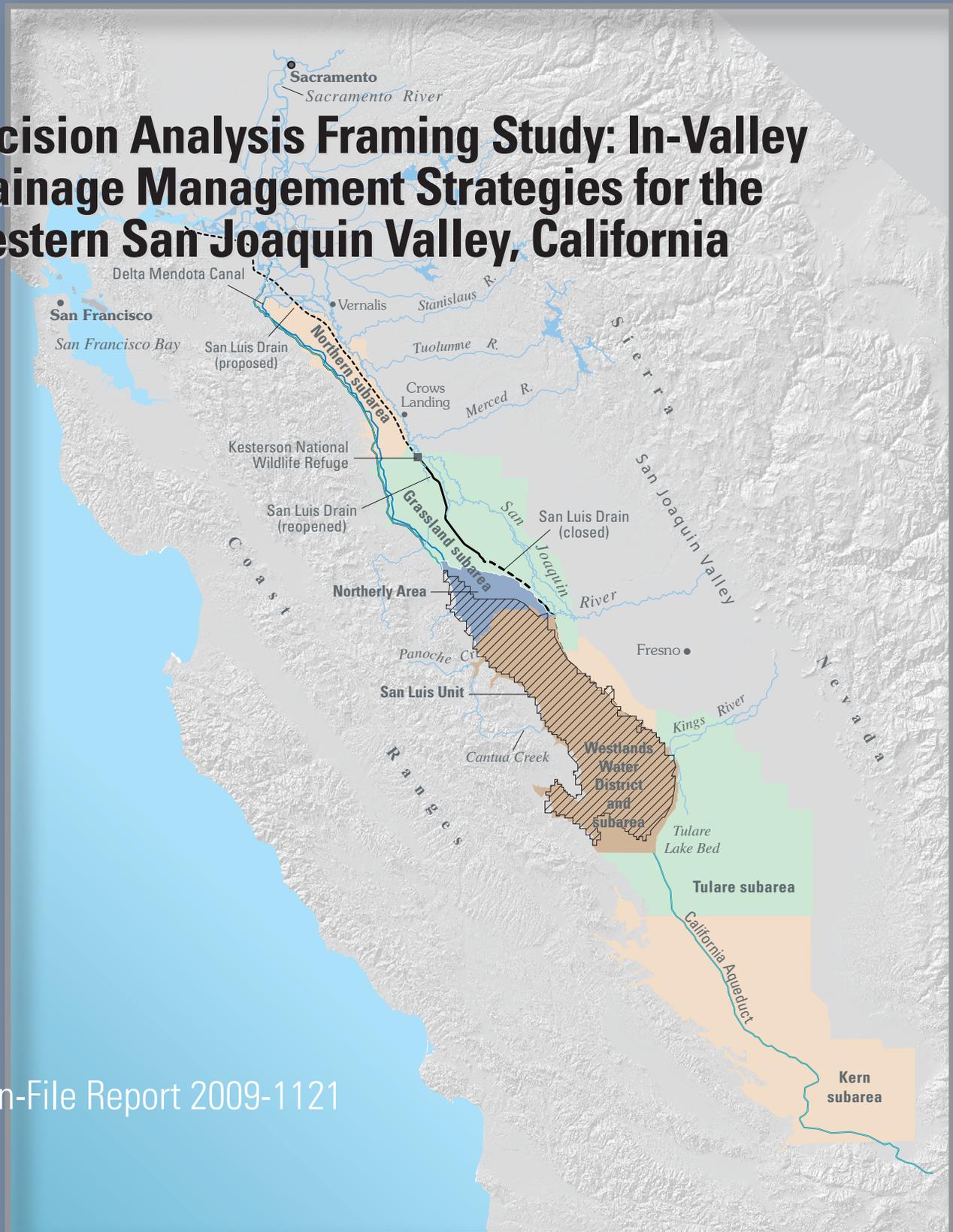


# Decision Analysis Framing Study: In-Valley Drainage Management Strategies for the Western San Joaquin Valley, California



Open-File Report 2009-1121

Cover: California relief map with western San Joaquin Valley highlighted.

Cover art by Jeanne DiLeo, USGS, Menlo Park, Calif.

# **Decision Analysis Framing Study: In-Valley Drainage Management Strategies for the Western San Joaquin Valley, California**

By Theresa S. Presser, Karen E. Jenni, Timothy Nieman, and James Coleman

Open-File Report 2009–1121

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# Decision Analysis Framing Study: In-Valley Drainage Management Strategies for the Western San Joaquin Valley, California

By Theresa S. Presser, U.S. Geological Survey, Menlo Park, California, Karen E. Jenni, Insight Decisions, Denver, Colorado, Timothy Nieman, Decision Applications, St. Helena, California, and James L. Coleman, U.S. Geological Survey, Reston, Virginia

## Abstract

Constraints on drainage management in the western San Joaquin Valley and implications of proposed approaches to management were recently evaluated by the U.S. Geological Survey (USGS). The USGS found that a significant amount of data for relevant technical issues was available and that a structured, analytical decision support tool could help optimize combinations of specific in-valley drainage management strategies, address uncertainties, and document underlying data analysis for future use. To follow-up on USGS's technical analysis and to help define a scientific basis for decisionmaking in implementing in-valley drainage management strategies, this report describes the first step (that is, a framing study) in a Decision Analysis process. In general, a Decision Analysis process includes four steps: (1) problem framing to establish the scope of the decision problem(s) and a set of fundamental objectives to evaluate potential solutions, (2) generation of strategies to address identified decision problem(s), (3) identification of uncertainties and their relationships, and (4) construction of a decision support model. Participation in such a systematic approach can help to promote consensus and to build a record of qualified supporting data for planning and implementation.

In December 2008, a Decision Analysis framing study was initiated with a series of meetings designed to obtain preliminary input from key stakeholder groups on the scope of decisions relevant to drainage management that were of interest to them, and on the fundamental objectives each group considered relevant to those decisions. Two key findings of this framing study are: (1) participating stakeholders have many drainage management objectives in common; and (2) understanding the links between drainage management and water management is necessary both for sound science-based decisionmaking and for resolving stakeholder differences about the value of proposed drainage management solutions.

Citing ongoing legal processes associated with drainage management in the western San Joaquin Valley, the U.S. Bureau of Reclamation (USBR) withdrew from the Decision Analysis process early in the proceedings. Without the involvement of the USBR, the USGS discontinued further development of this study.

# Introduction

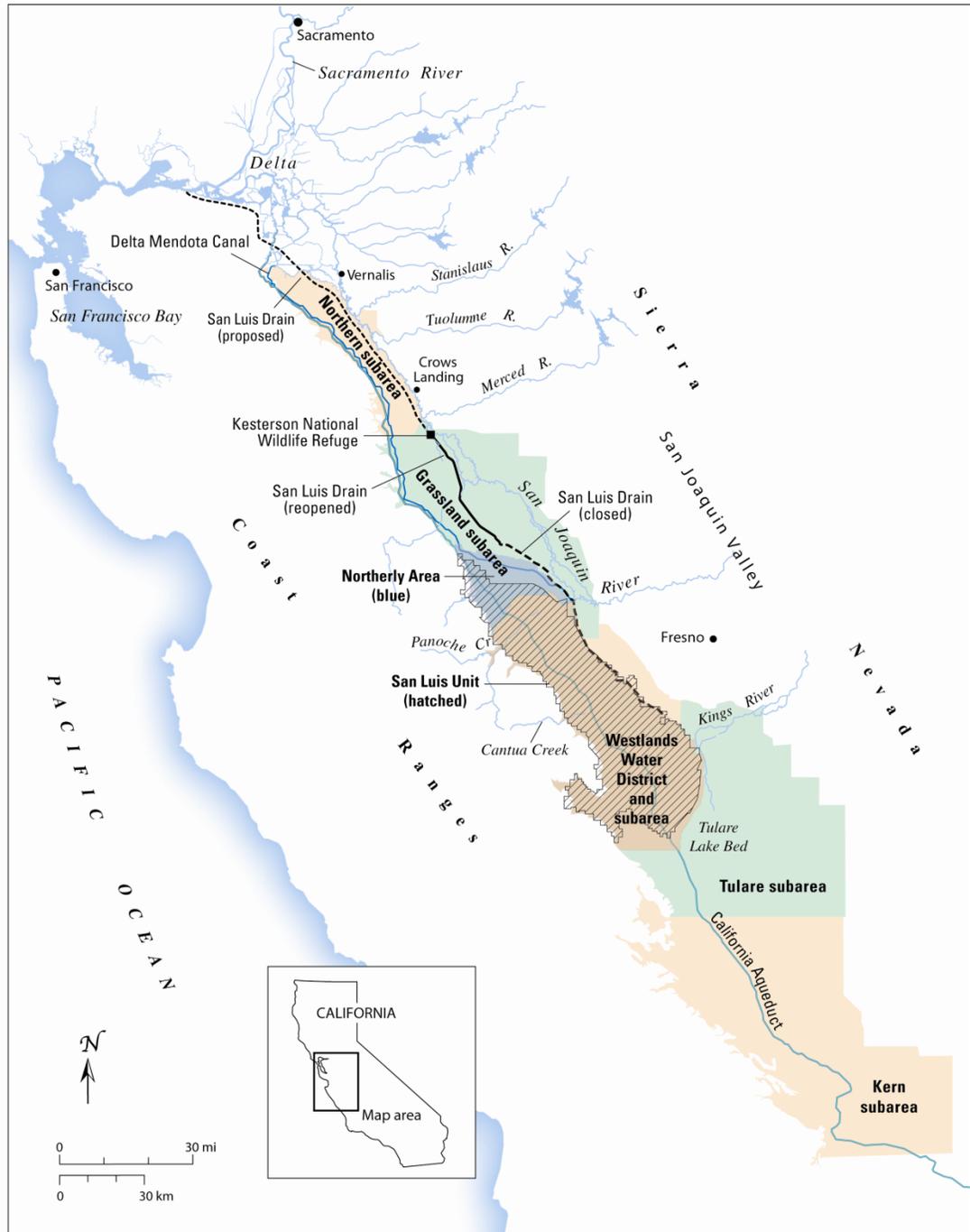
## Background

Drainage management in the San Joaquin Valley, California, has been recognized as an issue and a need since the late 1800s. Federal and State agencies, as well as local agencies and private parties, have been searching for solutions to drainage-related problems for decades. The USBR completed an Environmental Impact Statement (EIS) for alternative drainage management solutions for the San Luis Unit area of the western San Joaquin Valley in 2006 (U.S. Bureau of Reclamation, 2006). The San Luis Unit area encompasses approximately 730,000 acres within the Westlands, Panoche, Pacheco, and San Luis Water Districts that receive water from the Federal Central Valley Project (figure 1). The EIS divided the area into the Westlands Water District (north, central, and south sections) and the Northerly Area, which includes parts of the Grassland Drainage Area (figure 1).

A Record of Decision (ROD) was issued in 2007 with a description of two selected action alternatives (that is, the preferred alternative identified in the EIS and the locally preferred alternative) (U.S. Bureau of Reclamation, 2007). The selected approaches are both costly and controversial. Either solution chooses an in-valley alternative, and, as such, incorporates a decision not to export drainage outside the valley. What remain are decisions secondary to the high-level decision of in-valley drainage disposal concerning the technical details of an implementation plan that will balance (a) regional agricultural, hydrologic, environmental, and economic constraints; (b) contractual obligations for water allocation; and (c) requirement of drainage service for the valley.

In October 2007 Senator Feinstein initiated a process to bring together resource agencies and stakeholders in an effort to find consensus on drainage management and resolve drainage management problems in the San Luis Unit area of the western San Joaquin Valley. The project area was widened to include additional areas adjacent to the San Luis Unit, such as lands irrigated by the Firebaugh Canal Water District and the Central California Irrigation District. The process also included consideration of an alternative approach for managing the financial costs of drainage management through a public-private partnership. One envisioned goal of Senator Feinstein's initiated process was to find a solution that achieves a long-term sustainable salt and water balance in the root zone of irrigated lands in order to sustain agriculture in the valley. However, it was recognized that success in terms of sustainability for agriculture also needed to be defined based on consideration of fulfilling such competing goals as addressing concerns related to (1) impacts to the environment as selenium is released and stored within the valley and (2) adjustment of water contracts. Documents associated with the process included a draft drainage management proposal (*San Luis Unit Drainage Implementation Plan*) and draft legislation (*San Luis Unit Drainage Resolution Act*).

Senator Feinstein asked the USGS to participate in this process. Presser and Schwarzbach (2008) and the Decision Analysis (DA) framing study described here summarize the USGS participation in analyzing management approaches and assessing areas of uncertainty in implementing currently proposed drainage management plans (U.S. Senate, 2008a, b, c; U.S. Bureau of Reclamation, 2008a, b; California Central Valley Regional Water Quality Control Board, 2008). Figure 2 provides a timeline of this history.



**Figure 1.** Map of the western San Joaquin Valley. Illustrated are (1) the four subareas designated by the San Joaquin Valley Drainage Program; (2) the San Luis Unit that receives irrigation water from the Central Valley Project; and (3) the two areas designated in the San Luis Drainage Feature Re-Evaluation.

In Presser and Schwarzbach (2008), the USGS states in regards to drainage management issues and DA:

*Given the amount of analysis and documentation available from the SJVDP [San Joaquin Valley Drainage Program] and recent re-evaluations of drainage management, the USGS identifies not a lack of information, but rather a lack of decision analysis tools to enable meeting the combined need of sustaining agriculture, providing drainage service, and minimizing impacts to the environment. A more formal decision-making process may better address uncertainties; help optimize combinations of specific drainage management strategies; and document underlying data analysis for future use. The benefits of such a process of decision analysis are that it provides the flexibility to move forward in the face of uncertainty. It does, however, require long-term collaboration among stakeholders and a commitment to formalized adaptive management.*

Decision Analysis is a formal structured approach for evaluating decision options that has been used successfully to support a variety of policy-level decisions and provides a method to help integrate science and analysis into policy deliberations (Morgan and Henrion, 1990; Edwards and others, 2007). Decision Analysis offers a means for structuring deliberative processes with multiple stakeholders (Gregory and others, 2005); it allows many aspects of the analysis to be stakeholder-driven: objectives, alternatives, and technical evaluations can be provided by, or conducted jointly with, stakeholders. The DA approach was supported by the USGS Director in his letter to Senator Feinstein that accompanied the transmittal of the Presser and Schwarzbach (2008) report. In this letter, Director Myers (U.S. Geological Survey, 2008) stated:

*The USGS suggests outcome-based benchmarks be jointly developed through a decision analysis process involving all agencies and stakeholders. The USGS is willing to contribute to the work of such a group.*

Here we summarize that contribution.

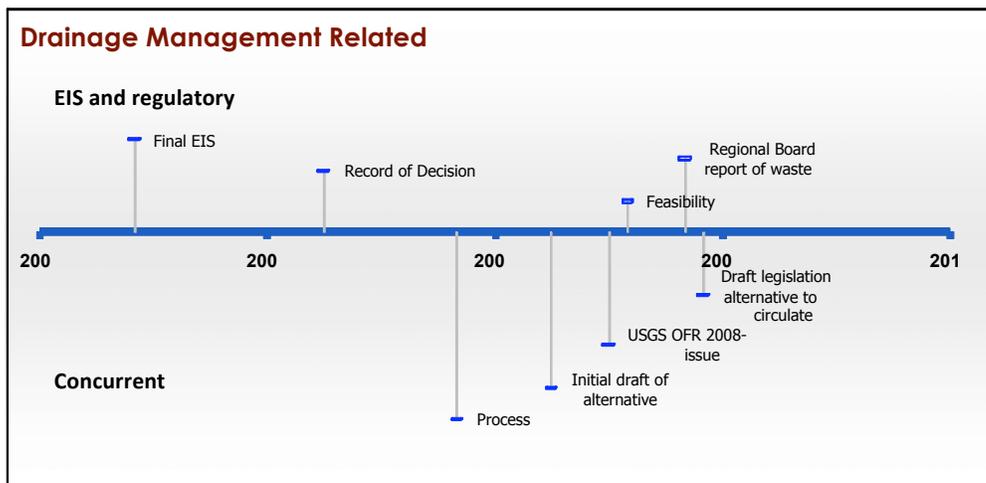


Figure 2. Timeline of recent drainage management related activities

## Approach Overview

In December 2008, following up on Presser and Schwarzbach (2008), USGS initiated a DA framing study to focus on issues related to drainage management in the San Luis Unit area of the western San Joaquin Valley. The overall goal of the DA study was to improve understanding and promote consensus among stakeholders by developing a common DA framework that could be used to examine, evaluate, and optimize potential solutions and strategies for resolving in-valley drainage management issues. As a first step in developing a DA framework, two decision analysts, under contract to the USGS (Karen Jenni of Insight Decisions and Timothy Nieman of Decision Applications), met with several individual stakeholder groups to provide an overview of DA, to explain how DA could help the stakeholders understand and address the various issues, and to begin the structuring process. The stakeholder groups included Federal, State, and local agencies; farming and water entities; and environmental communities actively involved in drainage management over the past three decades (appendix A). There are many stakeholder groups who are interested and actively involved in this issue: the goal for the framing study was to talk to a broad enough subset of these stakeholders that most, if not all, of the general perspectives on the issue would be represented. Funding and time constraints led to a focus on stakeholder groups who were participating in the process initiated by Senator Feinstein for this framing study. Hereafter when referring to stakeholders it is limited to only those stakeholders identified in appendix A. As part of the discussion, each group of stakeholders was asked to identify other stakeholder groups who might have different perspectives and who might be included in a broader discussion. The decision-structuring portion of the stakeholder meetings focused on setting the scope of issues needing to be addressed and on identifying a set of objectives that together would describe what each stakeholder group would like to see in an *ideal* solution to the drainage management problem.

Following stakeholder meetings conducted in December 2008 and January 2009, the USBR ended their participation in the DA process citing concerns regarding legal and other constraints, and their position that drainage management issues will be resolved by legislation for either (1) enactment of the proposed *San Luis Unit Drainage Resolution Act* or (2) implementation of an action alternative proposed as part of the EIS process. The USBR requested that the USGS end the DA study on the basis that it could jeopardize court decisions and pending outcomes of legal processes (U.S. Bureau of Reclamation, 2007). Therefore, the USGS agreed to end work on the DA study.

# Decision Analysis Framing Study for In-Valley Drainage Management

## Meeting Process and Feedback

In December 2008 and January 2009, the decision analysts met with stakeholder group participants. Stakeholder groups included the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, California Regional Water Quality Control Board (Central Valley Region), California Department of Water Resources, Grassland Drainage Area Farmers, Bay Institute, Friends of the Trinity River, and California Water Impact Network. Edgar Imhoff, program manager of the San Joaquin Valley Drainage Program from 1985 to 1990, also was invited to give his perspective.

The meetings were not formally structured and did not follow a set protocol. It is recognized that the initial participating groups represent only a subset of a larger set of stakeholder interests. Each meeting began with a summary of the DA process and the goals for the meeting. The stakeholders were asked to use the discussion as an opportunity to think broadly and creatively about drainage management issues: what is the scope of the issue, are there existing proposals that adequately address that scope, what is good and bad about those proposals, and how would they define an *ideal* solution. The decision analysts' task was to take the discussion and recast it into a DA structure: definition of scope, identification of objectives, and, to a lesser extent, description of preferred strategies.

After the meetings, each of the stakeholder groups received and reviewed this "DA framing" developed from their individual input. As described during the meetings, the decision analysts then took the information from all the groups and pulled together common elements to create a DA structure for consideration by the full group of participants. During this consolidation, the objectives of drainage management that are articulated in the final EIS and supporting documents were also considered and incorporated into this set of common elements. The proposal to the stakeholders at the time of the meetings was to convene a workshop of the stakeholder groups to review the decision structure, and to discuss, modify as necessary, and make a joint decision about whether further analysis would be useful. For reasons described above, the USGS decided not to continue with the analysis, so such a workshop was not held. This document summarizes the results of the stakeholder meetings<sup>1</sup> in terms of (1) a description of the problem scope; and (2) a preliminary set of fundamental objectives by which potential solutions and strategies could be evaluated.

All stakeholder meetings were informative and productive. A wide range of views was expressed and many of the difficulties associated with a problem with a long history and a large set of stakeholders with strongly held positions became clear. However, as described below in the discussion of objectives, there was a large degree of overlap in expressed goals and objectives from the various stakeholders, with few (though important) areas where the objectives of different stakeholders appear to be in conflict.

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<sup>1</sup> For legal reasons USBR participants agreed to participate in stakeholder meetings as a courtesy only. In discussions they referred the decision analysts to existing documentation as summarizing their objectives used and the basis for past decisions.

## Scope

In light of the numerous issues related to drainage management in the western San Joaquin Valley, including regulatory and legislative constraints affecting the scope and role of several of the stakeholder groups, identifying an appropriate scope for analysis and consensus building is itself difficult. Most participating stakeholders agreed that a useful statement of the scope of issues that need to be addressed is:

- comprehensive drainage management for the San Luis Unit area of the western San Joaquin Valley.

Additionally, all stakeholders recognized that the issues surrounding drainage management are closely associated with another complicated issue:

- water rights, water allocation, and water use in California.

The issue of water rights is inherent in drainage management because, from a regional perspective, there is hydrologic imbalance in the valley (that is, more water is being added to the system than is being removed; hence, the water table is rising and there is a need for drainage) (San Joaquin Valley Drainage Program, 1990). In general, less water applied as irrigation means less drainage produced, and less drainage produced means less drainage requiring treatment or causing pollution. Two important components of all proposed in-valley drainage management plans are (1) land retirement (that is, cease irrigation on some “retired” lands); and (2) source control (improved irrigation efficiency; shallow groundwater management; recycling). Both of these components reduce the amount of *applied water* in the valley and help reduce the hydrologic imbalance. However, the stakeholders recognized that they are less likely to achieve consensus on the broader scope of water rights issues, and that *however* those related issues are addressed, there remains a need for comprehensive management of drainage in the valley. Therefore, comprehensive drainage management for the San Luis Unit of the western San Joaquin Valley was considered by most participating stakeholders to be an appropriate scope that could benefit from further analysis. However, as noted in the next section, the link between drainage management and water allocation is recognized in the framing structure, and one objective in the proposed DA formulation addresses *water quantity*.

## Objectives

In a DA study, objectives describe what the stakeholders would like to accomplish with a solution to the problem being considered: they define what an *ideal* solution may achieve. In this case, stakeholders focused on what an ideal (from their perspective) comprehensive drainage management plan for the valley could achieve.

The participating stakeholders identified numerous objectives, and worded them in unique ways. The decision analysts reviewed, consolidated, and reworded those objectives to create a comprehensive set of objectives that attempts to capture all objectives mentioned by the stakeholders. The proposed consolidation of that list is below, listed in order of the number of stakeholder groups who mentioned the objective. For purposes of the “count,” the objectives articulated in the final EIS and supporting documents are considered to represent a stakeholder perspective.

At this point in the DA process (in decision framing with multiple stakeholders), objectives are identified and described at a level where there is the most agreement and overlap among stakeholders. *Detailed* definition of each objective and, importantly, how achievement of

that objective would be measured, is deferred until the basic framing is agreed upon. Thus, the list of objectives below would be considered a starting point, not a fully defined, final specification of performance measures.

From the stakeholders' perspective, an ideal comprehensive drainage management plan for the San Luis Unit area of the western San Joaquin Valley would achieve the following objectives:

- Minimize adverse impacts on the environment and ecological functions from drainage and drainage management (10 groups). This objective includes:
  - Impacts from legacy problems: contamination existing from past drainage;
  - Current and future impacts from contaminants in drainage water;
  - Impacts on surface water, ground water, and landscape;
  - Impacts on provision and health of refuges and wetlands;
  - Impact on the San Joaquin River and San Francisco Bay-Delta ecosystems;
  - Impacts on land surface (water-logging) and land use.
- Minimize total costs of drainage management (8 groups)
  - Minimize economic costs
    - Includes Federal costs, costs for farmers and others requiring drainage service;
    - Include comprehensive cost estimate, including, for example, energy costs, economic impacts of environmental and other impacts, etc.
  - Minimize carbon footprint / climate change impact (relates to the energy costs of some of the proposed components of a comprehensive drainage management plan).
- Sustain agricultural productivity of lands in the San Luis Unit area (8 groups)

Eight groups mentioned *sustaining* or *sustainable* agriculture explicitly as a fundamental objective. However, the definition of “sustain productivity” and “sustainable agriculture” remains poorly defined and appears to differ among groups. The objective was formulated as above by some groups, and as “maximize long-term sustainability of agriculture in the valley” by others.
- Minimize adverse impacts on local communities and economies (7 groups)
  - Discussion of this objective included identification of a number of ways in which the overall health of communities could be adversely (or positively) affected. Some stakeholders preferred an objective of “maximize positive contribution to local and regional communities and economies,” the mirror image of the formulation above. When stakeholders identified specific ways to benefit local communities, they generally mentioned specific *activities* (for example, maximize beneficial use of retired lands, maximize economic productivity of water use) that are better captured as decision alternatives in this DA framework than as objectives. Types of impacts on local communities, or possible sub-objectives, include:
    - Minimize loss of jobs
    - Maximize economic benefits of land and water use
    - Minimize “nuisance problems” (such as increased dust, weeds, and pests from unmanaged retired land)
- Minimize risks to human health (5 groups)
  - Includes risks to health from contaminants in surface and ground waters (both legacy and ongoing), risks through the food web, and the potential for air-borne risks associated with proposed drainage management actions

- Minimize the time required to address the drainage issues (2 groups)

Another objective that was raised in a variety of ways by most of the participating groups is directly connected to the larger issue of water rights and water allocation and, like the objectives above, was worded in a variety of ways. Unlike the above objectives, however, some participating stakeholders had diametrically opposed objectives related to water use and water allocation. Because a water-use objective (1) links to issues outside the scope described above; (2) is so important to many of the stakeholders; and (3) is the primary (perhaps only) area of direct conflict in basic objectives, this is obviously the most difficult factor to formulate into an objective for comprehensive drainage management.

One possible formulation described here functionally separates water *quantity* from the specific *uses* of that water. Under this approach, the stakeholders may agree that maximizing the quantity of Delta water that is available for alternative uses is a benefit, even while disagreeing about what those alternative uses should be.

- Maximize the amount of water available from the Delta for alternative uses and maximize the flexibility to use that water for other beneficial uses (6 groups)
  - Alternative uses specifically mentioned include continued agricultural irrigation on non-drainage impaired lands, River/Delta restoration, ecological and environmental uses, and economically productive uses.
  - Determining what appropriate and “beneficial” uses will be is an area where stakeholders are unlikely to agree.

Finally, there were several other objectives mentioned by one or two groups that do not fall into the larger categories above. These include:

- Maximize the life of the aquifers in the western San Joaquin Valley
- Minimize contribution to urban expansion in southern California
- Minimize adverse impacts of the drainage problem and/or the drainage management solution on other Central Valley Project contractors
- Minimize adverse impacts on cultural resources
- Minimize the amount of land in the valley that is unusable due to drainage impairment
- Minimize degradation of source waters (for example, to Trinity River)

## Summary

A DA process for structuring and supporting the analysis of complex problems, such as that of drainage management in the western San Joaquin Valley (Presser and Schwarzbach, 2008), includes the following steps: (1) problem framing to establish the scope of the decision problem(s) and a set of fundamental objectives to evaluate potential solutions; (2) generation of strategies to address the decision problem(s); (3) identification of uncertainties and their relationships, and (4) construction of a decision support model. Participation in such a systematic approach can help to promote consensus and to build a record of qualified supporting data for planning and implementation.

To follow-up on Presser and Schwarzbach (2008) and to help define a scientific basis for decisionmaking in implementing in-valley drainage management strategies, this report describes the first step (that is, a framing study) in a DA process.

In December 2008, a DA framing study was initiated with a series of meetings designed to obtain preliminary input from key stakeholder groups on the scope of decisions relevant to drainage management that were of interest to them, and on the fundamental objectives each group considered relevant to those decisions. The decision framework defined through the stakeholder meetings has two components. The *problem scope* is identified as *comprehensive drainage management for the San Luis Unit area of the western San Joaquin Valley*. Evaluation of a comprehensive drainage management plan would consider the impacts from legacy problems, contaminants in drainage water, and future drainage management actions. Environmental impacts, in particular, may encompass geographic areas outside of the San Luis Unit area of the western San Joaquin Valley or even outside of the valley. The *preliminary objectives* are identified as:

- *Minimize adverse impacts on the environment and ecological functions.*
- *Minimize total costs of drainage management.*
- *Sustain agricultural productivity of lands in the San Luis Unit area or, as an alternative formulation, maximize long-term sustainability of agricultural in the valley.*
- *Minimize adverse impacts on local communities and economies or (alternative formulation) maximize positive contribution to local and regional communities and economies.*
- *Minimize risks to human health.*
- *Minimize the time required to address the drainage issues.*
- *Maximize the amount of water available and the flexibility to use that water for other beneficial uses.*

Within the limitations detailed in this report, two key findings of this framing study are: (1) participating stakeholders have many drainage management objectives in common; and (2) understanding the links between drainage management and water management is desirable both for sound science-based decision making and for resolving stakeholder differences about the value of proposed drainage management solutions.

## Acknowledgments

The authors wish to thank the participants in the DA framing study for being so generous with their time. Thanks also to the Eastern Region Energy Resources Science Center for assistance with the fundamentals of the DA approach.

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[[http://www.usbr.gov/mp/nepa/nepa\\_projdetails.cfm?Project\\_ID=61](http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=61)]
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- U.S. Senate, 2008c, Letter to Karl Longley, Chairman, California Central Valley Regional Water Quality Control Board, Sacramento, California, dated 6/10/08 from Senator Feinstein, 3 p.

## Appendix A: List of stakeholders

December 2, 2008	Steve Detwiler, Tom Maurer, Joy Winckel U.S. Fish and Wildlife Service
December 2, 2008	Steve Schwarzbach U.S. Geological Survey
December 3, 2008	Gary Bobker (The Bay Institute), Terry Young (formerly with the Environmental Defense Fund) As representatives of interested environmental groups
December 4, 2008	Karen Schwinn, Tom Hagler, Eugenia McNaughton, Carolyn Yale U.S. Environmental Protection Agency, Region IX
December 5, 2008	Edgar Imhoff Program Manager, San Joaquin Valley Drainage Program (1985-1990)
January 5, 2009	Karl Longley, Pamela Creedon, Ken Landau, Rudy Schnagl, Clay Rogers California Regional Water Quality Control Board, Central Valley Region
January 6, 2009	Byron Lydecker (Friends of the Trinity River), Tom Stokely (California Water Impact Network) As representatives of interested environmental groups
January 8, 2009	Jeff Bryant, Dennis Falaschi, Joe McGahan Grassland Drainage Area Farmers
January 9, 2009	Mike Finnegan Federico Barajas, Mike Delamore, Mike Harris U.S. Bureau of Reclamation <i>(Note: the USBR participants agreed to this meeting as a courtesy. In discussions they referred the decision analysts to existing documentation as the basis for past decisions and clarified their legal constraints. See main document text for further explanation. )</i>
January 9, 2009	Jose Faria, California Department of Water Resources

Attempts were also made to have discussions with managers of the Westlands Water District and with National Marine Fisheries, but time and schedule constraints made such meetings infeasible. Further, because of the comprehensive nature of this problem to California, there were many more stakeholders interested in the process, but funding limited the initial number of invitees.