory Team

The Interagency Technical Advisory Team (ITAT) designs and implements the monitoring program and prepares the annual reports. Different partners collect data appropriate to their expertise or regulatory association (e.g. the Service collects biota data; the Regional Board collects water quality data; the dischargers collect sediment, flow and other water quality data). Quarterly reports if needed are generally prepared by the entity collecting the data in collaboration with other partners as appropriate. Individual chapters of the annual reports are prepared by the entity collecting the data but are reviewed by all participants. Problems or other issues along with recommendations are forwarded to the next level team for evaluation and decision making. The ITAT is generally made up of agency staff and contractors representing the dischargers.

Interagency Management and Policy Review Team

The Interagency Management and Policy Review Team (IMPRT) reviews annual and quarterly reports and data to assure compliance with set goals and triggers. They also review policy and recommendations are submitted to the oversight committee for action. If the dischargers are out of compliance the IMPRT determines the appropriate action and makes their recommendation to the oversight committee. They also review and decide upon technical issues brought to them by the ITAT as needed. The IMPRT is generally made up of agency mid-level staff (e.g. senior staff, supervisors, and branch and division chiefs) and contractors representing the dischargers.

Oversight Committee

The oversight committee consists of federal and state agency heads or their representative (e.g. regional directors, state directors, executive officers). They review recommendations brought to them by the IMPRT and make final decisions on issuance of compliance fees, approval of significant changes to the program, and other appropriate actions. An oversight committee would meet once a year or as needed.

Joint Powers Authority

With the situation presented by the WWD Drainage Plan, a joint powers authority could be considered to provide the necessary oversight and authority to implement a monitoring and compliance program. Joint power authorities allow local governments the ability to efficiently deliver services and implement programs across common needs.

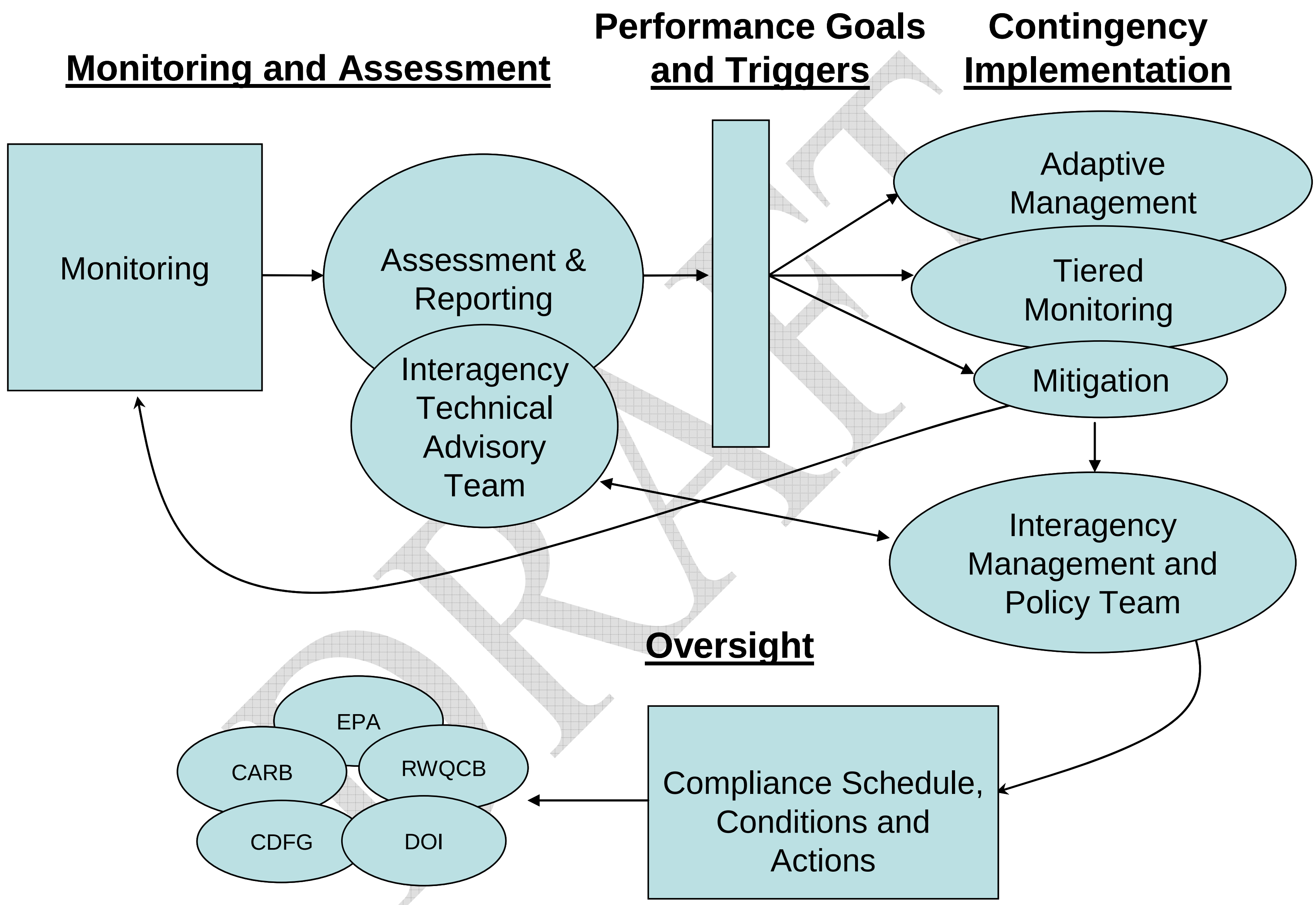


Figure 12. A conceptual diagram of an oversight system for a drainage monitoring and compliance program.

9. Roles and Responsibilities

This chapter summarizes primary regulatory, research or advisory roles and responsibilities of the primary stakeholders. Additional stakeholders, as well as final roles and responsibilities, would be determined during a later phase in the process as a detailed monitoring and compliance plan is developed.

Federal Agencies

U.S. Bureau of Reclamation

The BOR constructed and maintains federal dams and canals in 17 western states. Under the San Luis Act (1960), which authorized the supply of federal water to the San Luis Unit, the responsibility of constructing off-farm agricultural drainage infrastructure fell to the BOR. San Luis Unit farmers propose to assume this responsibility. The BOR has prepared an Environmental Impact Statement that analyzes options for treating and disposing of agricultural drainwater from the San Luis Unit. Final roles and responsibilities regarding San Luis Unit drainage issues will be determined in the settlement process and possibly in future legislation. USBR would likely participate in the oversight process.

U.S. Fish and Wildlife Service

The Service has authorities under the Fish and Wildlife Coordination Act, Migratory Bird Treaty Act and the Endangered Species Act that are relevant to potential impacts the drainage plan may have on Service trust resources.

The California Health and Safety Code, Section 25209.11 and Title 27, Article 9.7 Integrated On-Farm Drainage Management regulations specifically refer to coordination with state and federal resource agencies on appropriate monitoring and potential impacts to wildlife. However, the IFDM regulations only refer to the operation of the solar evaporators and do not address reuse areas which have the potential for contaminant exposure to wildlife. It is expected that the Regional Board would address potential impacts to resources from reuse areas via other appropriate state laws and regulations. Drainwater exposure to migratory birds and listed species at reuse areas is a concern for the Service.

It is the Service's expectation that WWD would implement the drainage plan consistent with the SLDFR FEIS and ROD. This includes appropriate monitoring and mitigation. The FEIS and ROD frequently refers to coordination with the Service on implementing monitoring and mitigation programs. Any recommendations by the Service will be consistent with recommendations we would provide to the BOR if they were implementing a drainage plan under the ROD. The Service would likely participate in the oversight process.

U.S. Geological Survey

The USGS is the federal agency primarily responsible for advancing water, earth and biological science. The USGS provides much of the scientific foundation for the policies and standards set by regulatory agencies. The USGS has a history of involvement in monitoring and research on the extent and effects of environmental contamination caused by agricultural drainwater in the

San Joaquin Valley as well as surface and groundwater monitoring. USGS would likely participate in the oversight process.

U.S. Environmental Protection Agency

The EPA develops and enforces regulations that implement federal environmental laws, including the Clean Water Act and the Clean Air Act. EPA establishes national standards for environmental contamination, but delegates to states and tribes the responsibility for issuing permits and for monitoring and enforcing compliance. EPA has a long-standing interest and involvement in agricultural drainwater contaminant issues in the area of the San Luis Unit. EPA would likely participate in the oversight process.

National Oceanic and Atmospheric Administration

The National Marine Fisheries Service program under the National Oceanic and Atmospheric Administration (NOAA Fisheries) protects marine resources via several regulatory authorities. Of most direct interest to drainage issues in the San Joaquin Valley are those laws and regulations addressing anadromous salmonids and sturgeon. These are the Magnuson Stevens Fishery Conservation and Management Act, the primary law governing marine fisheries; and the Endangered Species Act. The need for participation from NOAA Fisheries is anticipated to be minimal as most issues regarding salmonids and green sturgeon are addressed via the Grassland Bypass Project.

State Agencies

State Water Resources Control Board

The role of the SWRCB is to ensure the highest reasonable quality for waters of the State, while allocating those waters to achieve the optimum balance of beneficial uses. The SWRCB exercises its authority of water quality protection through nine Regional Water Quality Control Boards.

Central Valley Regional Water Quality Control Board

The Regional Board has regulatory responsibility for protecting the surface and groundwater resources of the Central Valley. Under the authority and mandate of the state Porter-Cologne Water Quality Act (sections 13240-13247) and the federal Clean Water Act (section 303) the Regional Board has developed and continues to amend and administer two "basin plans" applicable to the San Luis Unit Drainage Management plan. The basin plans consist of designated beneficial uses to be protected, water quality objectives for groundwater and surface water and an implementation program for meeting the objectives. The Regional Board regulates waste discharge by issuing Waste Discharge Permits that specify measures that must be taken and monitoring requirements that must be followed to assure that water quality is protected. In particular the Regional Board will administer California Health and Safety Code, Division 20, Chapter 6.5, Article 9.7, §25209.10-25209.19, and in Title 27 of the California Code of Regulations, Division 2, Subdivision 1, Chapter 7, Subchapter 6, §22900-22950 on solar evaporators as well as other laws and regulations for surface and groundwater protection associated with drainage management. The Regional Board would likely participate in the oversight process.

California Department of Fish and Game

The role of the California Department of Fish and Game (CDFG) is to manage and protect fish, wildlife, and plant resources, and the habitats upon which they depend in California. CDFG administers the California Endangered Species Act (CESA) which applies to species (and their habitats) that are listed by the state of California as threatened or endangered, including some species that are not federally listed. A state lead agency must consult with the CDFG during the CEQA process. CDFG also addresses stream alteration as well as other authorities under the California Fish and Game Code. In the San Joaquin Valley, the CDFG has a particular interest in protecting wildlife from agricultural drainwater contamination in state Wildlife Areas along the eastern and northern edges of the San Luis Unit. CDFG would likely participate in the oversight process.

California Department of Public Health

The California Department of Public Health (CDPH) has primary responsibility for protecting and improving the health of the people of California. The CDPH establishes health-based thresholds for contaminants and may issue warnings to consumers regarding consumption of potentially contaminated food or drink.

California Air Resources Board

The California Air Resources Board is the agency responsible for coordination and oversight of state and local air pollution control programs in California and for implementing the California Clean Air Act of 1988 (CCAA). The Federal Clean Air Act requires that the California Air Resources Board prepare an air quality control plan referred to as the State Implementation Plan (SIP) that contains the strategies and control measures that California will use to attain federal standards. The California Air Resources Board has also developed state air quality standards. The California standards for ozone and fine particulate matter (PM10) are generally more stringent than the federal standards.

<u>Local Agencies</u>

San Joaquin Valley Air Pollution Control District

The District has the primary responsibility for control of air pollution from sources other than motor vehicles and consumer products, which are the responsibility of the California Air Resources Board and EPA. San Joaquin Valley does not meet federal standards for ozone and particulate matter (PM10). The District is responsible for establishing the strategy and rules that the District will use to attain those standards. Therefore, the District has direct responsibility to ensure that emissions from solar evaporators or retired lands do not further degrade air quality in the San Joaquin Valley. The Air District would likely participate in the oversight process.

California Resource Conservation Districts

Resource Conservation Districts (RCDs) are "special districts" of the state of California, set up under California law (Division 9 of the Public Resources Code) to be locally governed agencies for educating landowners and the public about resource conservation and for implementing projects on public and private lands, including irrigation management projects. RCDs in the area of the San Luis Unit include the Westside Resource Conservation District and the Panoche

Resource Conservation District. The Westside Resource Conservation District authored the IFDM landowner and technical manuals. The WRCD would likely participate in the oversight process.

San Joaquin Valley Drainage Authority

The San Joaquin Valley Drainage Authority is a California Joint Powers Agency consisting of irrigation, water and drainage districts primarily on the west side of the San Joaquin Valley from Mendota to Tracy. It was formed for the purpose of developing cooperative solutions to the problems of agricultural drainage in this area.

Westlands Water District

The WWD obtains water from the federal Central Valley Project and distributes that water to its member farms in the San Luis Unit area. WWD proposes to assume responsibility from the USBR for providing for treatment and disposal of agricultural drainage in the San Luis Unit area. WWD would likely participate in the oversight process.

Other Water and Drainage Districts

Other water and drainage districts in the San Joaquin Valley and downstream may be affected by agricultural drainwater disposal adopted by farms in the San Luis Unit. These districts also manage their own drainage as needed. Some of these districts or a representative would likely participate in the oversight process.

Non-governmental Organizations

The Bay Institute

The Bay Institute is a non-profit research, education, and advocacy organization dedicated to the protection and restoration of the ecosystems of San Francisco Bay, the Sacramento - San Joaquin Delta, and the rivers, streams, and watersheds tributary to the estuary. The Bay Institute has a history of involvement in addressing watershed contaminant problems resulting from agricultural drainwater in the western San Joaquin Valley. As in the GBP process, one of the non-governmental organizations would likely participate in the agreement and monitoring design process but would not directly participate in the oversight process.

Natural Resources Defense Council

The Natural Resources Defense Council (NRDC) is an environmental action organization that uses law and science to protect wildlife and to ensure a safe and healthy environment. The NRDC has demonstrated a long-term interest in ensuring that any solution to the problem of San Joaquin Valley agricultural drainage will provide protection of wildlife and the environment. As in the GBP process, one of the non-governmental organizations would likely participate in the agreement and monitoring design process but would not directly participate in the oversight process.

10. Estimated Costs

A satisfactory cost estimate is not possible as yet due to the many components needing monitoring and the current unknowns in the design, size, and location of the facilities. A rough estimate may be garnered from looking at costs for current and past monitoring programs and research such as:

<u>Grassland Bypass Project</u>—The Service's* cost for biota monitoring alone are approximately $230,000/yr (includes quarterly sample collection, annual report writing, coordination on technical teams, analytical costs, and overhead)

<u>Kesterson Reservoir Closure Monitoring</u>—

<u>SJRIP Monitoring</u>—

<u>IFDM Monitoring and Research</u>—The Service's* costs for monitoring were approximately $55,000/yr (ca. 2003). The DWR, CDFG, and CVRWQCB also funded or performed research and monitoring.

<u>Evaporation Pond Monitoring and Research</u>—The Service's* costs for monitoring were approximately $120,000/yr (ca.1998)

*** USFWS monitoring costs are only a portion of the costs incurred. Other agency partnership and project proponent costs for non-biotic monitoring and support are not included here. Therefore, these costs are an underestimate of overall biota monitoring associated with these projects.**

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12. Acknowledgements

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Appendices

A) Westlands Regional Drainage Management Plan

Implementation of Drainage Services: 07/17/07 Draft
Email from WWD responding to Service questions on drainage plan details

B) Grassland Bypass Project Monitoring Plan

C) IFDM Regulations

D) USFWS IFDM Monitoring Report

E) IFDM Drift Monitoring Reports

DWR IFDM Drift Monitoring Report
Atmospheric Salt Emissions from the Concentration of Agricultural Drainage Water by Sprinkler Evaporator, CSU-Fresno

F) Evaporation Pond Monitoring

CVRWQCB Waste Discharge Monitoring Requirements
USFWS Monitoring Report

G) Conceptual Groundwater Monitoring Plan

Draft report by HydroFocus Inc.

H) Mitigation Protocols

USFWS Evaporation Pond Alternative Habitat and Compensation Protocols

I) Land Retirement Monitoring

Tiered contaminant monitoring requirements excerpted from the CVPIA Land Retirement Biological Opinion (1999)

J) San Joaquin River Improvement Project Monitoring

SJRIP Monitoring Plan
SJRIP 2006 Monitoring Report

K) Comments and Responses on the 12/14/2007 Draft Plan

U. S. Bureau of Reclamation
Westlands Water District
The Bay Institute
Central Valley Regional Water Quality Control Board
U.S. Geological Survey
U.S. Environmental Protection Agency
California Department of Water Resources
Response to Comment