Appendix 1A
Best Available Science

Note: All content of this appendix is newly adopted.

Best Available Science

The Delta Reform Act requires the Council to make use of the best available science in implementing the Delta Plan. Best available science is specific to the decision being made and the time frame available for making that decision. Best available science is developed and presented in a transparent manner consistent with the scientific process (Sullivan et al. 2006), including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used are cited and analytical tools used in analyses and syntheses are identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Ultimately, best available science requires scientists to use the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

Steps for Achieving the Best Science

Science consistent with the scientific process includes the following elements:

- Well-stated objectives
- A clear conceptual or mathematical model
- A good experimental design with standardized methods for data collection
- Statistical rigor and sound logic for analysis and interpretation
- Clear documentation of methods, results, and conclusions

The best science is understandable; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).

There are several sources of scientific information and tradeoffs associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following:

- Independently peer-reviewed publications including scientific journal publications and books (most desirable)
- Other scientific reports and publications
- Science expert opinion
- Traditional knowledge

Each of these sources of scientific information may be the best available at a given time and contain varying levels of understanding and uncertainty. These limitations should be clearly documented when scientific information is used as the basis for decisions.

Guidelines and Criteria

There have been several efforts to develop criteria for defining and assessing best available science. In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria must be defined in order to apply best available science in natural resource management (National Research Council 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review.

Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria in Table 1A-1. These criteria were adapted from criteria developed by the National Research Council. Proponents of covered actions should document their scientific rationale for applying the criteria in Table 1A-1 (i.e., the format used in a scientific grant proposal).

Table 1A-1
Criteria for Best Available Science

Criteria	Description
Relevance	Scientific information used should be germane to the Delta ecosystem and/or biological and physical components (and/or process) affected by the proposed decisions. Analogous information from a different region but applicable to the Delta ecosystem and/or biological and physical components may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.
Inclusiveness	Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).[a]
Objectivity	Data collection and analyses considered shall meet the standards of the scientific method and be void of nonscientific influences and considerations.
Transparency and openness	The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of uncertainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.
Timeliness	Timeliness has two main elements: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs[c]. In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.
Peer review	The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity. The following criteria represent a desirable peer review process[e]. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent external review team/panel and (2) have had no direct involvement in the particular actions under review. Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied formally to proposed projects and initial draft plans, in writing after official draft plans or policies are released to the public, and to final released plans. Formal peer review should also be applied to outcomes and products of projects as appropriate.

a. McGarvey 2007
b. National Research Council 2004, Sullivan et al. 2006
c. National Research Council 2004
d. Meffe et al. 1998
e. Adapted from Meffe et al. 1998

It is recognized that differences exist among the accepted standards of peer review for various fields of study and professional communities. When applying the criteria for best available science in Table 1A-1, the Council recognizes that the level of peer review for supporting materials and technical information

(such as scientific studies, model results, and documents) included in the documentation for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities.

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Appendix 1B
Adaptive Management

Note: All content of this appendix is newly adopted.

Adaptive Management

Adaptive management is defined in the Delta Reform Act as "a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives" (Water Code section 85052). Adaptive management can be applied at a program, plan or project level.

Adaptive management is a strategy that provides for making management decisions under uncertain conditions using the best available science rather than repeatedly delaying action until more information is available. Adaptive management allows for continuous learning resulting in management decisions based on what was learned, rather than adopting a management strategy and implementing it without regard for scientific feedback or monitoring. Adaptive management is an approach to resources management that increases the likelihood of success in obtaining goals in a manner that is both economical and effective because it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty.

To be effective, governance to support and implement adaptive management in the Delta must be flexible and have the capability to make timely changes to policies and practices in response to what is learned over time (e.g., the Delta Plan adaptive management approach described in Chapter 2). Governance for adaptive management should provide a decision-making structure that fosters communication among scientific experts, independent scientific reviewers, the relevant decision making authorities (e.g., state and federal fisheries agencies on issues related to aquatic ecosystem restoration) and a balanced approach to the involvement of interested stakeholders.

A Three-phase and Nine-step Adaptive Management Framework

The Council will use the three-phase and nine-step adaptive management framework in Figure 1B-1 that is described in detail below. The Council will use this framework to evaluate the usefulness of adaptive management for reviewing proposed covered actions involving ecosystem restoration and water management along with developing, implementing, and updating the Delta Plan (See Chapter 2). Ecosystem restoration and water management covered actions should include an adaptive management plan that considers all nine steps of this framework; however, they need not be rigidly included and implemented in the order described here and should not be used as a means to prevent action, but rather as a tool to enhance decision making. The intent is to build logical and clear information exchange and decision points into management actions that increase options and improve outcomes. In developing an adaptive management plan, the best available science should be used to inform the various steps of the adaptive management process.

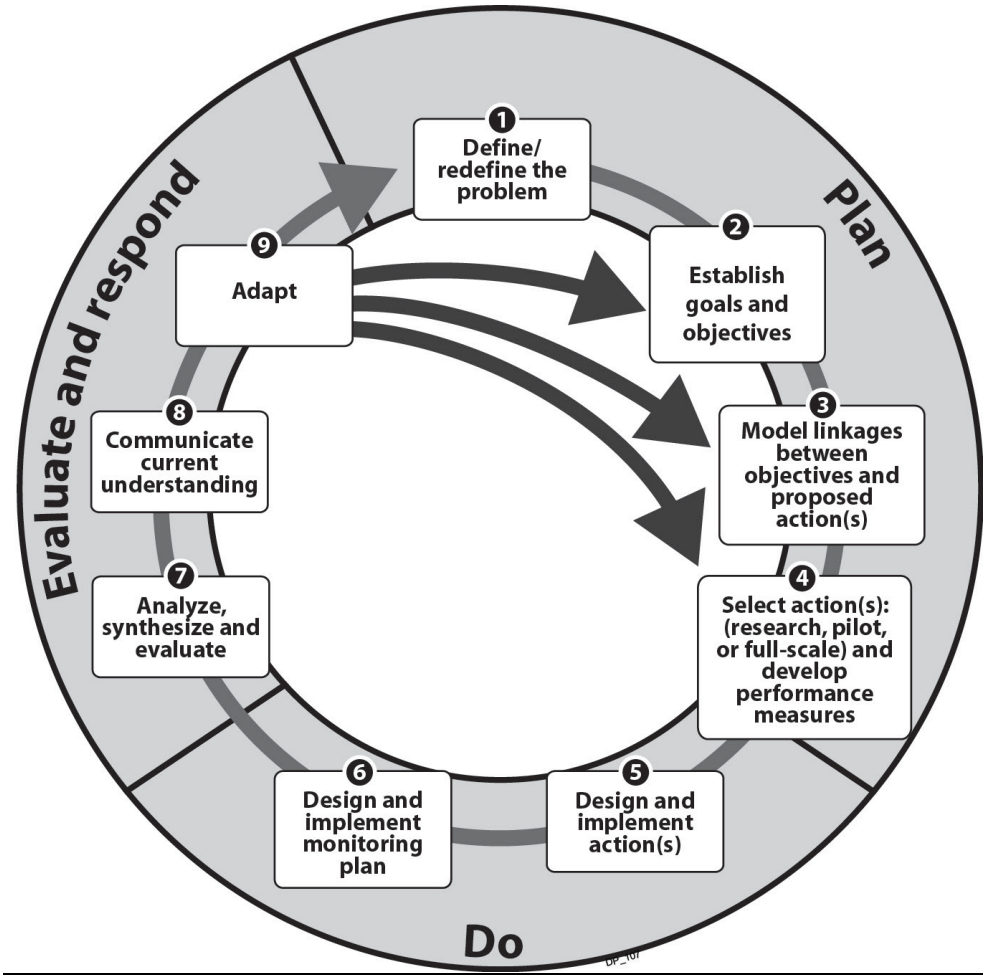

Figure 1B-1

A Nine-step Adaptive Management Framework

The shading represents the three broad phases of adaptive management (Plan, Do, and Evaluate and Respond), and the boxes represent the nine steps within the adaptive management framework. The circular arrow represents the general sequence of steps. The additional arrows indicate possible next steps for adapting (for example, revising the selected action based on what has been learned). This framework and the description of each step are largely derived from Stanford and Poole (1996), CALFED Bay-Delta Program (2000), Abal et al. (2005), and the Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management (2009).

Plan

The *Plan* phase of the adaptive management framework is presented as four steps.

1. Define/Redefine the Problem

The first step of effective adaptive management is to clearly define the problems that will be addressed in the form of a problem statement. The problem statement should clearly link to program goals and to specific objectives, which should be developed by proponents in an open manner. The boundaries of the problem (e.g., its geographic and temporal scales) should be defined in the problem statement.

2. Establish Goals and Objectives

Clear goals and objectives must be established by proponents of proposed covered actions for ecosystem restoration and water management and be based on the best available science (See GP 1 in Chapter 2).

Goals are broad statements that propose general solutions. Objectives are more specific than goals, and are often quantitative, specific narrative statements of desired outcomes allowing evaluation of how well the objectives are being achieved.

3. Model Linkages between Objectives and Proposed Action(s)

Models formalize and apply current scientific understanding, develop expectations, assess the likelihood of success, and identify tradeoffs associated with different management actions. Models can be conceptual, statistical, physical, decision support, or simulation. Models link the objectives to the proposed actions and clarify why an intended action is expected to result in meeting its objectives. Models provide a road map for testing hypotheses through statements that describe the expected outcome of an action.

Both qualitative (conceptual) and quantitative models can effectively link objectives and proposed actions by illuminating if and how different actions meet specific objectives. Conceptual models are particularly useful for decision makers, scientists, and the public because they illustrate the most critical cause-and-effect pathways. Conceptual models provide an articulation of the hypotheses being tested and how various actions might achieve particular objectives. Conceptual models also help to develop performance measures, which are qualitative or quantitative information that tracks status and trends toward meeting objectives. Conceptual models should be used in adaptive management planning because they help explain how other types of models, research, and actions will be used to explore hypotheses and address specific existing and anticipated uncertainties.

Recent conceptual models developed specifically for the Delta include comprehensive models developed as part of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The DRERIP models were designed to aid in the identification and evaluation of ecosystem restoration actions in the Delta, and include both ecosystem models (processes, habitats, and stressors) and species life history models. Another set of conceptual models was developed to plan the IEP's Pelagic Organism Decline (POD) investigations and to synthesize the POD results into "stories" about what may have happened to cause the rapid decline of multiple open-water fish species.

4. Select Action(s) (Research, Pilot, or Full-scale) and Develop Performance Measures

The process for selecting an action or several actions to meet objectives includes an evaluation of the best available science represented in the conceptual model. This evaluation should guide development of the action. Consideration should be given to the following:

- Level of the action(s) to be taken (research, pilot-scale project, or full-scale project)
- Geographical and temporal scale of the action(s)
- Degree of confidence in the benefits
- Consequences of being wrong

The scale of the action selected should be informed by the certainty of the relevant scientific information, consider the reversibility of the action, and account for the potential cost of delaying larger-scale actions. For example, when the best available science cannot predict the outcome of an action with a reasonable degree of certainty, and irreversible consequences exist for incorrectly predicting the outcomes of an action, further research or a pilot-scale action is likely more appropriate than a full-scale action, unless the cost of delaying a larger-scale action is very high (for example, a species of concern goes extinct or urban water supplies are cut off). In some instances, choosing to take no action could be the best selection (when no foreseen benefit would result from a research, pilot-scale, or full-scale action). Where possible, the action(s) selected should test cause-and-effect relationships in the conceptual model so that the model can be adapted using the information learned from implementing the action(s).

Performance measures derive from goals and objectives, and help to address the status and trends of progress toward achieving the goals and objectives. Performance measures can be placed in three general classes:

- Administrative: performance measures that describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs
- Output (also known as driver): performance measures that evaluate factors that may be influencing outcomes and include on-the-ground implementation and management actions
- Outcome: performance measures that evaluate ecosystem responses to management actions or natural outputs

The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become an output performance measure for another purpose.

Development of informative performance measures is a challenging task. Performance measures must be designed to capture important trends and to address whether specific actions are producing expected results. Performance measures are selected based on the conceptual model. In addition the monitoring plan should be designed so that the information collected supports performance measure analysis and reporting.

Efforts to develop performance measures in complex and large-scale systems with many ecosystem types like the Delta are commonly multi-year endeavors; however, initial performance measures provide value for initial assessments of progress made in the interim. The process for developing performance measures should address the rationale for each performance measure, metrics, method for analysis, baseline and reference conditions, expected outcomes, timeline for evaluation, and a communication/visualization element. The development of performance measures should be informed by the best available science and involve key stakeholders.

Do

The *Do* phase of adaptive management includes two steps that occur in parallel.

5. Design and Implement Action(s)

The design and implementation of action(s) include clearly describing specific activities that will occur under the selected action(s) and how they will link to the monitoring plan. Design includes creating a plan for implementing the action(s) and monitoring responses resulting from the action(s). The design of the action(s) should be informed by existing uncertainties, and should be directly linked to meeting the goals and objectives.

6. Design and Implement Monitoring Plan

A well-designed monitoring plan includes a data management plan. A data management plan describes the process for organizing and clearly documenting observations, including how data are collected; the methods, quality assurance, and calculations used; the time and space scales of the variables; and accurate site locations and characteristics. Data management is critical for analyses, syntheses, and evaluations.

A well-designed monitoring plan goes beyond data collection and data management. A monitoring plan often includes targeted research to answer why certain results are observed and others are not. A monitoring plan also includes clear communication of the information gathered and current understanding drawn from this information. A complete monitoring plan includes:

- Compliance monitoring (required by permits)
- Performance monitoring with pre-project monitoring (measuring achievement of targets)

- Mechanistic monitoring with concurrent targeted research (testing the understanding of linkages in the conceptual model)
- System-level monitoring (holistic, integrative and long term)

These types of monitoring can measure and communicate various types of information, including administrative/inputs (such as dollars awarded and spent or projects funded), compliance/outputs (such as tons of gravel added or acres exposed to tidal action), and effectiveness/outcomes (such as actual outcome expected from implementing an action at the local scale, suites of actions at the system-wide scales, and status and trends assessments). The monitoring plan design must include the development of monitoring metrics that can be integrated and summarized to inform decision makers and the public as described in step eight, *Communicate Current Understanding*.

Monitoring plan design requires making tradeoffs between resources spent on monitoring and resources spent on actions and analyses. To aid in this evaluation of tradeoffs, a rigorous pre-analysis using simulation models can show the information value of different variables that might be monitored. These values assessments can then be used to compare the benefits from monitoring certain variables against the benefit of using resources for other actions.

Implementation of actions and monitoring should be closely coordinated. Before an action is implemented, initial conditions should be clearly documented to the extent practical so that a baseline is established. Baseline data includes characterization of natural variation observed in the examined system over space and time. For many ecological and hydrological variables, an extensive set of baseline data is available because of the efforts of the Interagency Ecological Program and repositories of information such as those available from the U.S. Geological Survey and the California Department of Water Resources. The implementation of action(s) and monitoring should be clearly executed and communicated to the public. Status and trends metrics that compare conditions before and after action implementation are often good assessment and communication tools.

Evaluate and Respond

The *Evaluate and respond* phase of adaptive management includes three key steps.

7. Analyze, Synthesize, and Evaluate

Analysis, synthesis, and evaluation of the action(s) and monitoring are critical for improving current understanding. Analysis and synthesis should incorporate information on how conditions have changed, expectedly and unexpectedly, as a result of implementing the action(s). Because measurable change might not occur on short timescales, evaluations should also examine whether actions prevented further deteriorating conditions that would have occurred if no actions were taken. The evaluation should examine whether performance measures indicate that one or more of the objectives have been met as a result of the implemented action(s), and if so, why. If an objective is not met, the potential reasons why it was not met should be clearly identified and communicated. Analyses should be cumulative. As each year's data becomes available, analyses should assess whether the probability of the desired outcome has changed and, if so, how this affects decisions about the action. The results of the analysis, synthesis, and evaluation step could be published in technical peer-reviewed papers and reports for the purpose of external review, disclosure, and accessibility where results warrant this level of communication. Scientists and technical experts will be critical for carrying out this step.

8. Communicate Current Understanding

Communication of current understanding gained through analysis, synthesis, and evaluation of implemented action(s) and monitoring is a key step for informing and equipping policy makers, managers, stakeholders, and the public to appropriately respond and adapt. This step spans the *Do* and the *Evaluate and respond* phase of adaptive management because the communication of current

understanding and related recommendations for change requires both policy and technical expertise. The information communicated should be technically sound, well synthesized, and translated into formats conducive to informing a nontechnical audience (e.g., a report card format or a general science outlet such as a newsletter). The information should then be disseminated to those directly involved in the adaptive management process for the plan, program, or project and to those interested in the outcome of the action.

Technical staff and decision makers should be regularly involved in the exchange of information as data are analyzed and synthesized. Communication should be ongoing and occur at appropriate intervals at which an improved understanding could help refine other steps of the adaptive management framework.

The key to successful communication is a skilled and dedicated interdisciplinary person or team who understands the technical information learned, the functional needs of the decision makers, and how to best transmit this information. Communication should utilize various media (e.g., web-based materials, social media, outreach opportunities, public forums, etc.) and strive to meet the goals of transparency and clarity.

9. Adapt

Proponents of covered actions for ecosystem restoration and water management should be engaged and prepared to adapt to changes in current understanding and changes in current conditions (e.g., environmental or socio-economic). Informed and equipped with new results and understanding, decision makers should reexamine the other steps of the adaptive management framework and revise these steps where current understanding suggests doing so. Possible next steps could include redefining the problem statement, amending goals and objectives, altering the conceptual model, or selecting an alternative action for design and implementation. Also, decisions to adapt might be needed at various time intervals for the same adaptive management experiment. For example, decisions might need to be made daily (e.g., Delta water operations), yearly (e.g., implementation of landscape-scale restoration), or decadal (adaptive management of landscape-scaled restoration design).

Knowing when to adapt is not always obvious. Adaptive management actions should have a planned time frame that includes when to adapt (based on understandings of the system and its uncertainties), and that time frame should be abandoned only if the results show that the action is doing more harm than good or the anticipated benefit is not noted within a reasonable timeframe beyond what was expected. In general, one year's results, however anomalous, are seldom enough to demonstrate that the action should be subject to adaptive measures. Furthermore, when the analysis, synthesis, and evaluation of information learned from implementing an action indicates that no benefit results from the undertaken action, resources should no longer be spent on that action no matter how popular the action might be.

Decisions made within the adaptive management process for ecosystem restoration and water management actions should be made by decision makers for the entity responsible for implementing adaptive management. Adaptive management decisions relevant to revising and updating the Delta Plan will be made by the Council.

Appendix 2A
Transparency in Water Contracting: Water from the SWP

Note: All content of this appendix is newly adopted.

STATE OF CALIFORNIA • RESOURCES AGENCY • DEPARTMENT OF WATER RESOURCES

NOTICE TO

STATE WATER PROJECT CONTRACTORS

NUMBER: 03-09

DATE: 7/3/03

SUBJECT: Guidelines for Review of Proposed Permanent Transfers of State Water Project Annual Table A Amounts

FROM: INTERIM DIRECTOR, DEPARTMENT OF WATER RESOURCES

The Department of Water Resources is issuing the following guidelines prepared in connection with the Settlement Agreement, dated May 5, 2003, reached in *Planning and Conservation League et al. v. Department of Water Resources, 83 Cal. App. 4th 892 (2000).* These guidelines are effective upon the superior court's approval of the Settlement Agreement on May 20, 2003.

1. Purpose: The purpose of these guidelines is to describe the process for DWR's review of proposed permanent transfers of State Water Project Annual Table A Amounts and, by so doing, provide disclosure to SWP contractors and to the public of DWR's process and policy for approving permanent transfer of SWP Annual Table A Amounts. Such disclosure should assist contractors in developing their transfer proposals and obtaining DWR review expeditiously, and assist the public in participating in that review.

2. Coverage: These guidelines will apply to DWR's approval of proposed permanent transfers of water among existing SWP contractors and, if and when appropriate, to proposed permanent transfers of water from an existing SWP contractor to a new SWP contractor.

3. Interpretation: These guidelines are in furtherance of the State policy in favor of voluntary water transfers and shall be interpreted consistent with the law, including but not limited to Water Code Section 109, the Burns-Porter Act, the Central Valley Project Act, the California Environmental Quality Act, area of origin laws, the public trust doctrine, and with existing contracts and bond covenants. These guidelines are not intended to change or augment existing law.

4. Revisions: Revisions may be made to these guidelines as necessary to meet changed circumstances, changes in the law or long-term water supply contracts, or to address conditions unanticipated when the guidelines are adopted. Revisions shall be in accordance with the Settlement Agreement.

5. Distribution: The transfer guidelines shall be published by DWR in the next available edition of Bulletin 132, and also as part of the biennial disclosure of SWP reliability as described in the Settlement Agreement.

6. Contract Amendment: Permanent transfers of SWP water are accomplished by amendment of each participating contractor's long-term water supply contract. The amendment consists of amending the Table A upwards for a buying contractor and downwards for a selling contractor. The amendment shall be in conformity with all provisions of the long-term water supply contracts, applicable laws, and bond covenants. Other issues to be addressed in the contract amendment will be subject to negotiation among DWR and the two participating contractors. The negotiations will be conducted in public, pursuant to the Settlement Agreement and Notice to State Water Project Contractors Number 03-10.

7. Financial Issues: The purchasing contractor must demonstrate to DWR's satisfaction that it has the financial ability to assume payments associated with the transferred water. If the purchasing entity was not a SWP contractor as of 2001, special financial requirements pertain as described below, as well as additional qualifications.

8. Compliance with CEQA: Consistent with CEQA, the State's policy to preserve and enhance environmental quality will guide DWR's consideration of transfer proposals (Public Resources Code Section 21000). Identification of the appropriate lead agency will be based on CEQA, the CEQA Guidelines, and applicable case law, including *PCL v. DWR.* CEQA requires the lead agency at a minimum to address the feasible alternatives to the proposed transfer and its potentially significant environmental impacts (1) in the selling contractor's service area; (2) in the buying contractor's service area; (3) on SWP facilities and operations; and (4) on the Delta and areas of origin and other regions as appropriate. Impacts that may occur outside of the transferring SWP contractors' service areas and on fish and wildlife shall be included in the environmental analysis. DWR will not approve a transfer proposal until CEQA compliance is completed. The lead agency shall consult with responsible and trustee agencies and affected cities and counties and, when DWR is not the lead agency, shall provide an administrative draft of the draft EIR or Initial Study/Negative Declaration to DWR prior to the public review period. A descriptive narrative must accompany a checklist, if a checklist is used. The lead agency shall conduct a public hearing on the EIR during the public comment period and notify DWR's State Water Project Analysis Office of the time and place of such hearing in addition to other notice required by law.

9. Place of Use: The purchasing contractor must identify the place and purpose of use of the purchased water, including the reasonable and beneficial use of the water.

Typically, this information would be included in the environmental documentation. If a specific transfer proposal does not fit precisely into any of the alternatives listed below, DWR will use the principles described in these Guidelines to define the process to be followed. The information to be provided under this paragraph is in addition to the CEQA information described in Paragraph 8 of these guidelines.

a. If the place of use is within the contractor's service area, the contractor should disclose the purpose of the transferred water, such as whether the water is being acquired for a specific development project, to enhance overall water supply reliability in the contractor's service area, or some other purpose. If the transferred water is for a municipal purpose, the contractor should state whether the transfer is consistent with its own Urban Water Management Plan or that of its member unit(s) receiving the water.

b. If the place of use is outside the contractor's service area, but within the SWP authorized place of use, and service is to be provided by an existing SWP contractor, then, in addition to Paragraph 9(a) above, the contractor should provide DWR with copies of LAFCO approval and consent of the water agency with authority to serve that area, if any. In some instances, DWR's separate consent is required for annexations in addition to the approval for the transfer.

c. If the place of use is outside the SWP authorized place of use and service is to be provided by an existing SWP contractor, the contractor should provide information in Paragraph 9(a) and 9(b). Prior to approving the transfer, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. If DWR approves the transfer, DWR will petition State Water Resources Control Board for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

d. If the place of use is outside the SWP authorized place of use and service is not to be provided by an existing SWP contractor, DWR will consider the transfer proposal as a proposal to become a new SWP contractor. Prior to adding a new SWP contractor, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. DWR will consult with existing SWP contractors regarding their water supply needs and the proposed transfer. In addition to the information in Paragraph 9(a), 9(b), and 9(c), the new contractor should provide information similar to that provided by the original SWP contractors in the 1960's Bulletin 119 feasibility report addressing hydrology, demand for water supply, population growth, financial feasibility, etc.

DWR will evaluate these issues independently and ordinarily will act as lead agency for CEQA purposes. In addition, issues such as area of origin claims, priorities, environmental impacts and use of water will be addressed. The selling contractor may not be released from financial obligations. The contract will be subject to a CCP 860 validation action initiated by the new contractor. If DWR approves the transfer, DWR will petition the SWRCB for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

10. DWR Discretion: Consistent with the long-term water supply contract provisions, CEQA, and other provisions of law, DWR has discretion to approve or deny transfers. DWR's exercise of discretion will incorporate the following principles:

    a. As required by CEQA, DWR as an agency with statewide authority will implement feasible mitigation measures for any significant environmental impacts resulting from a transfer if such impacts and their mitigation are not addressed by other public agencies and are within DWR's jurisdiction.

    b. DWR will invoke "overriding considerations" in approving a transfer only as authorized by law, including but not limited to CEQA, and, to the extent applicable, the public trust doctrine and area of origin laws.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR's State Water Project Analysis Office, at (916) 653-4313 or Nancy Quan of his staff at (916) 653-0190.

STATE OF CALIFORNIA • RESOURCES AGENCY • DEPARTMENT OF WATER RESOURCES

NOTICE TO
STATE WATER PROJECT CONTRACTORS

NUMBER: 03-10

DATE: 7/3/03

SUBJECT: Principles Regarding Public Participation Process in State Water Project Contract Negotiations

FROM: Michael J. Spear
INTERIM DIRECTOR, DEPARTMENT OF WATER RESOURCES

The Department of Water Resources is issuing the following guidelines prepared in connection with the Settlement Agreement, dated May 5, 2003, reached in *Planning and Conservation League et al. v. Department of Water Resources, 83 Cal. App. 4th 892 (2000).* These guidelines are effective upon the superior court's approval of the Settlement Agreement on May 20, 2003.

1. Policy: Given the importance of the State Water Project to the State of California, and the key role that the long-term water supply contracts play in the administration of the SWP, DWR agrees that public review of significant changes to these contracts is beneficial and in the public interest.

2. Types of Activities to be Covered: Project-wide contract amendments (i.e., contracts with substantially similar terms intended to be offered to all long-term SWP Contractors) and contract amendments to transfer Table A amounts between existing SWP contractors will not be offered to the contractors for execution unless DWR has first complied with the public participation process as described in Paragraphs (3), (4), (5), and (6).

3. The Public Participation Process:

   1) Negotiations will be conducted in public.

   2) The public will be provided with advance notice of the time and place of the negotiations.

   3) The public will be provided the opportunity to observe negotiations and comment in each negotiating session.

4. Timing of Public Participation: Public participation ordinarily will precede the formulation of the project description in the California Environmental Quality Act process in order to assure that the public participation is meaningful. When DWR is a responsible agency, (e.g., when existing SWP contractors agree to transfer Table A amounts between themselves), the public participation will be scheduled to facilitate coordination with the lead agency's CEQA process.

5. Activities That Will Not Be Subject to Public Participation: Informal discussions prior to exchange of formal drafts and discussion of topics that are authorized to be kept confidential by law will not be subject to the public participation process.

6. Contract Amendments Resulting From Litigation: If litigation has been formally initiated, and settlement negotiations result in a proposal to adopt project-wide amendments to settle the litigation, all proposed contract amendments shall be subject to the public participation process before they are approved by DWR.

Notices of public negotiations will be put on the DWR website.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR's State Water Project Analysis Office, at (916) 653-4313, or Nancy Quan of his staff at (916) 653-0190.

Appendix 2B
Transparency in Water Contracting: Water from the CVP

Note: All content of this appendix is newly adopted.

Public Law 97-293

Title II, Reclamation Reform Act of 1982

Section 226: Public Participation

SEC. 226: Public Participation

Section 9 of the Reclamation Project Act of 1939 (43 U.S.C. 485h) is amended by adding at the end the following new subsection:

"(f) No less than sixty days before entering into or amending any repayment contract or any contract for the delivery of irrigation water (except any contract for the delivery of surplus or interim irrigation water whose duration is for one year or less) the Secretary shall—

"(1) publish notice of the proposed contract or amendment in newspapers of general circulation in the affected area and shall make reasonable efforts to otherwise notify interested parties which may be affected by such contract or amendment, together with information indicating to whom comments or inquiries concerning the proposed actions can be addressed; and

"(2) provide an opportunity for submission of written data, views and arguments, and shall consider all substantive comments so received."

Title 34, Public Law 102-575

Central Valley Project Improvement Act

Section 3405.

Water Transfers, Improved Water Management and Conservation

The Law

Section 3405. Water Transfers, Improved Water Management & Conservation

(a) Water Transfers.--In order to assist California urban areas, agricultural water users, and others in meeting their future water needs, subject to the conditions and requirements of this subsection, all individuals or districts who receive Central Valley Project water under water service or repayment contracts, water rights settlement contracts or exchange contracts entered into prior to or after the date of enactment of this title are authorized to transfer all or a portion of the water subject to such contract to any other California water user or water agency, State or Federal agency, Indian Tribe, or private non-profit organization for project purposes or any purpose recognized as beneficial under applicable State law. Except as provided herein, the terms of such transfers shall be set by mutual agreement between the transferee and the transferor.

(1) Conditions for Transfers.--All transfers to Central Valley Project water authorized by this subsection shall be subject to review and approval by the Secretary under the conditions specified in this subsection. Transfers involving more than 20 percent of the Central Valley Project water subject to long-term contract within any contracting district or agency shall also be subject to review and approval by such district or agency under the conditions specified in this subsection:

(A) No transfer to combination of transfers authorized by this subsection shall exceed, in any year, the average annual quantity of water under contract actually delivered to the contracting district or agency during the last three years of normal water delivery prior to the date of enactment of this title.

(B) All water under the contract which is transferred under authority of this subsection to any district or agency which is not a Central Valley Project contractor at the time of enactment of this title shall, if used for irrigation purposes, be repaid at the greater of the full-cost or cost of service rates, or, if the water is used for municipal and industrial purposes, at the greater of the cost of service or municipal and industrial rates.

(C) No transfers authorized by this subsection shall be approved unless the transfer is between a willing buyer and a willing seller under such terms and conditions as may be mutually agreed upon.

(D) No transfer authorized by this subsection shall be approved unless the transfer is consistent with State law,

including but not limited to provisions of the California Environmental Quality Act.

(E) All transfers authorized by this subsection shall be deemed a beneficial use of water by the transferor for the purposes of section 8 of the Act of June 17, 1902, 32 Stat. 390, 43 U.S.C. 372.

(F) All transfers entered into pursuant to this subsection for uses outside the Central Valley Project service area shall be subject to a right of first refusal on the same terms and conditions by entities within the Central Valley Project service area. The right of first refusal must be exercised within ninety days from the date that notice is provided of the proposed transfer. Should an entity exercise the right of first refusal, it must compensate the transferee who had negotiated the agreement upon which the right of first refusal is being exercised for that entity's total costs associated with the development and negotiation of the transfer.

(G) No transfer authorized by this subsection shall be considered by the Secretary as conferring supplemental or additional benefits on Central Valley Project water contractors as provided in section 203 of Public Law 97-293 (43 U.S.C. 390(cc)).

(H) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary has determined, consistent with paragraph 3405(a) (2) of this title, that the transfer will not violate the provisions of this title or other Federal law and will have no significant adverse effect on the Secretary's ability to deliver water pursuant to the Secretary's Central Valley Project contractual obligations or fish and wildlife obligations under this title because of limitations in conveyance or pumping capacity.

(I) The water subject to any transfer undertaken pursuant to this subsection shall be limited to water that would have been consumptively used or irretrievably lost to beneficial use during the year or years of the transfer.

(J) The Secretary shall not approve a transfer authorized by this subsection unless the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer will have no significant long-term adverse impact on groundwater conditions in the transferor's service area.

(K) The Secretary shall not approve a transfer unless the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer will have no unreasonable impact on the water supply, operations, or financial

conditions of the transferor's contracting district or agency or its water users.

(L) The Secretary shall not approve a transfer if the Secretary determines, consistent with paragraph 3405(a) (2) of this title, that such transfer would result in a significant reduction in the quantity or decrease in the quality of water supplies currently used for fish and wildlife purposes, unless the Secretary determines pursuant to finding setting forth the basis for such determination that such adverse effects would be more than offset by the benefits of the proposed transfer. In the event of such a determination, the Secretary shall develop and implement alternative measures and mitigation activities as integral and concurrent elements of any such transfer to provide fish and wildlife benefits substantially equivalent to those lost as a consequence of such transfer.

(M) Transfers between Central Valley Project contractors within countries, watersheds, or other areas of origin, as those terms are utilized under California law, shall be deemed to meet the conditions set forth in subparagraphs (A) and (I) of this paragraph.

(2) Review and Approval of Transfers.--All transfers subject to review and approval under this subsection shall be reviewed and approved in a manner consistent with the following:

(A) Decisions on water transfers subject to review by a contracting district or agency or by the Secretary shall be rendered within ninety days of receiving a written transfer proposal from the transferee or transferor. Such written proposal should provide all information reasonably necessary to determine whether the transfer complies with the terms and conditions of this subsection.

(B) All transfers subject to review by a contracting district or agency shall be reviewed in a public process similar to that provided for in section 226 of Pub. L. 97-293.

(C) The contracting district or agency or the Secretary shall approve all transfers subject to review and approval by such entity if such transfers are consistent with the terms and conditions of this subsection. To disapprove a transfer, the contracting district or agency or the Secretary shall inform the transferee and transferor, in writing, why the transfer does not comply with the terms and conditions of this subsection and what alternatives, if any, could be included so that the transfer would reasonably comply with the requirements of this subsection.

(D) If the contracting district or agency or the Secretary fails to approve or disapprove a proposed transfer within ninety

days of receiving a complete written proposal from the transferee or transferor, then the transfer shall be deemed approved.

(3) Transfers executed after September 30, 1999 shall only be governed by the provisions of subparagraphs 3405(a) (1) (A) -(C), (E), (G), (H), (I), (L), and (M) of this title, and by State law.

(f) Increased Revenues.--All revenues received by the Secretary as a result of the increased repayment rates applicable to water transferred from irrigation use to municipal and industrial use under subsection 3405(a) of this section, and all increased revenues received by the Secretary as a result of the increased water prices established under subsection 3405(d) of this section, shall be covered to the Restoration Fund.

Section 3407(d)(2)(a). Restoration Fund

(d) Adjustment and Assessment of Mitigation and Restoration Payments.--

(1) In assessing the annual payments to carry out subsection (c) of this section, the Secretary shall, prior to each fiscal year, estimate the amount that could be collected in each fiscal year pursuant to subparagraphs 2(A) and (B) of this subsection. The Secretary shall decrease all such payments on a proportionate basis from amounts contained in the estimate so that an aggregate amount is collected pursuant to the requirements of paragraph (c) (2) of this section.

(2) The Secretary shall assess and collect the following mitigation and restoration payments, to be covered to the Restoration Fund, subject to the requirements of paragraph (1) of this subsection:

(A) The Secretary shall require Central Valley Project water and power contractors to make such additional annual payments as are necessary to yield, together with all other receipts, the amount required under paragraph (c) (2) of this subsection; Provided, That such additional payments shall not exceed $30,000,000 (October 1992 price levels) on a three-year rolling average basis; Provided further, That such additional annual payments shall be allocated so as not to exceed $6.00 per acre-foot (October 1992 price levels) for agricultural water sold and delivered by the Central Valley Project, and $12.00 per acre-foot (October 1992 price levels) for municipal and industrial water sold and delivered by the Central Valley Project;

Provided further, that the charge imposed on agricultural water shall be reduced, if necessary, to an amount within the probable ability of the water users to pay as determined and adjusted by the Secretary no less than every five years, taking into account the benefits resulting from implementation of this title; Provided further, That the Secretary shall impose an additional annual charge of $25.00 per acre-foot (October

1992 price levels) for Central Valley Project water sold or transferred to any State or local agency or other entity which has not previously been a Central Valley Project customer and which contracts with the Secretary or any other individual or district receiving Central Valley Project water to purchase or otherwise transfer any such water for its own use for municipal and industrial purposes, to be deposited in the Restoration Fund; And Provided further, That upon the completion of the fish, wildlife, and habitat mitigation and restoration actions mandated under section 3406 of this title, the Secretary shall reduce the sums described in paragraph (c)(2) of this section to $35,000,000 per year (October 1992 price levels) and shall reduce the annual mitigation and restoration payment ceiling established under this subsection to $15,000,000 (October 1992 price levels) on a three-year rolling average basis. The amount of the mitigation and restoration payment made by Central Valley Project water and power users, taking into account all funds collected under this title, shall, to the greatest degree practicable, be assessed in the same proportion, measured over a ten-year rolling average, as water and power users' respective allocations for repayment of the Central Valley Project.

For additional information, please contact CVPIA Program Manager (916) 978-5190
February 4, 2011

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Appendix 3
Habitat Restoration*

Note: All content of this appendix is newly adopted.

* The Council adopts this document as part of Section 5006. It therefore has regulatory effect despite the markings on the document indicating it is a 'draft'.

II. Habitats

ERPP Goal 4 (Habitats) is to protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics. The ERPP identified a number of key habitat types for which conservation and restoration would be pursued in the Delta. These habitat types are continuting to be reviewed and evaluated as a part of various habitat conservation plans in terms of the natural communities they seek to conserve, and within the ERP. As these evaluations are completed, scientists and managers will have a better understanding of these natural communities, and will be better able to monitor status and trends in these natural communities at a regional scale, as well as build this information into future management plans.

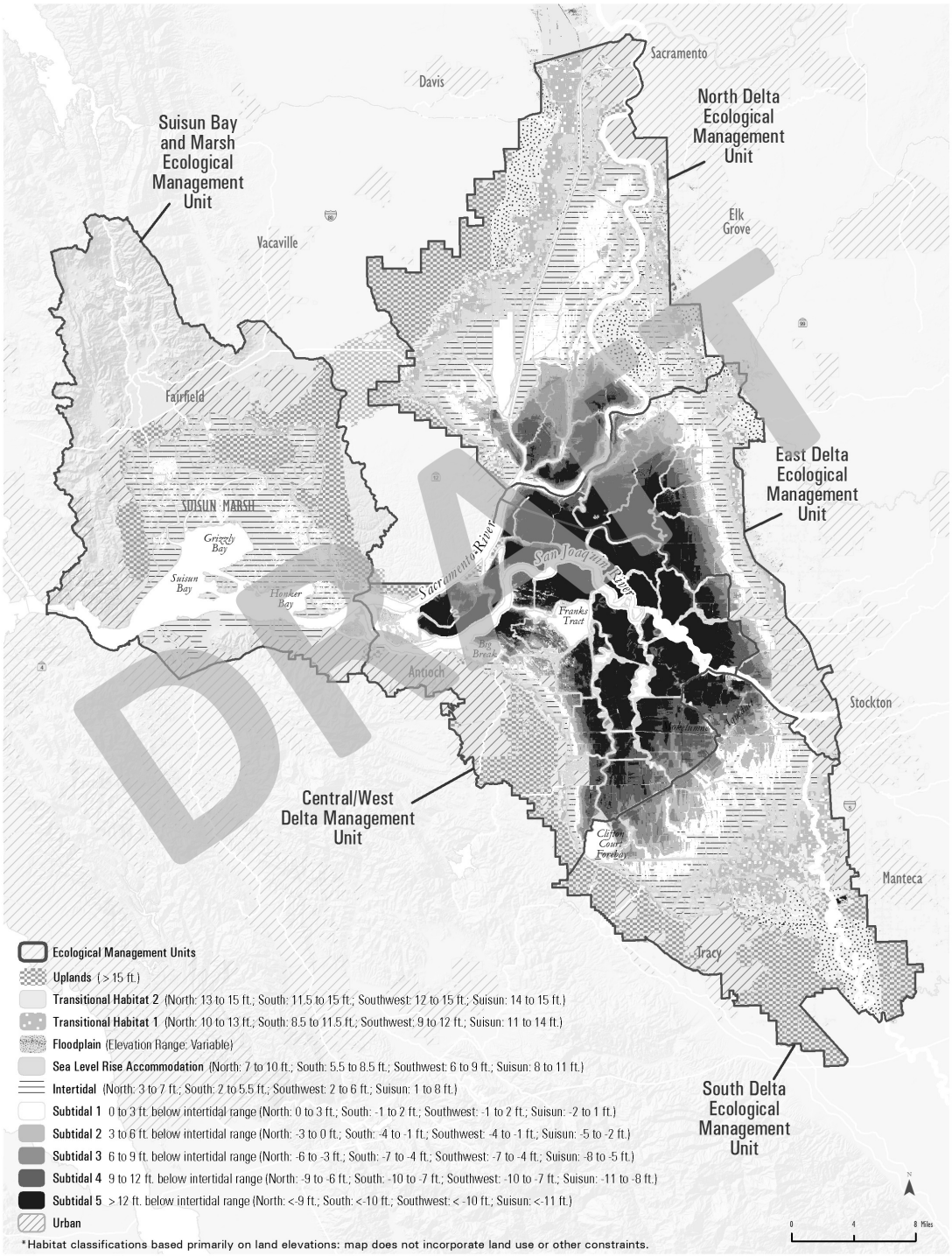
There were two strategies in the Delta Vision Strategic Plan associated with the creation and restoration of habitat: Strategy 3.1, "Restore large areas of interconnected habitats—on the order of 100,000 acres—within the Delta and its watershed by 2100"; and Strategy 3.2, "Establish migratory corridors for fish, birds, and other animals along selected Delta river channels". These two strategies describe actions regarding inundation of floodplain areas, restoration of tidal and riparian habitat, and protection of grasslands and farmlands.

Development of the Delta Conservation Strategy Map. This element in the Conservation Strategy contributes to identification of restoration opportunities within the Delta, primarily based on land elevations with consideration of current urban land use constraints (Figure 4). Existing non-urban land uses, infrastructure, and other constraints at these locations were not considered for this map. These features will be addressed in future analyses of site-specific proposals. Figure 4 presents existing elevations in the Delta, which we consider a starting point for developing priorities for habitat restoration. Several broad habitat types were identified for restoration and have been classified according to three ranges of land elevation: upland areas, intertidal areas, and subsided lands/deep open water areas. Appendix E provides a crosswalk between habitat categories in this Conservation Strategy for the Delta and those in the ERP Plan.

In accordance with the recommendations in the Delta Vision Strategic Plan and in light of expected sea level rise, the areas of the Delta that are of highest priority for restoration include lands that are in the existing intertidal range, floodplain areas that

can be seasonally inundated, and transitional and upland habitats. Assuming a rise in sea level of approximately 55 inches over the next 50-100 years (Cayan et al. 2009), these areas would become shallow subtidal, seasonally inundated floodplain, and intertidal and upland habitats respectively. The next highest priority for restoration to tidal marsh would be lands below the intertidal range that are not highly subsided, and are within the range of feasibility for subsidence reversal projects. The lower elevation boundary of subsided lands appropriate for tidal marsh restoration has not been established, and may vary depending on location, configuration, availability of dredge spoils, and other factors that may promote or inhibit soil accretion associated with vegetation establishment. The most subsided lands would be the lowest priority for restoration to tidal marsh because raising elevations to the range appropriate for vegetation establishment is likely to be infeasible. However, these deeply subsided lands may have value as deep water habitat, although the benefits of increasing deep water habitat in the delta ecosystem have not been established.

Elevations of the Delta-Suisun Marsh Planning Area



For the purposes of compliance with OAL printing requirements, this figure has been modified for increased legibility in black and white. This figure has been adapted from the original color Figure 4 on page 32 of the DFW Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions, 2011.

Figure 4: Land elevations in the Delta and Suisun Marsh. Current land elevations will largely determine what habitat types can be accommodated.

Delta Agricultural Lands. It is important to note that a significant portion of the land within the Delta is dedicated to agricultural production, some of which is considered suitable for habitat restoration. Despite this, it is projected that much of this land will remain dedicated to agriculture into the future. Expected reductions in the availability of freshwater for all beneficial uses, due to changing precipitation patterns and extended droughts, means that sea level rise will increase salinity in some areas of the Delta, particularly the western and central Delta, even absent any natural perturbations such as an earthquake-induced levee breach of a major Delta island. There simply will not be enough freshwater in the future to continue maintaining all parts of the Delta as a freshwater pool year-round. It is therefore probable that Delta agriculture will adapt naturally over time to these expected changes in the Delta, through a combination of planting more drought- and salt-tolerant crops as agricultural biotechnology becomes more widely available; growing crops that can be used to produce ethanol or other biofuels; seeking more opportunities for cultural/economic diversification (e.g., ecotourism); and managing for wetlands and associated plants for wildlife benefits rather than agriculture and/or toward development of a carbon emissions offset trading market. Some U.S. Department of Agriculture programs already exist that provide financial incentives for landowners to manage natural areas on their properties, including but not limited to the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program. While largely successful in other States, funding for implementation of these programs in California must be augmented to make participation more attractive to landowners who face higher capital and production costs. ERP will continue to fund projects on agricultural lands which benefit wildlife and help ensure that agricultural properties are conserved.

ERPP Vision for Agricultural Lands: Improve associated wildlife habitat values to support special-status wildlife populations and other wildlife dependent on the Bay-Delta. Protecting and enhancing agricultural lands for wildlife would focus on encouraging production of crop types that provide high wildlife habitat value, agricultural land and water management practices that increase wildlife habitat value, and discouraging development of ecologically important agricultural lands for urban or industrial uses in the Sacramento-San Joaquin Delta and Suisun Marsh/North San Francisco Bay Ecological Management Zones.

ERPP volume 1, July 2000

ERPP Vision for Tidal Perennial Aquatic Habitats: Increase the area and improve the quality of existing connecting waters associated with tidal emergent wetlands and their supporting ecosystem processes. Achieving this vision will assist in the recovery of special-status fish, wildlife, and plant populations and provide high-quality aquatic habitat for other fish, wildlife, and plant communities dependent on the Bay-Delta. Restoring tidal perennial aquatic habitat would also result in higher water quality and increase the amount of shallow-water and mudflat habitats; foraging and resting habitats and escape cover for water birds; and rearing and foraging habitats, and escape cover for fish.

ERPP volume 1, July 2000

Delta Upland Areas. Connectivity of existing habitat to higher elevation areas will be critical for Delta habitats and species with rising sea level, global warming, and regional climate change. As the sea level rises, existing intertidal habitat will become subtidal, and adjacent uplands will become intertidal. Additionally, adjacent higher elevation habitat will be critical for wildlife to escape flooding. Changes in regional climate are expected to result in precipitation patterns of more rain and less snow, shifting tributary

peak runoff from spring to winter, making extreme winter runoff events more frequent and intense, and bringing about longer dry periods in summer. In light of these expected changes, and ongoing conversion of open space lands to urban uses, some of these higher elevation areas will be expected to accommodate additional flood flows in new or expanded floodplain areas.

Upland areas in the Delta are best characterized as lands well above current sea level (i.e., greater than five feet in elevation, depending on location). Aquatic habitats in this category include seasonally-inundated floodplain, seasonal wetlands (including vernal pools), and ponds, while terrestrial habitats in this category include riparian areas, perennial grasslands, and inland dune scrub, as well as agricultural lands. Protecting and creating a mosaic of different upland habitat types that are well distributed, and connected to other natural communities is important for maintaining genetic diversity of the numerous species which use these areas for all or part of their life cycles. The aquatic and terrestrial habitat types that comprise upland areas often co-occur (e.g., agricultural lands that are seasonally inundated to benefit waterfowl, and perennial grasslands that support vernal pools). Thus, this habitat category highlights the importance of preserving and enhancing a diversity of habitats in support of numerous species and ecological processes, as well as allowing the system to respond to drivers of change such as sea level rise.

Stage 2 Actions for Upland Areas:

Action 1: Acquire land and easement interests from willing sellers in the East and South Delta that will accommodate seasonal floodplain areas, and shifts in tidal and shallow subtidal habitats due to future sea level rise.

Action 2: Conduct research to determine scale and balance of flow, sediment, and organic material inputs needed to restore riverine ecosystem function.

Action 3: Develop a better understanding of species-habitat interactions, species-species interactions, and species responses to variable ecosystem conditions in order to better determine natural versus human-induced responses of upland habitat restoration.

Action 4: Determine contaminant and runoff impacts of agriculture and urban areas, and develop predictions of effects on the ecosystem from future expansion of these land uses.

Action 5: Restore large-scale riparian vegetation along waterways wherever feasible, including opportunities for setback levees.

The rationales for protection and enhancement of seasonal wetlands, vernal pools, riparian areas, perennial grasslands, and inland dune scrub are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information (CALFED 2000b). For the purposes of this Conservation Strategy, the discussion on restoring upland habitats will be focused on seasonally-inundated floodplains and protection of agricultural and open space lands for wildlife-compatible uses.

With increasing sea level, global warming, and regional climate change, uplands adjacent to Delta tidal fresh and brackish wetlands will be important for future uphill colonization of these wetlands. In light of these expected changes, protection of uplands from ongoing conversion to urban uses should be a high priority to allow adaptation to climate change and maintain sustainable natural aquatic communities into the future.

Much has been learned since 2000 about creating habitats in upland areas, particularly with respect to seasonally-inundated floodplains and their importance to many of the Delta's aquatic species. As knowledge has increased, the risk and uncertainty associated with restoring this habitat is decreasing. Thus, restoration of seasonally-inundated floodplains is a very high priority for the Delta in the near term.

Delta Floodplain. A natural floodplain is an important component of rivers and estuaries that allows many essential ecological functions to occur. Healthy floodplains are morphologically complex. They include backwaters, wetlands, sloughs, and distributaries that carry and store floodwater. Floodplain areas can constitute islands of biodiversity within semi-arid landscapes, especially during dry seasons and extended droughts. The term *floodplain* as used here means the generally flat area adjoining rivers and sloughs that are inundated every 1.5 to 2 years when flows exceed the capacity of the channel (bank full discharge). Peak flows in winter and spring that occur every 1.5 to 2 years are considered by river geomorphologists to be the "dominant discharge" that contributes the most to defining the shape and size of the channel and the distribution of sediment, bar, and bed materials. Larger flood events can cause major changes to occur, but they do not happen often enough to be the decisive factor in river geomorphology.

Floodplain areas have the potential to support highly productive habitats, as they represent a heterogeneous mosaic of habitats including riparian habitat, freshwater tidal marsh, seasonal wetlands, perennial aquatic, and perennial grassland habitats, in addition to agricultural lands. During inundation floodplains are used by numerous native fish for spawning and early growth (Moyle 2002). There has been extensive research on the Yolo Bypass and lower Cosumnes River, in addition to some research in the Sutter Bypass, indicating that native resident and migratory fish show a positive physiological response (i.e., enhanced growth and fitness) when they have access to floodplain habitats (Moyle et al. 2004, Ribeiro et al. 2004, Moyle et al. 2007), which likely benefits them as they complete subsequent stages of their respective life cycles. Inundated floodplain areas provide important spawning and rearing habitat for splittail and rearing habitat for juvenile Chinook salmon (Sommer et al. 2001, Sommer et al. 2002, Moyle et al. 2007). Splittail need about 30 consecutive days of floodplain inundation to produce good survival through the larval stage and survival improves with longer durations (Moyle et al. 2004). Without access to adequate floodplain spawning habitat, splittail reproduction declines drastically as seen during the late 1980s and early-1990s.

Managing the frequency and duration of floodplain inundation during the winter and spring, followed by complete drainage by the end of the flooding season, could favor native fish over non-natives (Moyle et al. 2007, Grimaldo et al. 2004) and reduce nuisance insect problems. Frequency, timing, and duration of inundation are important factors that influence ecological benefits of floodplains. To favor splittail recruitment and benefit salmon fry and smolt growth, DFG recommends during above normal and wet years, once 10 days of floodplain inundation have been achieved based on runoff and discharge from upstream reservoirs between January 1 and May 30, then reservoir

discharges should be continued to maintain uninterrupted inundation for at least 30 days in the Yolo Bypass and at suitable locations in the Sacramento River or the San Joaquin River (DFG 2010b).

Studies on the Cosumnes and Sacramento Rivers indicate that dynamic processes are needed to support complex dynamic riparian habitats and upland systems which form the floodplain habitat (Moyle et al. 2007). Native plants and animals have adapted to the random brief floodplain events that are characteristic of California's hydrology. Riparian habitats would be a component of these future restoration actions. Extant riparian habitats exist along levees and at the higher elevations in intertidal habitats, and in floodplain habitats – usually on fluvial soils or where levees are created with a mineral soil. The voluntary recruitment of this habitat type on Prospect Island and the higher elevation areas of Liberty Island and Little Holland Tract underscore the proclivity of natural restoration when proper soil conditions and elevation occur.

Stage 2 Actions for Floodplains:

Action 1: Continue coordination with Yolo Basin Foundation and other local groups to identify, study, and implement projects on public or private land with willing participants, to create regionally significant improvements in habitat and fish passage.

Action 2: Continue implementing projects at the Cosumnes River Preserve, such as restoring active and regular flooding regimes and flood riparian forest habitat; measuring flora and fauna response to restoration; and monitoring surface and groundwater hydrology and geomorphic changes in restored areas.

Action 3: Pursue opportunities for land and easement acquisitions in the Yolo Bypass and along the lower Cosumnes and San Joaquin Rivers, which could be utilized as floodplain inundation areas in the near term or in the future.

Research on the Cosumnes River also shows the many ecosystem benefits that floodplains provide. The Cosumnes River is the only remaining unregulated river on the western slope of the Sierra Nevada. The Cosumnes River Preserve comprises 46,000 acres. The free-flowing nature of the river allows frequent and regular winter and spring overbank flooding that fosters the growth of native vegetation and the wildlife dependent on those habitats. In addition to the value of floodplain habitat to the Delta's native species, floodplains are believed to enhance the estuarine food web, as they support high levels of primary and secondary productivity by increasing residence time and nutrient inputs into the Delta (Sommer et al. 2004). Ahearn et al. (2006) found that floodplains that are wetted and dried in pulses can act as a productivity pump for the lower estuary. With this type of management, the floodplain exports large amounts of Chlorophyll *a* to the river. Floodplain habitat on the Cosumnes River Preserve has been shown to provide many benefits to native fish (Swenson et al. 2003, Ribeiro et al. 2004, Grosholz and Gallo 2006, Moyle et al. 2007).

Because floodplain areas are inundated only seasonally, many other habitat types that occur in upland areas can be accommodated on floodplains when high winter and early spring flows are not present. The Department of Water Resources Flood Protection Corridor Program provides grant funding to local agencies and nonprofit organizations for nonstructural flood management projects that include wildlife habitat enhancement and/or agricultural land preservation, and acquisition of flood easements. Such easements provide a way to bring floodplain benefits to species seasonally, while also

accommodating agricultural production in summer, fall, and early winter. Delta crops such as rice, grains, corn, and alfalfa provide food for waterfowl and other terrestrial species, and, with appropriately timed plowing and harvest, may serve as surrogate habitat in the absence of historical habitat such as tidal marsh. From Highway 99 west to the Cosumnes River Preserve is a good example of an area that provides a wildlife-friendly agriculture mix. It is the largest conservation easement acquisition funded by ERP during Stage 1. The ERP also provided funding for planning activities or property acquisitions and restoration of wildlife friendly agriculture in the Yolo Bypass, along the Cosumnes River, and along the San Joaquin River near Mossdale Crossing.

Although the benefits of floodplains have been demonstrated, there are several cautions related to restoring seasonal floodplains:

- Restoration must incorporate as much natural connection with the river as possible, to reduce potential stranding of native fish. Large-scale flooding events also help reduce stranding by creating channels on the landscape which allow for natural drainage, and multiple pulse flows help ensure fish receive the migratory cues they need. Deep drainage canals or other unnatural scour holes deeper than a couple feet should be removed. Such areas remain too cool during drainage and don't provide the emigration cues needed for most fishes.
- The periodic wetting and drying of floodplain areas make these areas especially prone to methylmercury production and transport. Within the context of the Delta Total Maximum Daily Load (TMDL) for methylmercury that is currently being developed, floodplain restoration activities should include the investigation and implementation of Best Management Practices (BMPs) to control methylmercury production and/or transport.

Delta-Upland Transitional Corridor. The establishment of a corridor of protected agricultural and natural lands is needed to protect valuable habitats and to facilitate the movement of wildlife between the the Delta's Cache Slough area and the Denverton Slough in Suisun Marsh, this area currently contains a mosaic of perennial grasslands and vernal pool areas, and has been identified by local planners as having great potential for ecological benefits from restoration.

Dune Scrub Habitat. Two ERP grants have been used to fund surveys to locate potential habitat restoration sites capable of supporting Antioch dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Potential areas were located and are being assessed for enhancement, but no enhancement has been funded nor have funds for annual monitoring and reporting been identified. Continued evaluation and enhancement of dune scrub habitat is needed during Stage 2 implementation.

Delta and Suisun Marsh Intertidal Areas. Tidal marshes across North America have been shown to play a critical role for native fish by providing improved foraging opportunities, increased growth, and refuge from predators (Boesch and Turner 1984, Baltz et al. 1993, Kneib 1997, Madon et al. 2001). The tidal marshes of the Delta have

received relatively little study; however, research conducted in the San Francisco Estuary and elsewhere along the Pacific coast has shown tidal marsh benefits to native fish, especially salmonids (Simenstad 1982, West and Zedler 2000, Bottom et al. 2005, Maier and Simenstad 2009).

Intertidal areas in the Delta are best characterized as lands between one and seven feet above sea level, depending on location (Figure 4). All lands in the intertidal range are assumed to have the ability to support some tidal marsh habitats (either brackish or freshwater) with associated mudflats, sloughs, channels, and other open water features. Some areas are capable of supporting large areas of contiguous habitat, and others may support only small patches (e.g., mid-channel islands and shoals). Properly functioning tidal marsh habitats have subtidal open water channels with systems of dendritic and progressively lower-order intertidal channels that dissect the marsh plain. These diverse habitats provide structure and processes that benefit both aquatic and terrestrial species.

ERPP Vision for Saline Emergent Wetland: Increase the area and protect the quality of existing saline emergent wetlands from degradation or loss. Wetland habitat will be increased to assist in the recovery of special-status plant, fish, and wildlife populations. Restoration will provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta.

ERPP Vision for Fresh Emergent Wetland: Increase the area and improve the quality of existing fresh emergent wetlands from degradation or loss and increase wetland habitat. Achieving this vision will assist in the recovery of special-status plant, fish, and wildlife populations, and provide high-quality habitat for other fish and wildlife dependent on the Bay-Delta.

ERPP volume 1, July 2000

The rationales for protection and enhancement of fresh and brackish tidal marsh areas are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information (CALFED 2000a). For the purposes of this Conservation Strategy, the discussion on restoring habitats in intertidal areas will focus on what has been learned about the importance of these areas since 2000, particularly as it relates to various species' use of tidal marsh areas and the role of these areas in enhancing the aquatic food web.

Studies of species' use of tidal marsh habitat in the Delta are limited, but ERP and other programs have conducted several studies since the ROD that continue to augment knowledge regarding the role of intertidal habitats for desirable aquatic species. The largest effort to study tidal marsh habitat in the Delta and its benefits to native fish was a series of projects known as the BREACH studies (Simenstad et al 2000), which investigated geomorphology, sedimentation, and vegetation at four reference sites and six restored tidal marsh sites in the Delta. Of the one reference and three restored sites sampled for fish and invertebrates, relative density of both native and introduced fish species was higher at the reference marsh (Simenstad et al. 2000). Although all of the sites were dominated by the introduced fish, the abundance of native fish was highest in winter and spring (Grimaldo et al. 2004). In stomach content analyses, all life stages of chironomids (midges) were shown to be a very important food source for fish, both adjacent to tidal marsh habitats and in open water areas. Chironomid association with marsh vegetation indicates the importance of this habitat to the aquatic food web.

Overall abundance of fish larvae was highest in marsh edge habitat when compared to shallow open water and river channels (Grimaldo et al. 2004). Unfortunately, the BREACH study sites are not representative of the Delta's large historical marshes. Most sites are small and severely degraded areas located along the edge of levees or on small channel islands.

An example of an ongoing study of species use of tidal marsh within intertidal land elevations is the ongoing monitoring associated with restoration of Liberty Island, a 5,209-acre island in the northern Delta that breached naturally nearly ten years ago. The Liberty Island project provides a good example of passive restoration of various habitat types, including some deeper, open water, subtidal, areas at the southern end and freshwater emergent tidal marsh and sloughs with riparian habitat at the higher elevations at the northern end. Liberty Island's sloughs are populated with otters, beavers, muskrats, and numerous species of ducks and geese. Native fish species using the area include Chinook salmon, splittail, Longfin and delta smelt, tule perch, Sacramento pike minnow, and starry flounder. In some areas, native species account for up to 21 percent of the fish collected; for reference, native species only account for approximately 2 to 10 percent elsewhere (Malamud-Roam et al. 2004). Ongoing monitoring at Liberty Island for almost eight years is showing that fish species assemblages at this restored area increasingly resemble assemblages at reference marsh sites. The ERP hopes to build upon the success of this restoration project by increasing the size of the project and developing a dendritic channel system on its interior (DFG 2008b).

In many estuaries of the Pacific Northwest, including the Columbia and Fraser river estuaries, Chinook salmon fry usually occupy shallow, near shore habitats including tidal marsh, where they feed and grow and adapt to salt water (Healey 1982; Levy and Northcote 1982; Simenstad et al. 1982). They often move far up into tidal wetlands on high tides, and may return to the same channels on several tidal cycles (Levy and Northcote 1982). In estuaries throughout Washington, subyearlings and fry occur mainly in marshes when these habitats are available (Simenstad et al. 1982). Tidal marsh restoration has been shown to result in recovery of life history diversity in the Salmon River estuary of Oregon. Tidal marsh habitat in this estuary had largely been lost due to diking by the early 1960s (Gray et al. 2002). In surveys conducted in the mid-1970s, Chinook salmon juveniles were found to rear in the estuary only to a limited extent during the spring and early summer months (Bottom et al. 2005b). Three sites in the estuary were restored to tidal action between 1978 and 1996 and by the early 2000s juvenile salmon were making extensive use of restored marsh habitats for rearing, with estuarine resident times up to several months (Bottom et al. 2005b). Tidal marsh restoration expanded life history variation in the salmon population; the amount of time spent rearing in the estuary was variable and juveniles moved into the ocean over a broad range of time and at a broad range of sizes (Bottom et al. 2005b). Chinook salmon show remarkable phenotypic plasticity in their ability to adapt to new locations and form multiple life history types from a single introduction of fish (Williams 2006); with restoration of tidal marsh in the Delta, Chinook salmon in the Sacramento and San Joaquin rivers may be able to regain varied life history types over time.

A number of additional studies are demonstrating that regardless of species actual use of tidal marsh areas, these habitats could be extremely important for their possible role in augmenting the Delta's aquatic food web, particularly in the saline portion of the estuary.

- Tagging and stomach content studies show that Chinook salmon fry may use intertidal habitat. According to Williams (2006), tagged hatchery fry remain in the Delta up to 64 days and tend to occupy shallow habitats, including tidal marsh. Stomach contents of salmon rearing in the Delta are dominated by chironomids and amphipods, suggesting that juvenile salmon are associated with marsh food production. Juvenile salmon in the Delta also undergo substantial growth (Kjelson et al. 1982, Williams 2006). These findings coincide with studies elsewhere in the Pacific Northwest (Healey 1982, Levy and Northcote 1982, Simenstad et al. 1982), which found that Chinook salmon fry usually occupy shallow, near-shore habitats including tidal marshes, creeks, and flats, where they feed and grow and adapt to salt water (Healey 1982; Levy and Northcote 1982; Simenstad et al. 1982), and that they often move into tidal wetlands on high tides and return to the same channels on several tidal cycles (Levy and Northcote 1982). Also, in estuaries throughout Washington, subyearlings and fry occur mainly in marshes when these habitats are available (Simenstad et al. 1982). In fact, Healey (1982) identified freshwater tidal marshes as the most important habitat to juvenile salmon in the Pacific Northwest. More recently, in the Columbia River estuary, emergent tidal marsh has been shown to support the greatest abundance of insects and highest stomach fullness scores for juvenile salmon, with chironomids again being the dominant prey type (Lott 2004).
- In a study of carbon types and bioavailability, tidal marsh sloughs in Suisun Bay had the highest levels of dissolved, particulate, and phytoplankton-derived carbon (Sobczak et al. 2002). Chlorophyll *a* concentration, used as a measure of standing crop of phytoplankton, was highest in tidal sloughs and supports the greatest zooplankton growth rate (Mueller-Solger et al. 2002) when compared to other habitat types, such as floodplains and river channels. High levels of primary production (as measured by Chlorophyll *a*) seen in several regions in the interior of Suisun Marsh are likely due to high residence time of water, nutrient availability, and absence of non-native clams (DFG 2008b).
- Modeling (Jassby et al. 1993 and Cloern 2007) and empirical studies (Lopez et al. 2006) show that productivity from high-producing areas, such as marsh sloughs, is exported to other connected habitats. Phytoplankton biomass location is only weakly correlated with phytoplankton growth rates across several aquatic habitats. Therefore other processes, including mixing and transport, are important in determining phytoplankton distribution in the Delta. The data shows that Suisun Marsh plays a significant role in estuarine productivity by providing an abundant source of primary production and pelagic invertebrates, both of which are significantly depleted in bay and river channel areas (DFG 2008b).

Tidal marsh may also help improve the pelagic food web by reducing the concentration

of ammonium in the water. Ammonium has been shown to inhibit phytoplankton blooms in Suisun Bay and possibly other open-water habitats in the Delta by inhibiting the uptake of nitrate by diatoms (Wilkerson et al. 2006, Dugdale et al. 2007). In a nutrient-rich estuary in Belgium, tidal freshwater marsh was shown to transform or retain up to 40 percent of ammonium entering the marsh during a single flood tide (Gribsholt et al. 2005). Nitrification (the conversion of ammonium to nitrate) accounted for a large portion of the transformation (30 percent). Nitrification rate in the marsh system was measured at 4 to 9 times that which occurs in the adjacent water column (Gribsholt et al. 2005). Increased tidal marsh habitat may, therefore, improve the base of the aquatic food web in the Delta by increasing primary production within the marshes, and by increasing the ratio of nitrate to ammonia in the estuary.

At the outset of ERP, restoration of intertidal and shallow subtidal areas (at that time, termed "shallow water habitat", defined as water less than two meters in depth at mean lower low water) was a very high priority, and based on what has been learned since 2000, continues to be a very high priority for the Delta. However, the extensive spread of non-native submerged aquatic vegetation (SAV) in intertidal and shallow subtidal areas renders them less suitable for native fish (Nobriga et al. 2005, Brown and Michniuk 2007, Nobriga and Feyrer 2007). Brown and Michniuk (2007) reported a long-term decline in native fish abundance relative to non-native fish. This decline in native fish abundance occurred coincident with the range expansion of non-native SAV (principally *Egeria densa*) and non-native black bass (centrarchids), both of which are discussed further in the Stressors section below. Predation by largemouth bass is one mechanism hypothesized to result in low native fish abundance where SAV cover is high (Brown 2003, Nobriga et al. 2005). Largemouth bass have a higher per-capita predatory influence than all other piscivores in SAV-dominated intertidal zones (Nobriga and Feyrer 2007). Restoration of Delta intertidal habitats must, therefore, be designed and managed to discourage non-native SAV, or native fish may not benefit from them (Grimaldo et al. 2004, Nobriga and Feyrer 2007).

In summary, restoration of tidal marsh areas in the Delta remains a very high priority for the ERP; however, several cautions must be kept in mind. A major concern is that restored tidal marsh would be colonized by non-native species, which would in turn limit the benefits to native species. Another potential constraint facing the restoration of intertidal habitats is the methylation of mercury in sediments. Therefore, restoration of tidal marsh within intertidal land elevations should be designed as large-scale experiments, and should be rigorously monitored to establish relationships between this habitat and species population abundance. As this information continues to be collected and synthesized, the risk and uncertainty associated with restoring this habitat are expected to decrease.

Subsided Delta Lands and Deep Open Water Areas. Subsided land areas in the Delta are best characterized as land well below current sea level (below approximately six feet in elevation), and include both terrestrial areas (islands that have subsided over time) and deep open water areas (subsided islands that flooded in the past and were never reclaimed). Aquatic habitats in this category include seasonal wetlands and

ponds that occur within subsided land areas, in addition to deep open water areas that occur on flooded islands such as Franks Tract and Mildred Island (also called pelagic habitat).

Stage 2 Actions for Subsided Lands/Deep Open Water Areas:

Action 1: Implement wildlife-friendly agriculture and wetland projects.

Action 2: Secure easements and land interests on which subsidence reversal projects can occur.

Action 3: Continue research on the creation and management of deep open water areas (e.g., Liberty Island) to evaluate physical and biological properties and species use.

With increasing sea level, global warming, and regional climate change, the existing configuration of Delta levees and deeply subsided islands are not expected to remain intact over the long term. A forecast rise in sea level of approximately 55 inches over the next 50-100 years (Cayan et al. 2009) is expected to increase pressure on the Delta's levee system. Changes in regional climate and the shift of tributary peak runoff from spring to winter are expected to make extreme winter runoff events more frequent and intense, further compounding pressure on Delta levees seasonally. In light of these expected changes, in addition to human-induced impacts (e.g., increased runoff from continued conversion of open space lands to urban uses), there is a considerably higher likelihood of Delta levee failure and subsequent island flooding in the future. ERP implementation must therefore adapt to these expected pressures, including planning for optimizing the value of newly-flooded deep islands for the aquatic species that may utilize them in the future.

Terrestrial areas in this category include mainly agricultural lands, some of which are not in active agricultural production. Central Valley Joint Venture (2006) recognizes that agricultural easements to maintain waterfowl food supplies and buffer existing wetlands from urban development may become increasingly important in basins where large increases in human populations are predicted. In addition, ongoing rice cultivation may help minimize subsidence. Subsidence reversal, carbon sequestration, and wildlife-friendly agricultural projects are appropriate on these deep islands in the near term, as they are expected to provide benefits to the local economy, wildlife, and waterfowl while protecting lands from uses that may be unsustainable over the longer term.

The rationales for protection and enhancement of seasonal wetlands and wildlife-friendly agriculture are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information (CALFED 2000b). For the purposes of this document, the discussion on restoring habitats on subsided lands will be focused on subsidence reversal and carbon sequestration, and on continuing to research and restore deep open water areas for the Delta's pelagic fish species, as these deep open water habitat types are known to be important, positively or negatively, for individual native pelagic fish species.

Delta Subsidence Reversal. The exposure of the bare peat soils to air causes oxidation and decomposition, which results in subsidence, or a loss of soil elevation, on Delta islands. Flooding these lands and managing them as wetlands reduces their exposure to oxygen, so there is less decomposition of organic matter, which stabilizes

land elevations. Wetland vegetation cycles lead to biomass accumulation, which sequesters carbon and helps stop and reverse subsidence (Fujii 2007). As subsidence is reversed, land elevations increase and accommodation space (the space in the Delta that lies below sea level and is filled with neither sediment nor water), on individual islands is reduced (Mount and Twiss 2005). A reduction in accommodation space decreases the potential for drinking water quality impacts from salinity intrusion in the case of one or more levee breaks on deeply subsided Delta islands.

A pilot study on Twitchell Island funded by the ERP in the late 1990s investigated methods for minimizing or reversing subsidence. The study showed that by flooding soils on subsided islands approximately one foot deep, peat soil decomposition is stopped, and conditions are ideal for emergent marsh vegetation to become established. In the Twitchell Island pilot project, researchers saw some initial soil accumulation during the late 1990s and early 2000s, and noted that accretion rates accelerated and land surface elevation began increasing much more rapidly after about seven years, as plant biomass was accumulated over time. Land surface elevation is estimated to be increasing at an annual rate of around four inches, and is expected to continue to increase (Fujii 2007).

The USGS is interested in implementing a subsidence reversal program Delta-wide, given the results of their Twitchell Island pilot study. Such a program would involve offering financial incentives to landowners to create and manage wetland areas on their lands (Fujii 2007). Large-scale, whole-island approaches to reversing subsidence would be beneficial for multiple purposes. Programs that offer incentives for 10- or 20-year studies for subsidence reversal on large tracts of land could help improve Delta levee stability and reduce the risk of catastrophic failure. Assuming that accretion rates continue at about four inches annually, estimates suggest a 50 percent reduction in accommodation space in 50 years if subsidence could be pursued throughout the Delta. This reduction in accommodation space jumps to 99 percent over the next 100 years (Fujii 2007). Some deeply subsided lands could also be used as disposal sites for clean dredged sediments, providing local flood control improvements while helping raise land elevations on subsided islands more quickly. This accommodation space reduction, in addition to helping stabilize levees over the longer term, would create additional areas for restoration of additional tidal marsh habitat.

While the primary objectives of creating wetlands on deep Delta islands would be to reverse subsidence and sequester carbon, there would be significant ancillary benefits to wildlife such as waterfowl. Delta agricultural lands and managed wetland areas provide a vital component to Pacific Flyway habitat for migratory waterfowl by increasing the availability of natural forage, ensuring improved body condition and breeding success (CALFED 2000b).

Deep Open Water Habitat. All permanent aquatic habitats in the Delta are occupied by fish of some type. In planning for restoration of Delta aquatic habitats, it is important to consider which fish will occupy which habitat and when; and what type of benefits fish will gain from the habitat. Fish assemblages in the Delta, each with a distinct set of

environmental requirements, include native pelagic species (e.g., delta and longfin smelt), freshwater planktivores, dominated by non-native species such as threadfin shad and inland silverside; anadromous species (e.g., salmon and steelhead), slough-residents associated with beds of SAV (e.g., centrarchide), and freshwater benthic species (e.g., prickly sculpin) (Moyle and Bennett 2008). Habitat diversity is necessary to support multiple fish assemblages in the Delta. Restoration efforts need to focus on creating habitats required by desirable species, while avoiding habitats dominated by undesirable species.

With the increasing threats of levee failure from continuing land subsidence, exacerbated by sea level rise, higher seasonal runoff, and random events such as an earthquake, the Delta is likely to have more large areas of deep, open water in the future (Moyle and Bennett 2008). Important attributes to manage to increase habitat variability and provide improved water quality conditions include salinity, contaminant inputs, and connectivity to surrounding habitats (Moyle and Bennett 2008). Fish assemblages will respond differently to future environmental changes.

New open water habitats may also result from intentional activities on a smaller and more managed scale than whole-island flooding. The intentional removal of levees on islands at the periphery of the Delta in order to create marsh habitat on intertidal land elevations would result in open water below the tidal zone similar to that which is developing at Liberty Island. Exchange of materials between the restored tidal marsh and adjacent open water could result in higher productivity in open water habitat. As mentioned in the discussion on tidal marsh restoration, the potential for SAV dominated by non-native species to establish in new shallow water environments is a concern. On Liberty Island, SAV has not become a dominant component of the open water habitat. This may be a result of tidal flow velocities, wind-induced disturbance and high turbidities, or some other factor. Continuing research and monitoring of the Liberty Island project will improve understanding of the dynamics of a large island breach at the periphery of the Delta, and help plan for future marsh or open water restoration projects.

There are many uncertainties related to future characteristics of flooded island and open water habitats (Moyle and Bennett 2008). These include configuration and location of flooded islands; physical properties such as depth, turbidity, flow, and salinity; biological properties such as productivity of phytoplankton and copepods; and susceptibility to invasion by non-native species such as *Egeria densa*, centrarchids, and invasive non-native clams. Adaptive management, combined with large-scale experimentation on new open water habitat, would help to reduce uncertainties. This could occur through the planned flooding of at least one Delta island, or through an organized study plan that would go into effect in the event of an unplanned levee breach (Moyle and Bennett 2008).

Appendix 4
Elevation Map

Note: All content of this appendix is newly adopted.

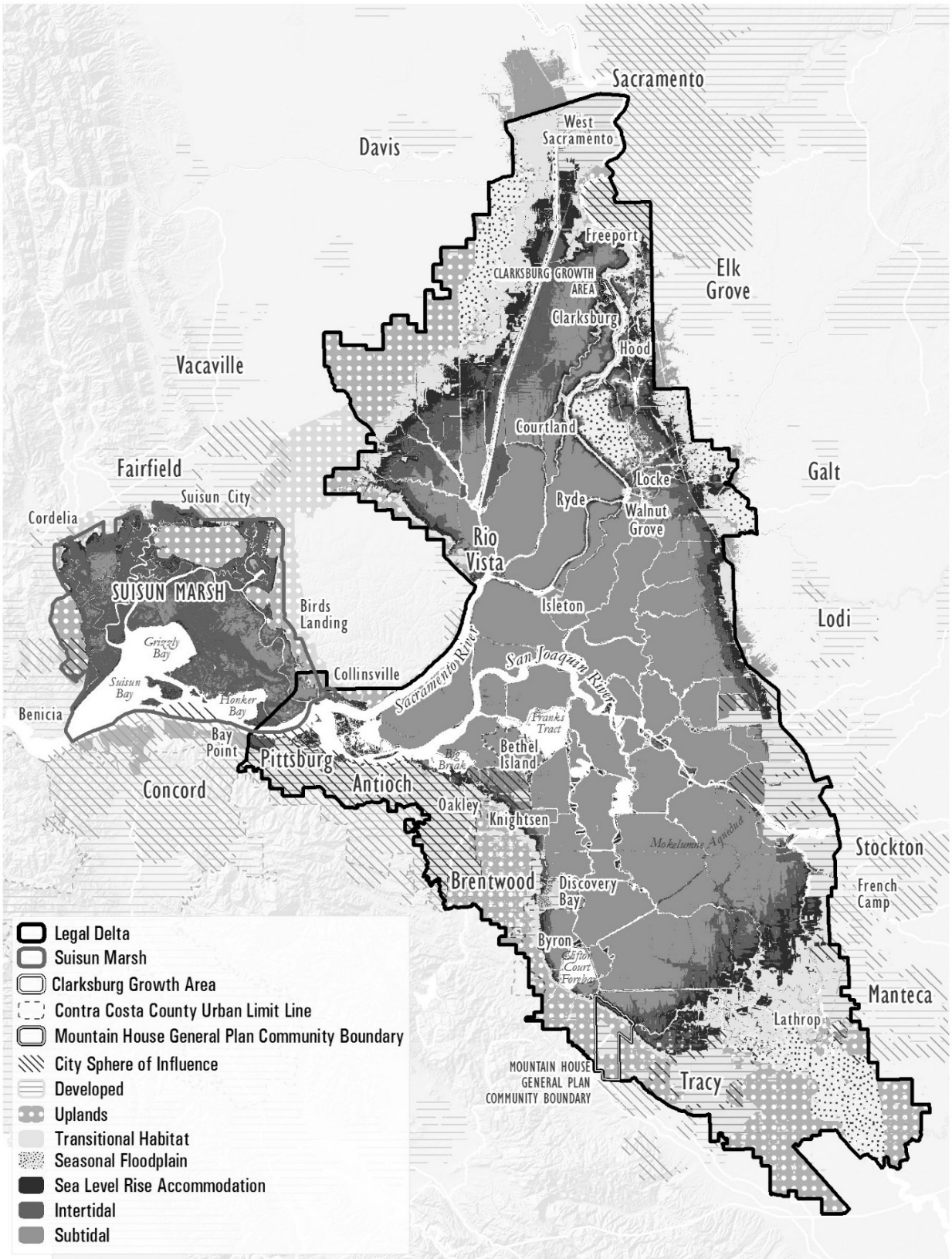


Figure 4-1
Habitat Types Based on Elevation, Shown with Developed Areas in the Delta and Suisun Marsh
Source: Adapted from DFG 2011

Appendix 5
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects

Note: All content of this appendix is newly adopted.

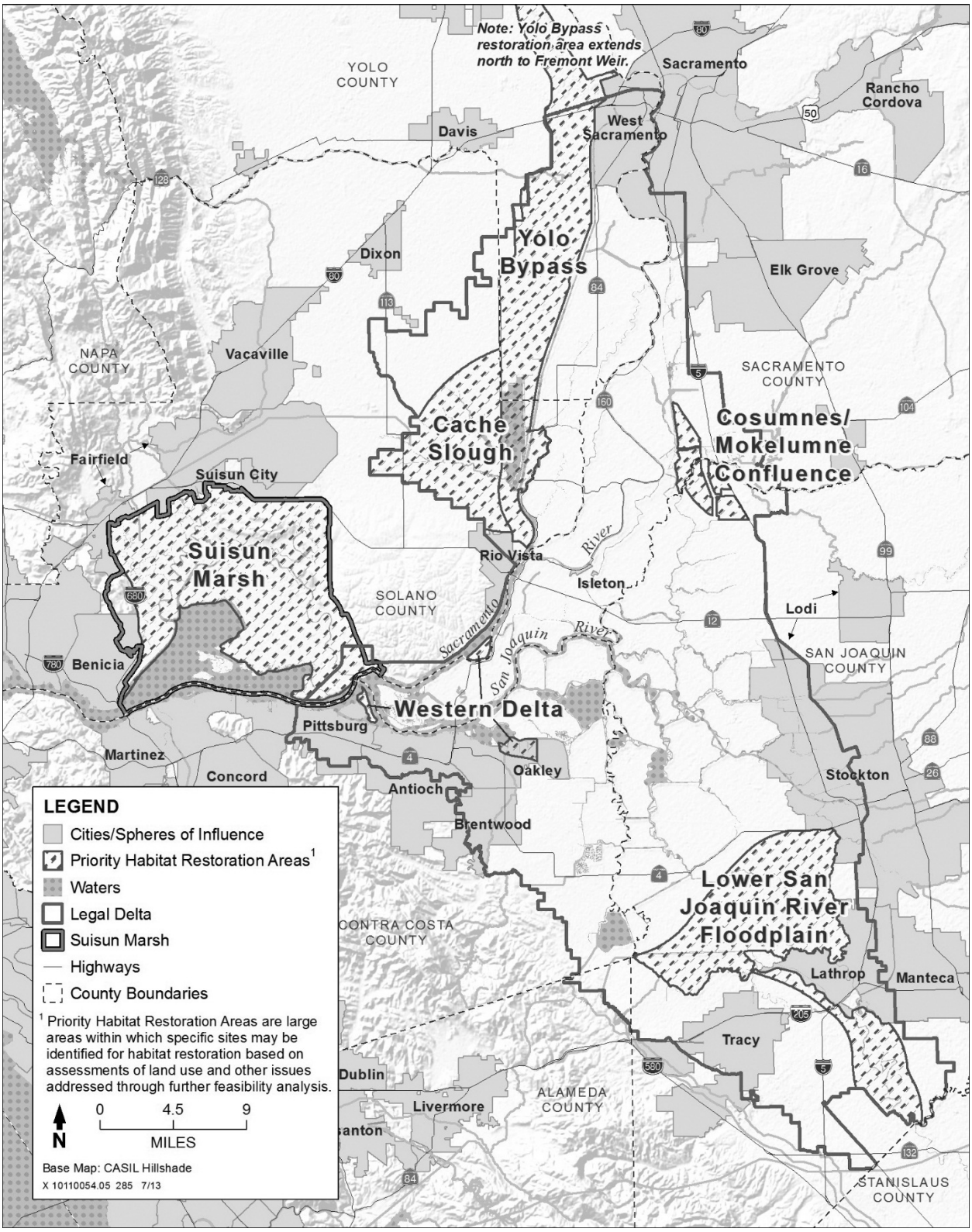


Figure 5-1

Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects

Source: DFG 2011

Appendix 6
Delta Primary and Secondary Zones and Suisun Marsh

Note: All content of this appendix is newly adopted.

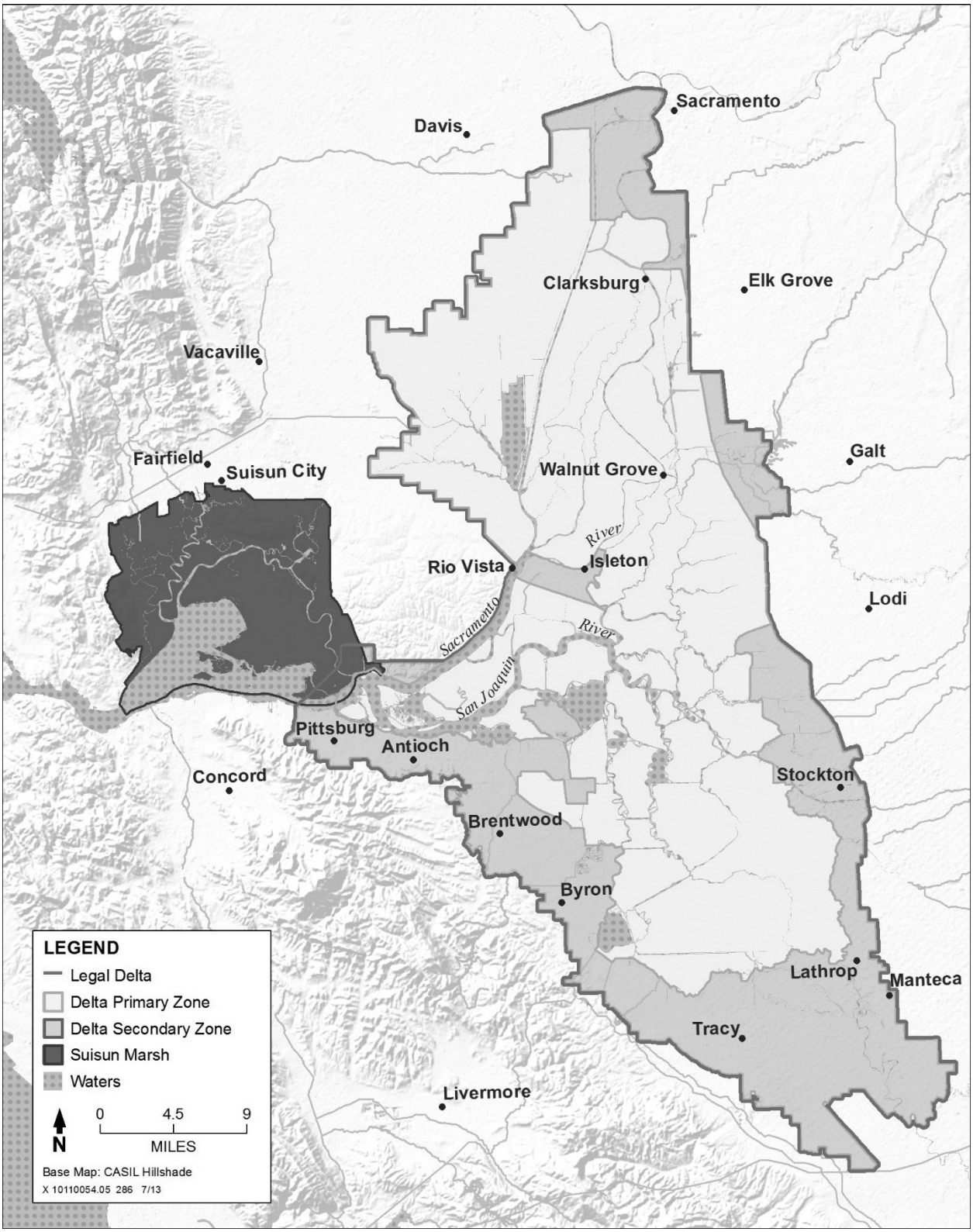


Figure 6-1
Delta Primary and Secondary Zones and Suisun Marsh

Appendix 7
Delta Communities

Note: All content of this appendix is newly adopted.

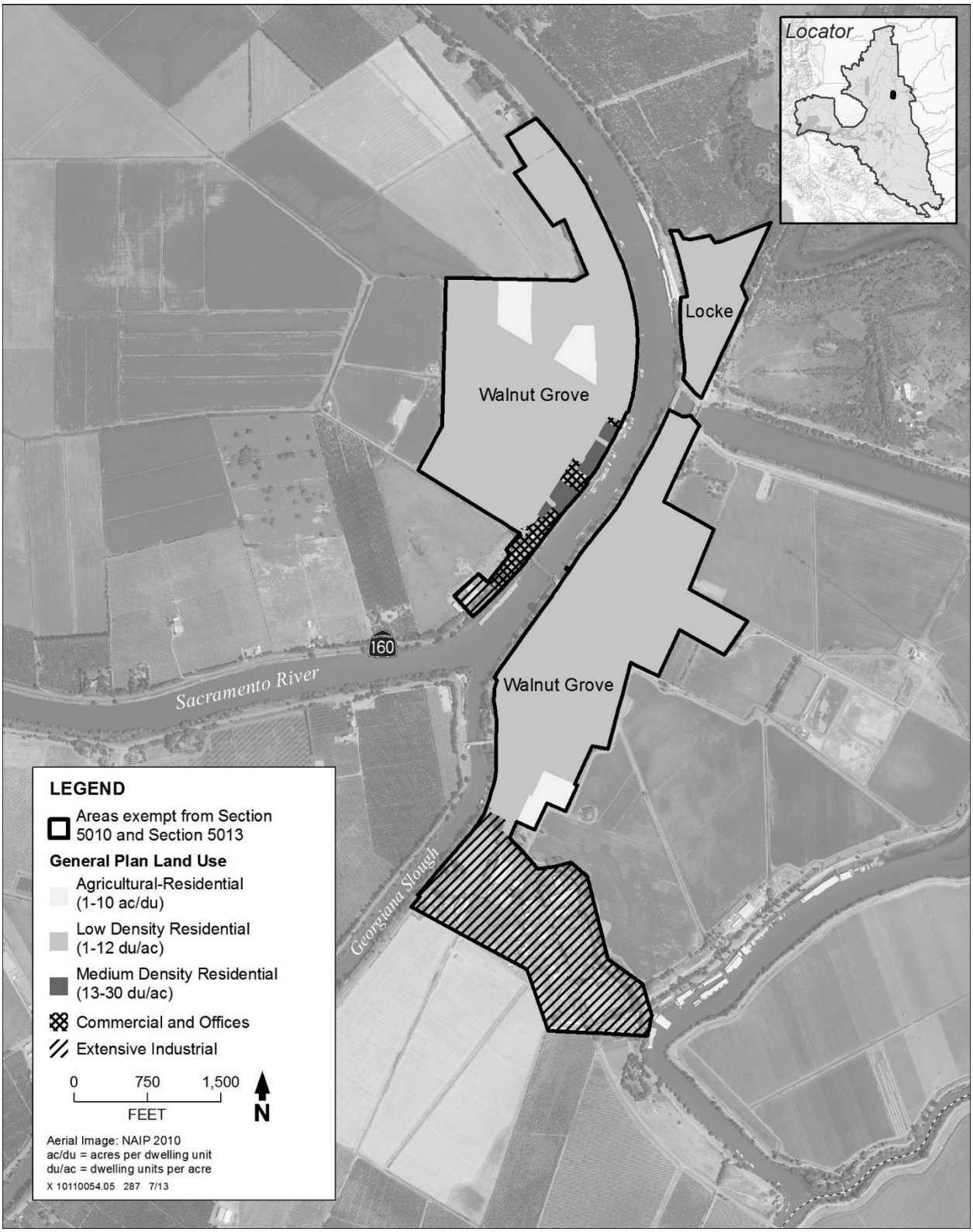


Figure 7-1
Towns of Locke and Walnut Grove
Source: Sacramento County 2011

Figure 7-2
Town of Hood
Source: Sacramento County 2011, Sacramento County 2012, Sacramento County 2013

Figure 7-3
Town of Ryde
Source: Sacramento County 2011

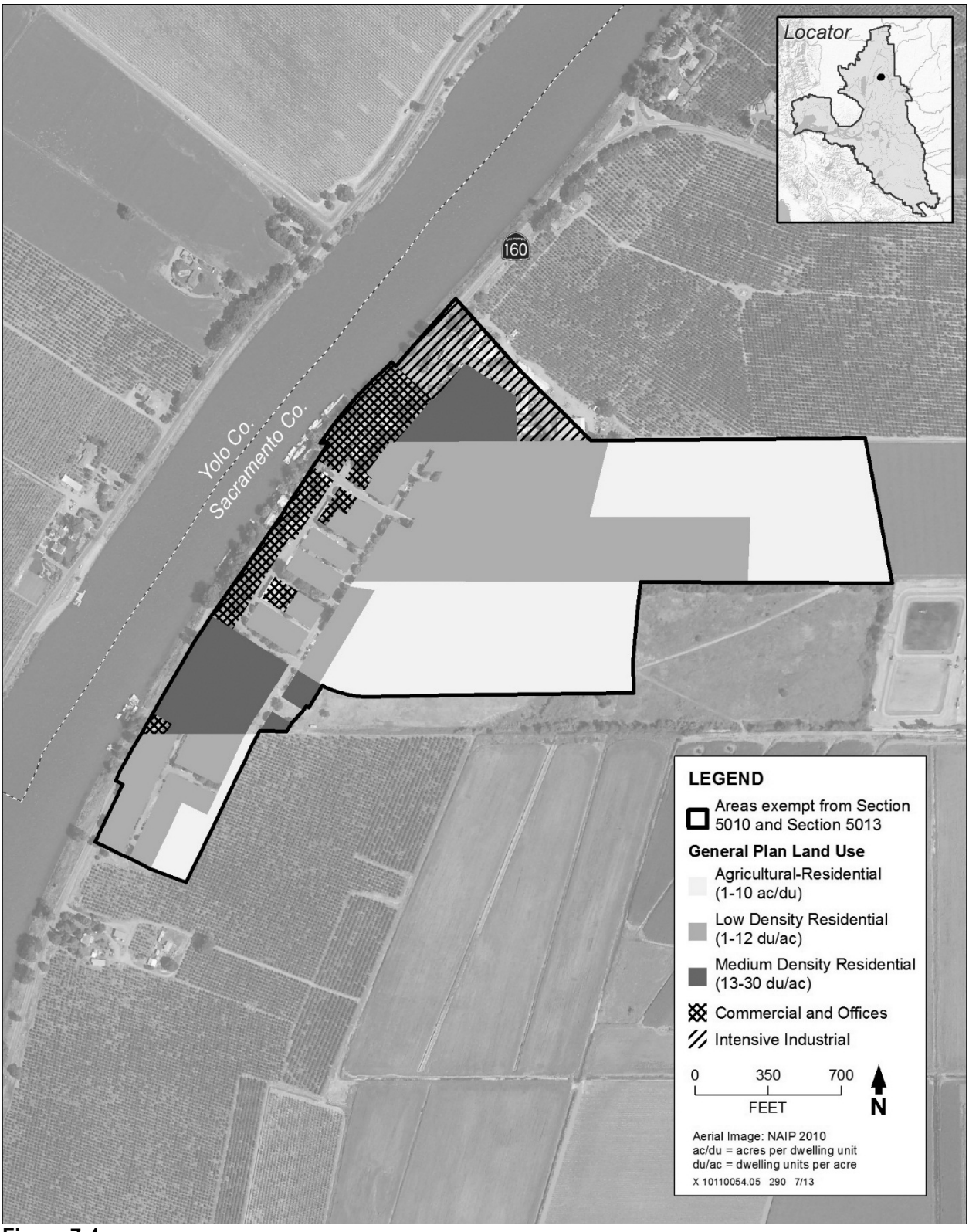


Figure 7-4
Town of Courtland
Source: Sacramento County 2011

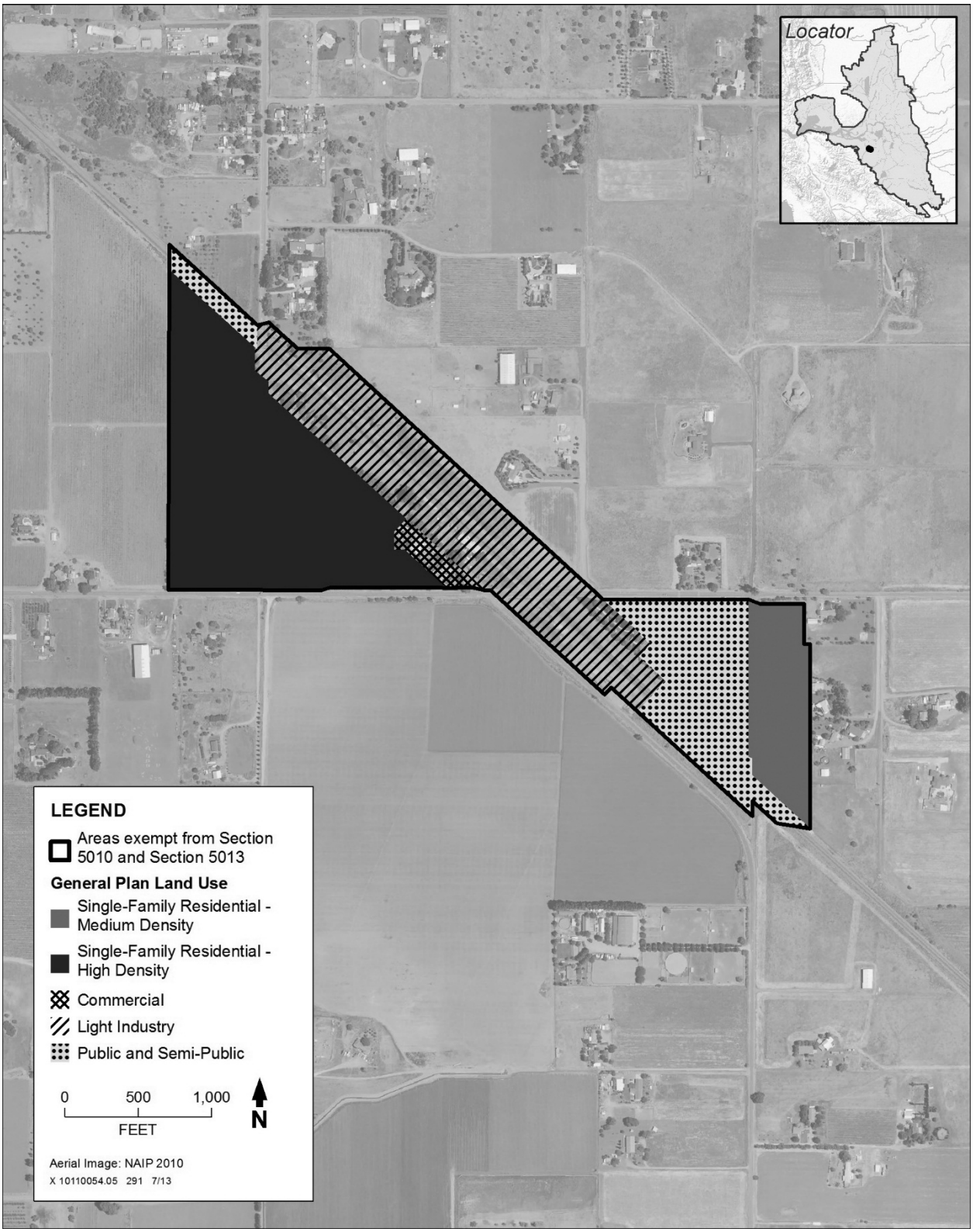


Figure 7-5
Town of Knightsen
Source: Contra Costa County 2011

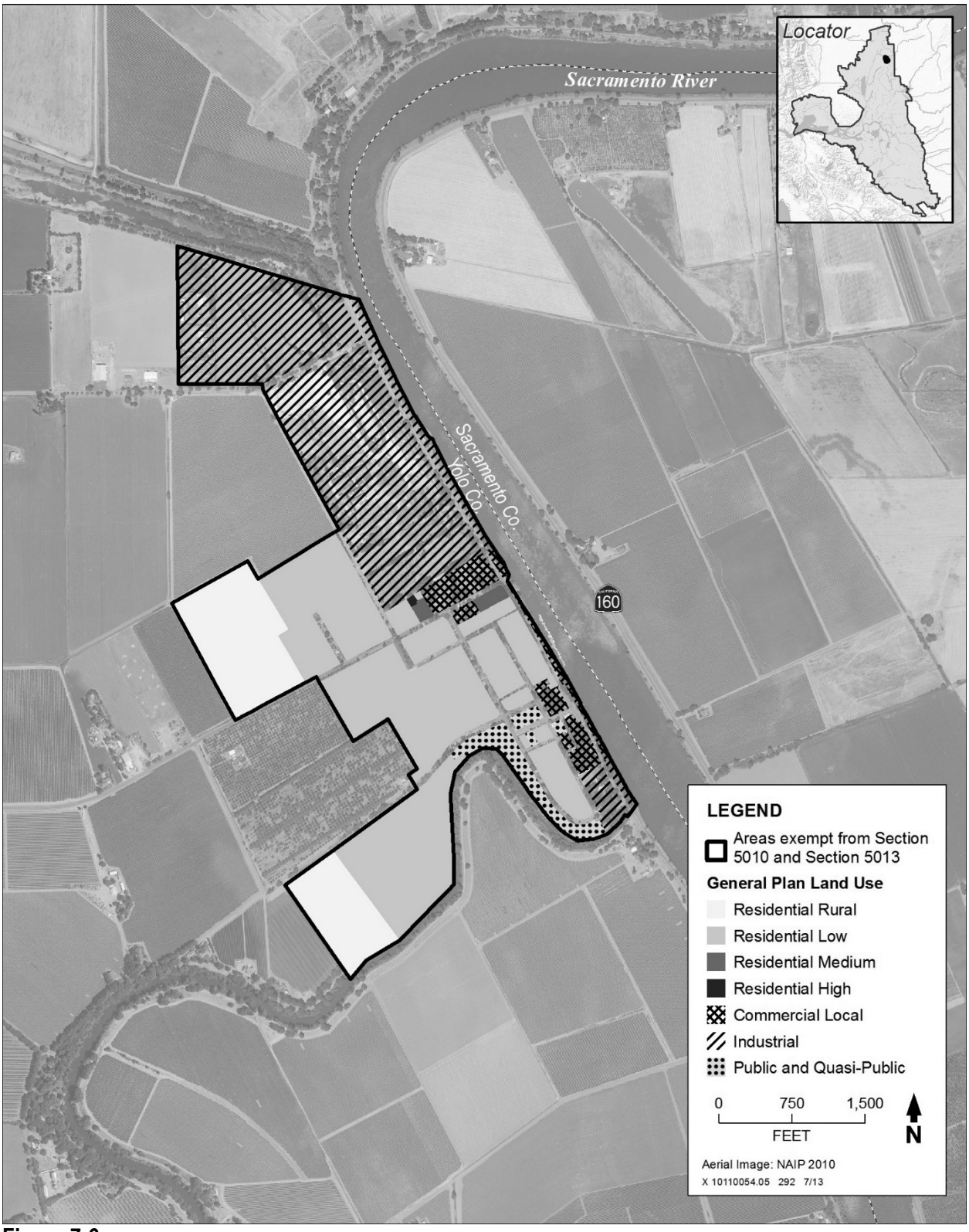


Figure 7-6
Town of Clarksburg
Source: Yolo County 2010

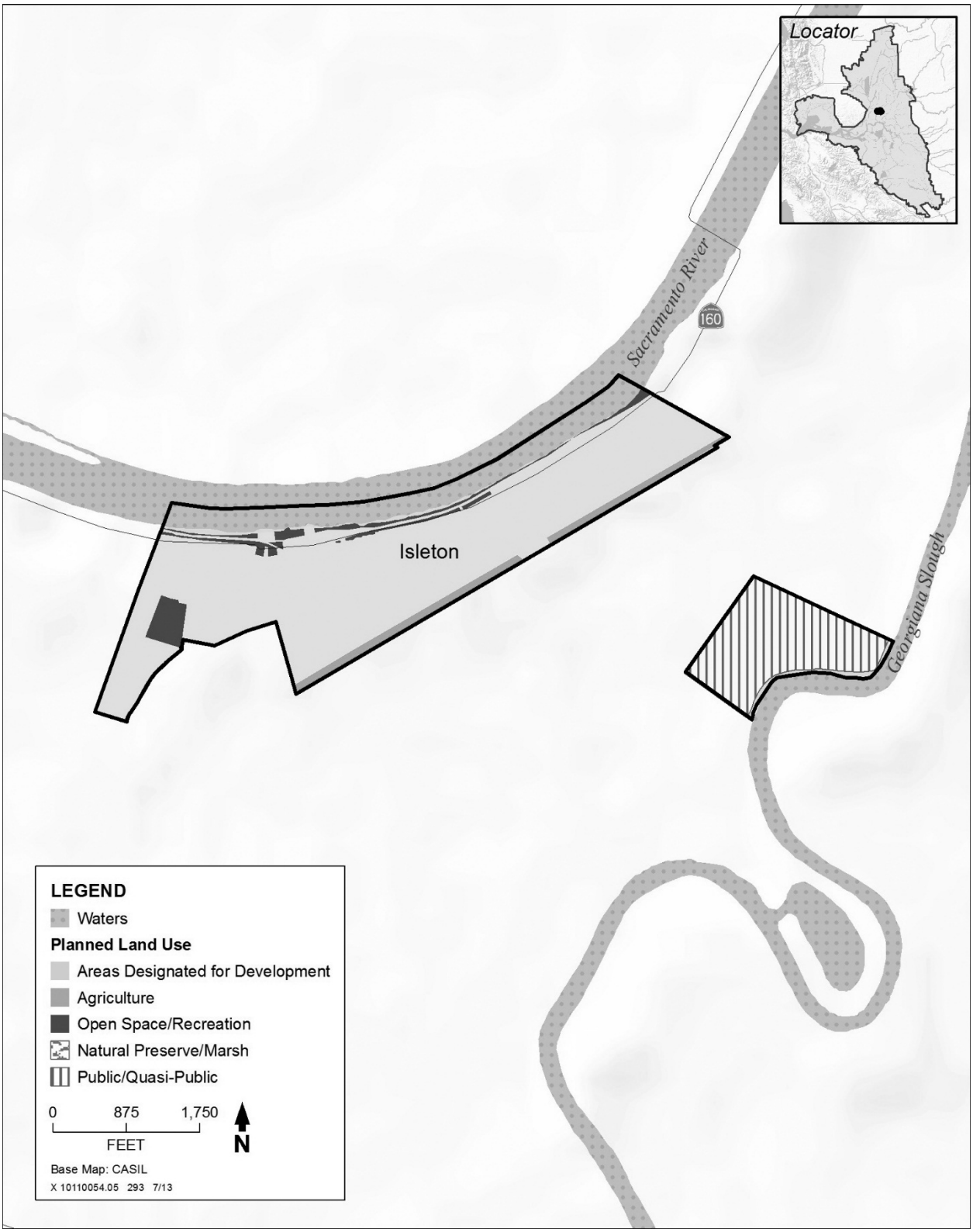


Figure 7-7
City of Isleton
Source: City of Isleton 2000

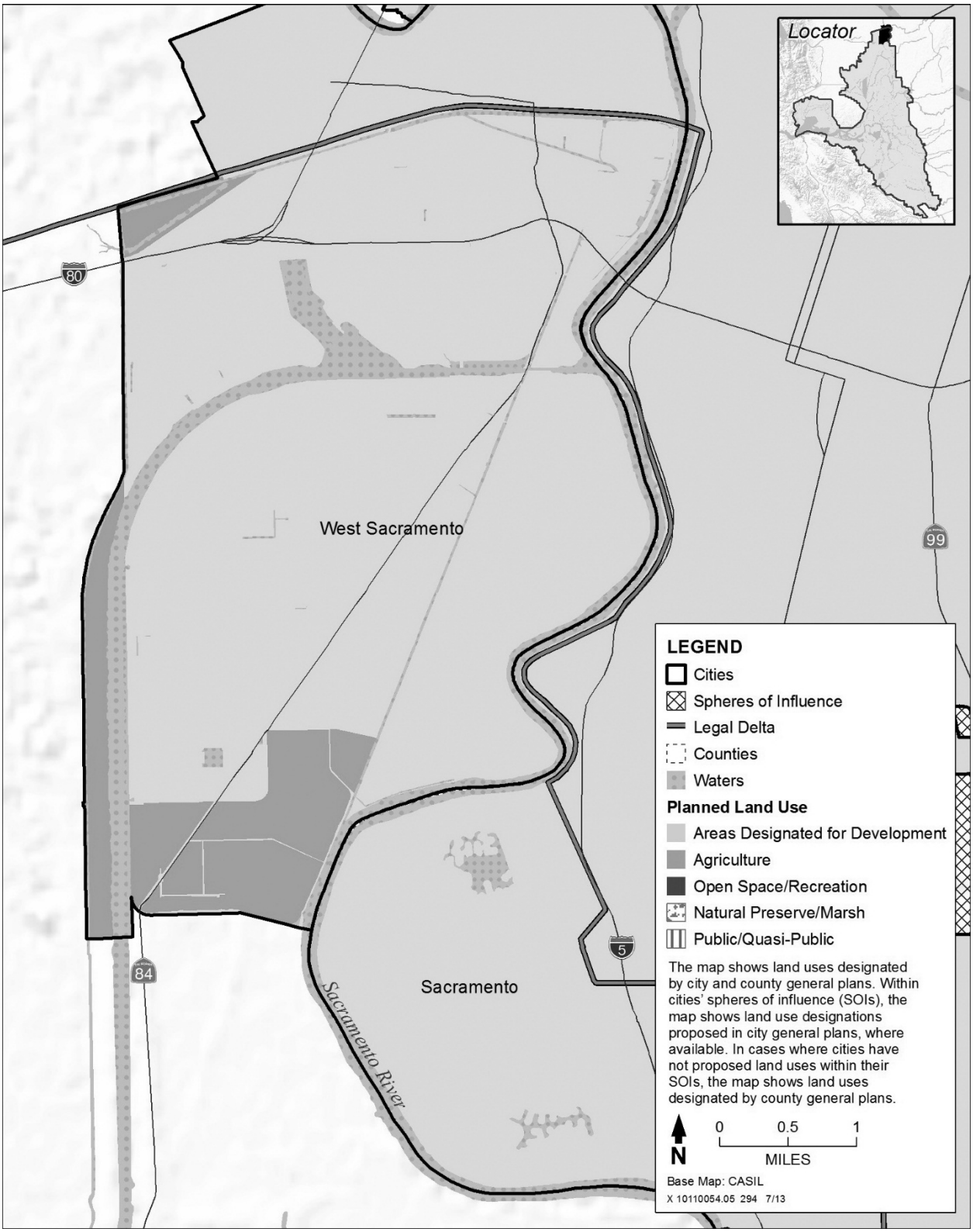


Figure 7-8
City of West Sacramento
Sources: City of Sacramento 2008, Sacramento County 2011, City of West Sacramento 2010

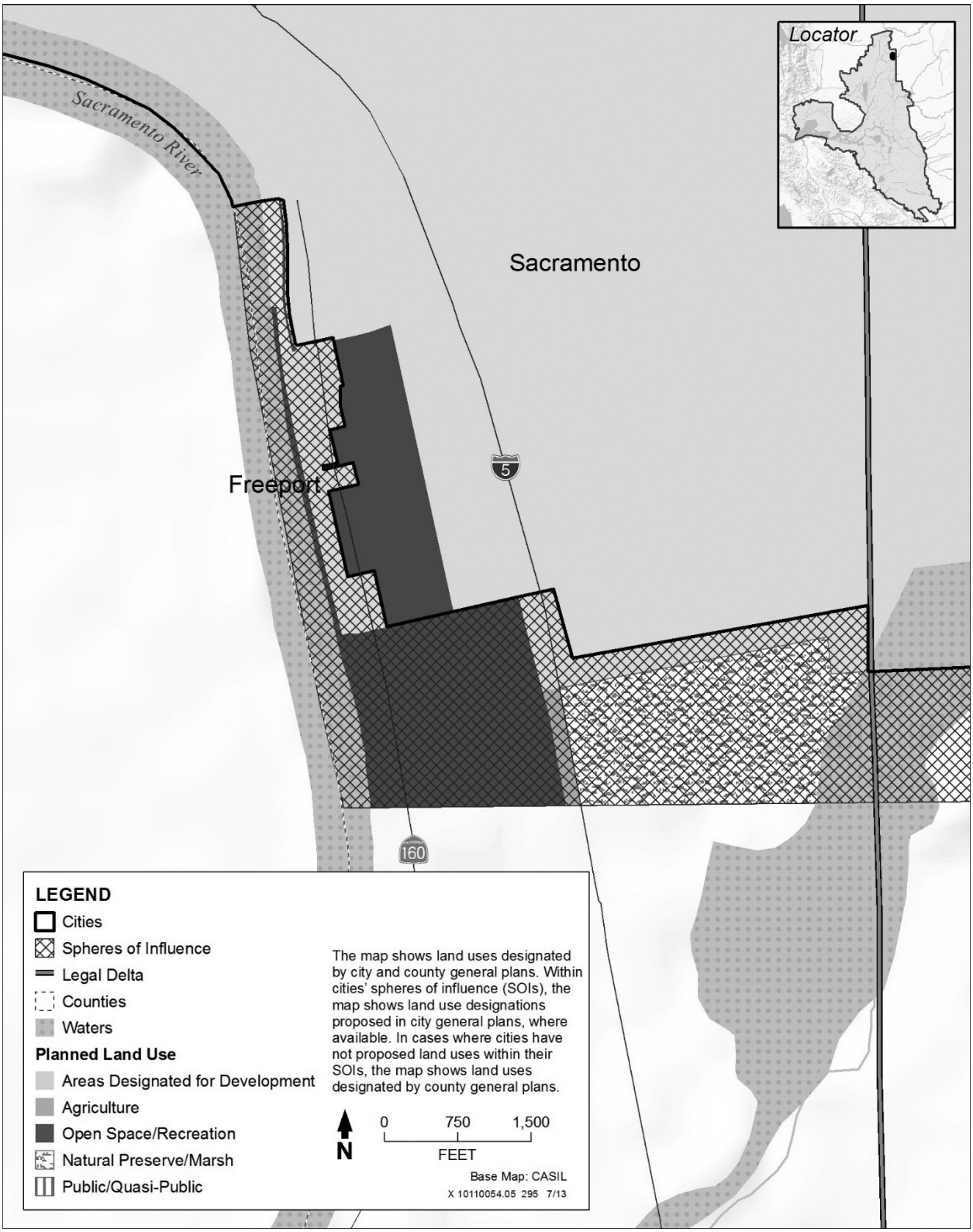


Figure 7-9
Town of Freeport and the City of Sacramento's Sphere of Influence
Sources: City of Sacramento 2008, Sacramento County 2012

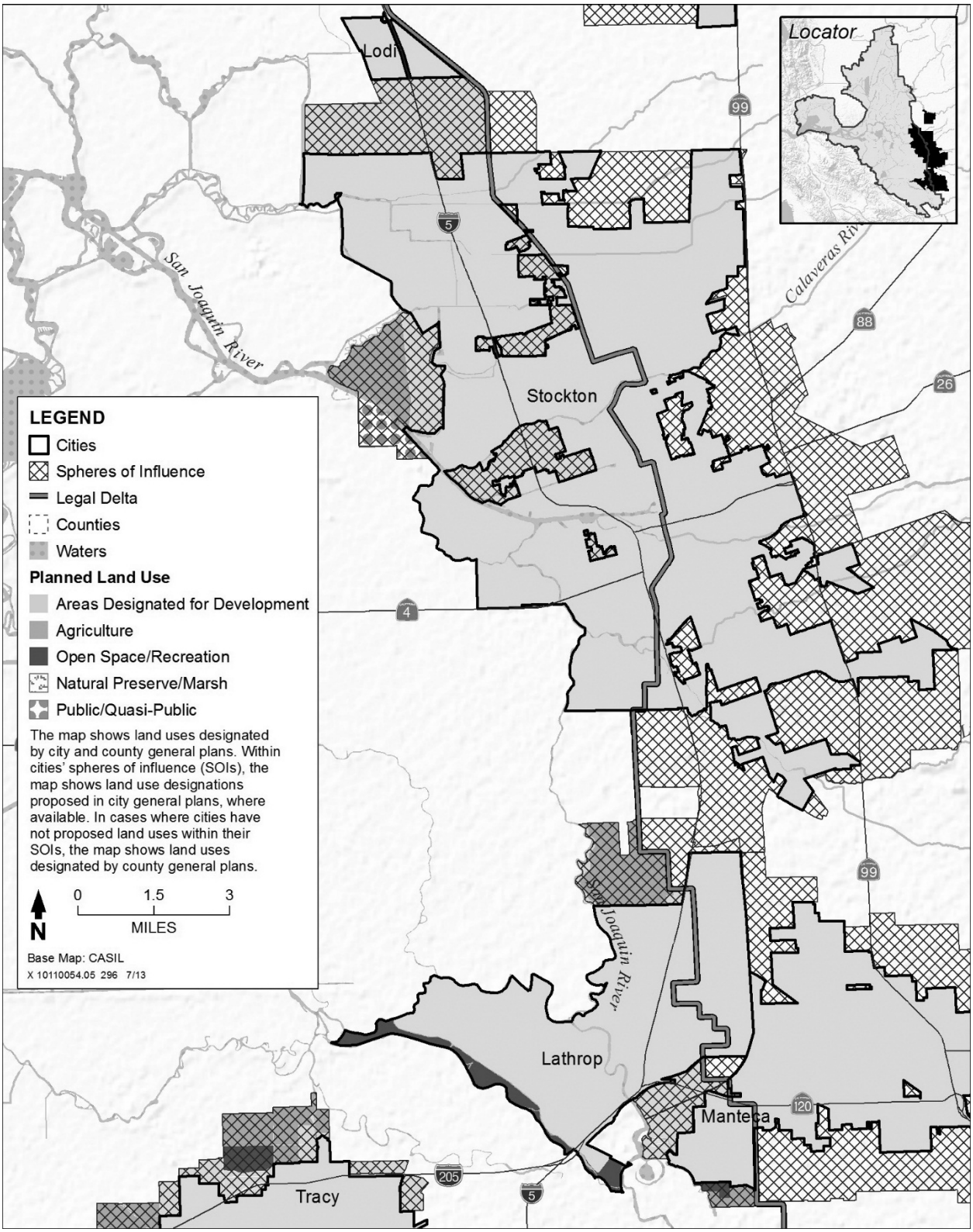


Figure 7-10

Cities of Stockton, Lodi, Lathrop, and Manteca and their Spheres of Influence

Sources: San Joaquin County 2008, City of Stockton 2011, City of Manteca 2012, City of Lathrop 2012

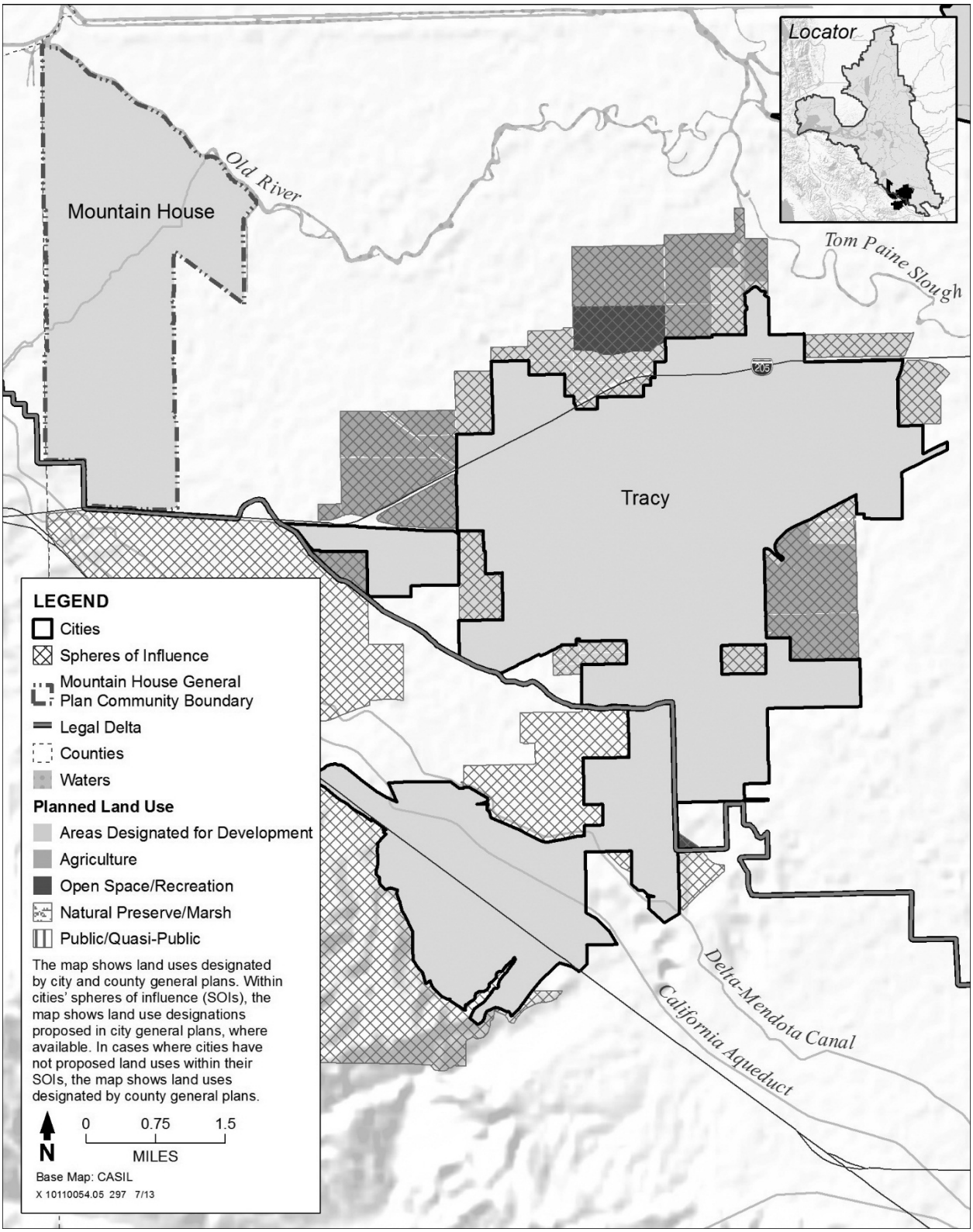


Figure 7-11

City of Tracy and its Sphere of Influence, and the Community of Mountain House

Sources: City of Tracy 2011, Mountain House Community Services District 2008, San Joaquin County 2008

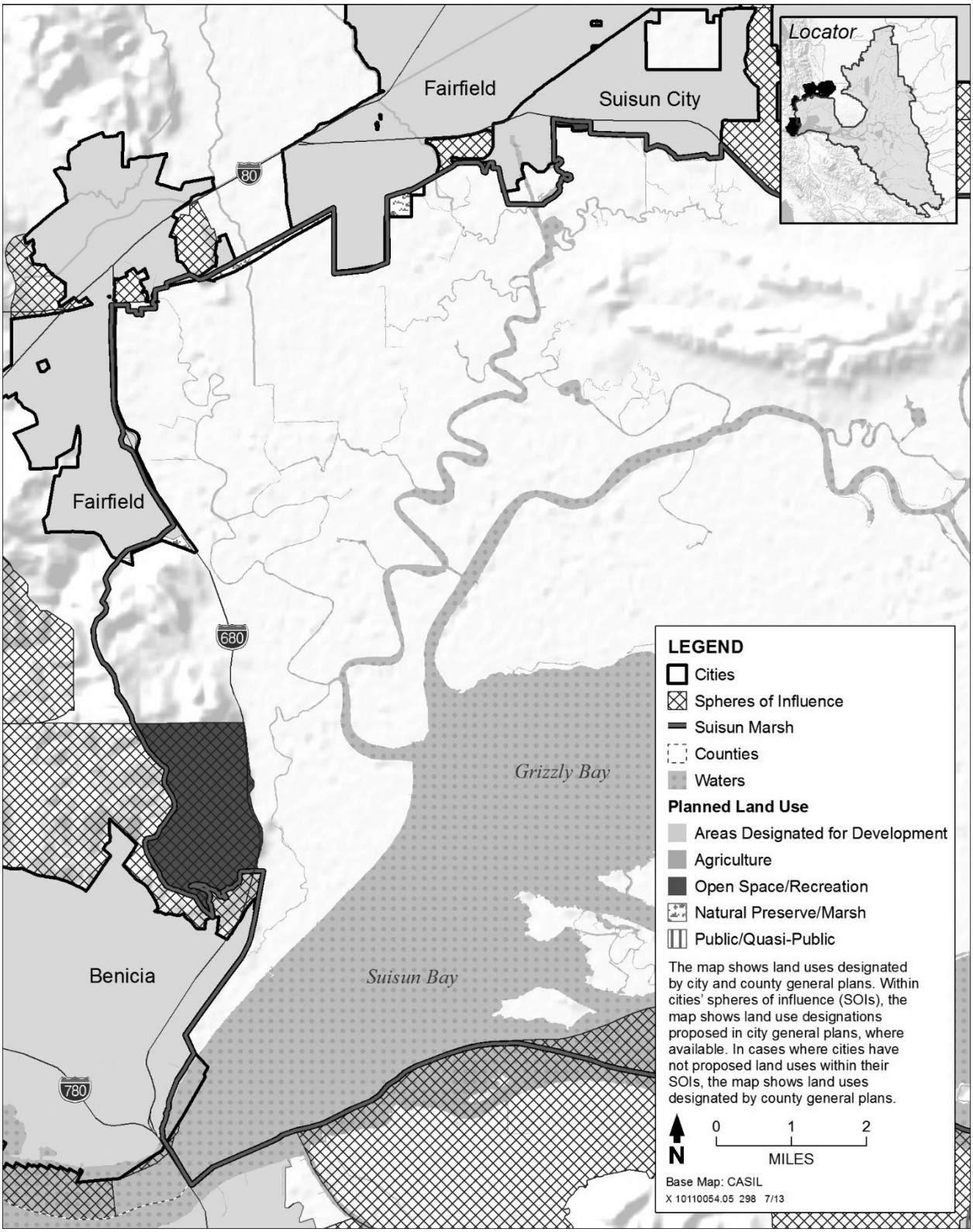


Figure 7-12
Cities of Fairfield, Suisun City, and Benicia and their Spheres of Influence
Sources: City of Benicia 2003, City of Fairfield 2008, City of Suisun City 2011

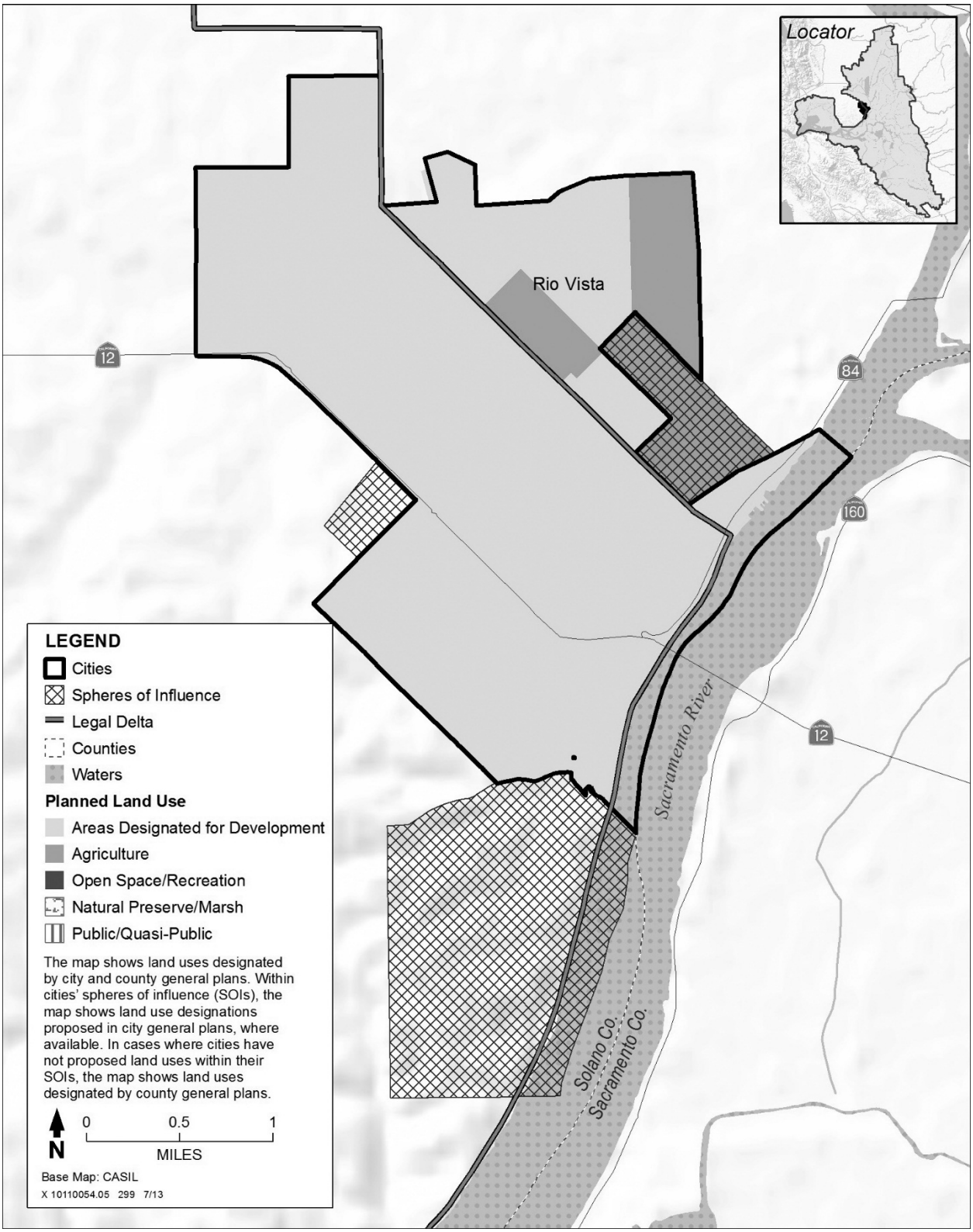


Figure 7-13
City of Rio Vista and its Sphere of Influence
Source: City of Rio Vista 2001

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Appendix 8
Setback Levee Evaluation Areas

Note: All content of this appendix is newly adopted.

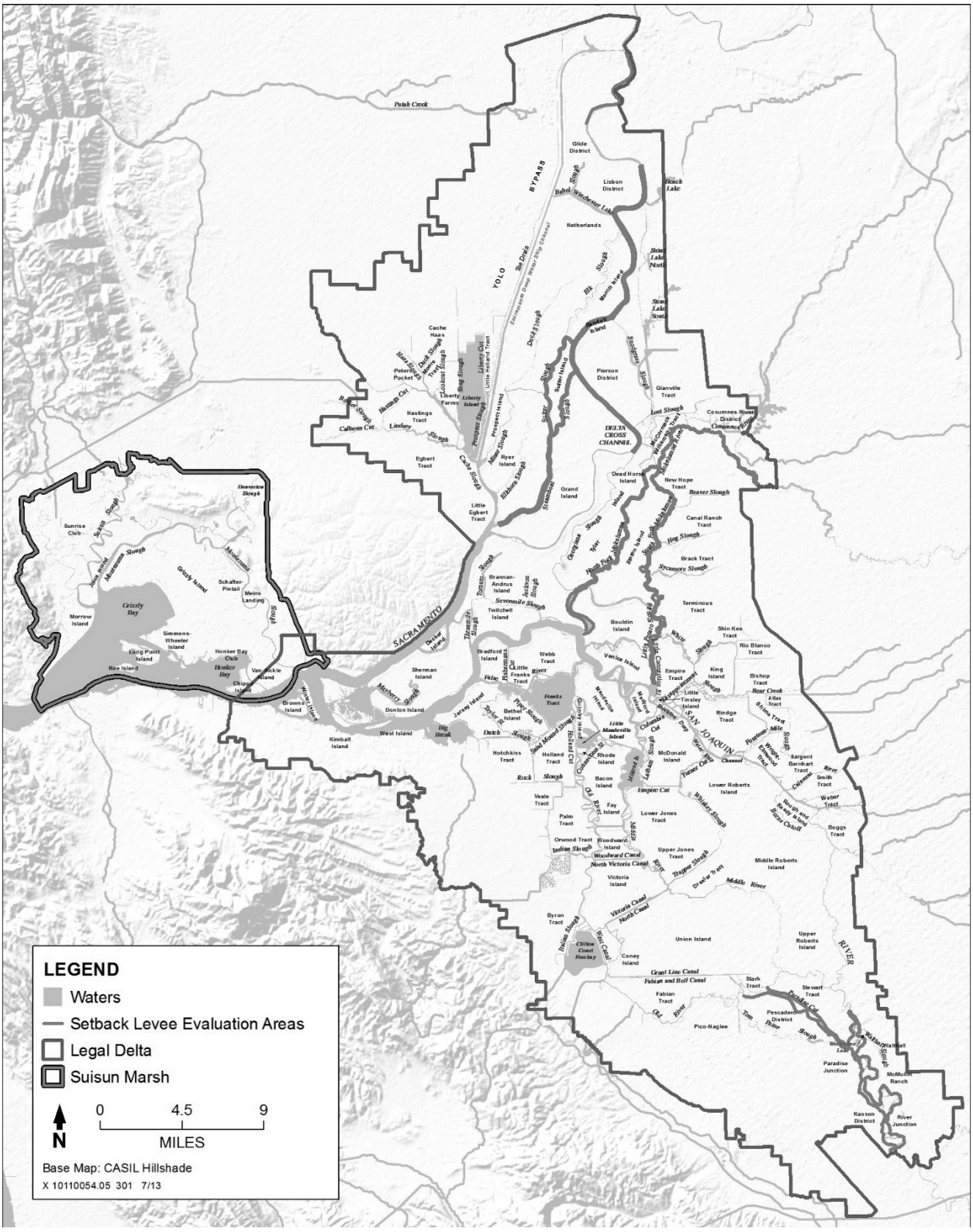

Figure 8-1
Setback Levee Evaluation Areas