CHAPTER 1
Governance and Region Description

The purpose of this Integrated Regional Water Management Plan (IRWMP) is to document the regional water resource management conditions, needs and strategies; to describe the process and projects that will improve regional water resources management in the IRWM region; and, to comply with the Final California Department of Water Resources (DWR) Integrated Regional Water Management (IRWM) Grant Program Guidelines. This report accomplishes these goals in the following six chapters:

- Chapter 1 Introduction, Governance, and Region Description
- Chapter 2 Objectives
- Chapter 3 Plan Development Process
- Chapter 4 Resource Management Strategies
- Chapter 5 Potential Projects and Prioritization
- Chapter 6 Implementation Strategy

The purpose of this chapter is to provide a description of the governance structure and provide the Region Description of the Northern Sacramento Valley (NSV) IRWMP region, which includes all or portions of the following counties:

- Butte County
- Colusa County
- Glenn County
- Shasta County
- Sutter County
- Tehama County

This chapter is prepared in accordance with the DWR IRWM Grant Program Guidelines, dated November 2012 (IRWM Guidelines)[1].

[1] Final DWR IRWM Grant Program Guidelines for IRWM Implementation and Planning grants funded by Proposition 84 (*The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coast Protection Bond Act of 2006*), Chapter 2, and the Stormwater Flood Management (SWFM) grants funded by Proposition 1E (*The Disaster Preparedness and Flood Prevention Bond Act of 2006*).

Chapter 1
Governance and Region Description

In accordance with the IRWM Guidelines, the IRWMP governance description must include the following elements:

- Regional Water Management Group
- Governance Structure
- Additional Provisions:
  - Public Outreach and Involvement Processes
  - Effective Decision Making
  - Balanced Access
  - Effective Communication
  - Long-Term Implementation
  - Coordination with Neighboring IRWM efforts and State and Federal Agencies
  - Collaborative Processes
  - Interim and Formal Changes
  - Updating or Amending the IRWMP

Additionally, a region description should include the following elements:

- Watersheds and Water Systems
- Internal Boundaries
- Water Supplies and Demands
- Water Quality
- Social and Cultural Makeup
- Major Water Related Objectives and Conflicts
- IRWMP Regional Boundary
- Neighboring/Overlapping IRWM efforts

These elements are described in more detail below. Information for the descriptions provided below was derived from previous documents and new information prepared during this IRWMP effort, the Sacramento Valley IRWMP prepared by the Northern California Water Association (NCWA) in 2006, and other regional planning documents.

1.1 GOVERNANCE

The governance of the IRWMP, including development of the Regional Water Management Group (RWMG), the RWMG governance structure, and other provisions for outreach, modification, and implementation are described below.

1.1.1 Regional Water Management Group

CWC 10539 defines an RWMG as follows:

> *RWMG means a group in which three or more local agencies, at least two of which have statutory authority over water supply or water management, as well as those other persons who may be necessary for the development and implementation of a plan that meets the requirements of CWC §10540 and §10541, participate by means of a joint powers agreement, Memorandum of Understanding (MOU), or other written agreement, as appropriate, that is approved by the governing bodies of those local agencies.*

The NSV RWMG consists of a group of six local agencies: the Counties of Butte, Colusa, Glenn, Shasta, Sutter, Tehama, all of which have some degree of statutory authority over water supply and water management. None of the signatories, however, have total control over water supply and water management in their respective boundaries. Therefore, a substantial effort has been made by the IRWMP signatories to solicit input and coordinate water supply planning with all of the agencies with authority over water supply and management within the IRWM planning area.

1.1.2 Governance Structure

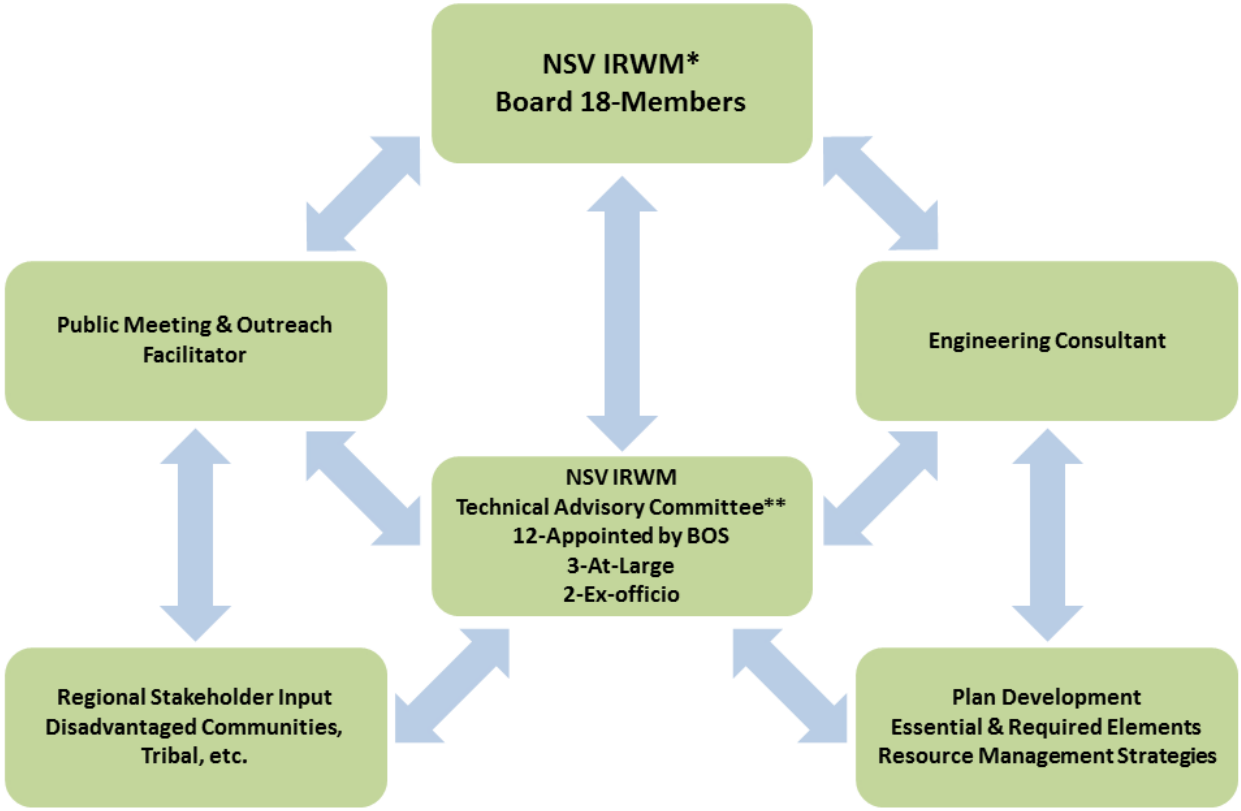
The current governance structure was developed and implemented during 2010 and 2011, prior to commencing development of this IRWMP. The process to develop that structure is documented in Technical Memorandum No. 3 (TM3), Appendix A to this IRWMP. TM3 describes the development and formation of the RWMG (the NSV Board) and its technical support group (Technical Advisory Committee, TAC). This structure was implemented pursuant to the provisions of the Four-County MOU, Appendix B to this IRWMP as a single document with the original MOU and subsequent amendments. The specific governance structure was formed through action by each of the six county Boards of Supervisors.

The 18-member NSV Board consists of three individuals selected by each of the respective county Boards of Supervisors. This composition was chosen to develop a supportable IRWMP to guide future water resources management decisions and help to secure implementation support. The NSV Board began meeting in January 2011 and focused its initial efforts on developing Bylaws that established the name of the organization, membership, purpose, names and duties of officers, meeting policies and procedures, and provisions for future amendments. NSV Board meetings are public and subject to the Brown Act, so that all people interested in the NSV IRWMP process have an opportunity to express their thoughts directly to the Board. Implementation details are set forth in the NSV Bylaws, which also describe the meeting policies and procedures for both the NSV Board and TAC. The NSV Bylaws are appended to this IRWMP as well (Appendix C). The TAC was established as a working-level group to act as staff to the Board. The relationships among the Board, the six counties and the TAC are shown on Figure 1-1 (see next page).

The NSV Board directs the activities of the TAC and receives its recommendations. Following adoption of this IRWMP, the Board's continuing role is to ensure that the IRWMP is implemented and updated, while safeguarding and supporting collaboration among stakeholders. Although the NSV Board is not an implementing entity, the membership of the NSV Board and

institutional structures within the NSV provide tremendous resources and capability for implementing most any project or program individually or in partnerships.

Figure 1-1. NSV IRWM Board Organizational Structure



* Each of the six counties Boards of Supervisors appoint members to the NSV Board, with at least one appointee being a county supervisor.
** Technical Advisory Committee – Six county staff and six landowner representative appointed by each of the six counties Boards of Supervisors (BOS), three at-large appointed by the Board, two regional organization self-appointed (ex-officio).

1.1.3 Additional Provisions

Additional provisions of the IRWMP governance are described below.

1.1.3.1 Public Outreach and Involvement Processes

Consistent with the Bylaws, all NSV Board meetings are open to the public. In compliance with the Brown Act, the NSV Board posts its meeting agendas and meeting packages in advanced of the meetings. Meeting minutes and sign-in sheets are kept for each of the meetings. Future meeting frequency will continue to be guided by both budget and agenda topic considerations, but generally continuing on a semi-annual basis, with the TAC continuing on a quarterly basis. The NSV Board expects to solicit public comments at its regular meetings at least annually on progress towards implementing the IRWMP.

To notify the public about the IRWMP's pending adoption, a Notice of Intent (NOI) to adopt this IRWMP was published in local newspapers throughout the region as shown in Appendix D.

1.1.3.2 Effective Decision Making

The current process of NSV Board decision-making has worked well since the NSV Board was established in late 2010, and began meeting in early 2011. Changes to the Bylaws have been adopted several times to improve the effectiveness of meetings and assure that decision-making is adequately supported. The Bylaws define voting requirements for both making regular decisions (for example, adopting IRWMP Goals and Objectives, providing guidance to the TAC and consultants, *etc*.) and amending the Bylaws. NSV Board decisions are informed by recommendations from the TAC, in addition to extensive public input at both TAC and NSV Board meetings.

1.1.3.3 Balanced Access

During the two-year period for development of this IRWMP, the NSV Board and TAC have made effective efforts at providing public access to their deliberations. Initial meetings were held at various locations throughout the region, eventually moving most meetings to Willows as a location central to the region. Two rounds of public workshops (January 2012 and June 2012) were held at three different locations each throughout the region to provide greater public access. The IRWMP web site has also proven to be a successful means of providing timely information to the public and allow public comments to be sent to the consultant team, NSV Board and TAC.

In addition, two separate letters at different points in the IRWMP development process were sent to each of the Tribes in the six-county NSV IRWMP region. One of the public outreach meetings was also held at the Cachil DeHe Band of Wintun Indians facilities in Colusa.

The county staff representatives on the TAC, one from each of the six counties, have also conducted substantial outreach to Disadvantaged Communities (DAC) and a wide range of interest groups. This has been conducted as a component of the local cost match pursuant to the Proposition 84 planning grant for the NSV IRWMP.

All meeting agendas, attachments and meeting minutes are distributed by email as well as through the NSV IRWMP web site (http://www.nsvwaterplan.org/).

1.1.3.4 Effective Communication

To date, the IRWMP process has focused on developing the IRWMP and providing communication within the NSV region. Much of that communication is described above in the content of “balanced access”. In addition, the NSV Board plans to continue informing its membership and the public of opportunities to learn more about important regional and statewide water issues, particularly those that could have an impact on water use and supplies within the NSV region. Many of the same public entities engaged in the NSV IRWMP also sponsor the periodic NSV Water Forum, which in the past has examined and heard presentations on issues related to the Sacramento-San Joaquin Delta, groundwater management and conjunctive use, and water quality. The NSV Board is cognizant that the NSV region’s concerns and opportunities benefit from being considered in the context of other water issues in California.

1.1.3.5 Long-Term Implementation

Implementation will be based on the MOU, as amended from time to time to reflect implementation obligations. The existing MOU (last amended in 2010) is aimed at the IRWMP planning process, leading to adoption of the IRWMP. Anticipated future changes to the MOU include but may not be limited to: (1) budget and funding sources to support the NSV Board and TAC implementation activities; (2) a process by which changes to the IRWMP are to be made, both interim and formal. Potential changes to the IRWMP are addressed in Sections 1.1.3.8 and 1.1.3.9.

It is clear that county staff will have an even more prominent role in IRWMP implementation than they have had in the planning process. This will include a range of activities that were done by consultants during IRWMP development with funding for those activities provided by the Proposition 84 planning grant. The counties continue to update their individual staff and institutional capabilities to assure that they will be able to make the most cost-effective use of their collective capabilities.

1.1.3.6 Coordination with Neighboring IRWM efforts and State and Federal Agencies

NSV Board meetings consistently include reports from DWR staff on a wide range of current water issues that may be of interest in the NSV region, which historically include details on special issues such as the Central Valley Flood Protection Plan and changes in the IRWM Guidelines. Coordination with other State agencies as well as federal agencies has been limited to seeking input on specific projects to be included in the IRWMP and interactions with Congressional representative staff at public outreach workshops throughout the IRWMP development process. Meetings were also held with Congressional representative staff prior to the development of the IRWMP to inform them of the upcoming IRWMP development process. The following Federal agencies were invited to the TAC, Board and Outreach meetings, but did not attend: USBR, USF&WS and USACE. Participation by State and federal agency representatives in the NSV Water Forum meetings has also provided valuable input and interaction on a number of important water issues addressed by the IRWMP. The Board believes the level of State and federal agency participation during the IRWMP development process was appropriate for the needs of the IRWMP.

The NSV region is also represented in the Roundtable of Regions and in the Strategic Focus Group for DWR's Strategic IRWM Plan as the current TAC Chair and other representatives from the NSV IRWM group regularly participate in these meetings. During Plan development, the current TAC Chair was also the appointed representative from the NSV region for the Strategic Focus Group.

Coordination with other RWMGs and water issues in their regions has been accomplished in three ways. The first is participation by several TAC county staff in conference calls of other RWMGs in the Proposition 84 designated Sacramento Valley funding region. These calls are directed at discussing common issues and concerns over how Proposition 84 implementation funds are allocated among the various RWMGs in the Sacramento Valley. The second is participation by the TAC Chair in the statewide "Roundtable of Regions", in which all RWMGs statewide discuss their issues and concerns about IRWMP planning, funding and

implementation. The third is the ongoing efforts at direct coordination with each of the RWMGs immediately adjacent to the NSV region.

1.1.3.7 Collaborative Processes

As addressed in Sections 1.1.3.3 and 1.1.3.4 above, the NSV RWMG has an excellent public process track record. An early example was the public process used to develop and adopt NSV IRWMP goals and objectives. The IRWMP consultant team developed an initial draft for discussion at TAC meetings, after which substantial changes were made based on extensive input from TAC members and the public. Initial recommendations from the TAC to the NSV Board were met with additional changes from NSV Board members, and several rounds of monthly TAC and NSV Board meetings leading to adoption of the final goals and objectives at the Board's June 2012 meeting. This extended process almost doubled the time in the IRWMP development schedule for this task, but assured that there was broad understanding of the meaning and implications of a wide range of potential goals and objectives.

The NSV Board expects that future amendments to the goals and objectives will be based on real-world experience during implementation of the IRWMP, and will be implemented in a similar way to the development of the initial goals and objectives.

1.1.3.8 Interim and Formal Changes

The NSV Board and TAC have developed and made use of solid, documented administrative procedures during development of the IRWMP. Interim changes to the IRWMP that do not alter either the goals or objectives, such as an updated list of ranked projects, are expected to be considered through adoption of an addendum to the IRWMP and an abbreviated public process through regular or special NSV Board meetings. More specifically, it is anticipated that the list of ranked projects will be updated annually as new project proposals are developed and new details on current proposed projects are known. A "formal change" to the IRWMP implies fundamental changes to the adopted NSV IRWMP, which would likely require a more formal approach. As described in Section 1.1.3.2, the NSV Board will develop appropriate changes to its Bylaws to provide the necessary authority and process to make both interim and formal changes to the IRWMP.

1.1.3.9 Updating or Amending the IRWMP

This would be a formal change to the IRWMP, which would require a thorough review of all components of the IRWMP as set forth in the then current DWR IRWM Guidelines. It is premature to know the extent to which an "update" planning process can be funded, or at least partially funded, with State funds. Regardless, the NSV Board expects to be able to expedite an update process as compared to the effort required to develop the initial IRWMP since: (1) the future focus will be on significant changes to the adopted IRWMP; and (2) the NSV Board has institutional experience and a workable governance structure which is expected to shorten both the time and effort leading to an updated, amended IRWMP. The NSV Board does not expect to consider any formal changes for at least two years following adoption. Amendments to the IRWMP will be driven by the need for any fundamental changes that may be required to protect the water resources of the region and meet the goals and objectives of the IRWMP.

The NSV Board expects to be able to modify the list of projects and programs included in the adopted IRWMP based on NSV Board discussion, public input during NSV Board meetings and NSV Board vote, as discussed in Section 1.1.3.8.

1.2 WATERSHEDS AND WATER SYSTEMS

In general terms, the watersheds included in this NSV IRWMP are tributary to the Sacramento River downstream of Shasta Dam and within all or portions of:

- Butte County
- Colusa County
- Glenn County
- Shasta County
- Sutter County
- Tehama County

The NSV IRWMP planning area does not include the Sacramento River upstream of Shasta Dam, the Trinity River system, or watershed areas outside of the participating counties listed above (for example, the Feather River upstream of the Butte County/Plumas County boundary, and the Trinity River system are not included because they are outside the boundaries of the participating counties). Although Shasta Lake and the Sacramento River upstream of Shasta Dam are within Shasta County, it is included in neighboring IRWMP efforts, described in Section 1.9 – Neighboring/Overlapping IRWMP.

1.2.1 General Description of Natural and Anthropogenic Water Features

General descriptions of the natural and anthropogenic water features in the region are provided in this section.

1.2.1.1 Natural Water Features

The main rivers within the region are the Feather and the Sacramento, which contribute significantly to the statewide water supply. According to the California Water Plan Update 2009, the Sacramento River provides approximately 80 percent of the inflow to the Delta, and it is the largest and most important riverine ecosystem in the State of California.

There are over 1,900 named streams and numerous unnamed tributaries within the IRWM planning area. Most of the streams within the IRWM planning area are eventually tributary to the Sacramento River. Natural water features are shown on Figure 1-2 (located at the end of Chapter 1).

The Sacramento River IRWMP prepared by NCWA describes the local watersheds in detail. General descriptions of some of the named watersheds tributary to the Sacramento and Feather Rivers, excerpted from that IRWMP, are provided below in alphabetical order.

The Antelope Creek watershed drainage is approximately 123 square miles, and the average stream discharge is 107,200 acre-feet per year (af/yr). In the wettest years, average flows in winter months range from 200 to 1,200 cubic feet per second (cfs). In the driest years, flows in winter average 50 cfs. In all but the wettest years, summer and early fall flows average from 20 to 50 cfs. The natural flow pattern is altered by diversions in the lower creek from spring through fall. Flows are typically diverted from April 1 through October 31.

The Battle Creek watershed is approximately 360 square miles. Monthly mean flow ranges from 265 to 766 cfs, with an average flow of 516 cfs.

The Big Chico Creek watershed is approximately 72 square miles. The average annual discharge is 102,100 acre-feet (ac-ft). Summer flows drop to an average of 30 cfs, and winter flows average more than 300 cfs.

The Butte Creek watershed is approximately 809 square miles. Water imported from the Sacramento and Feather Rivers through irrigation diversions substantially augments natural flows on the lower stretches via tailwater discharges. The mean monthly flow for the period of record at a gage station near Chico is 417 cfs. Peak flow occurs during mid-February and averages 826 cfs. The lowest flows are typically in September, averaging 119 cfs. Below Chico, instream flows downstream of Gorrill Dam during irrigation season, between mid-July and September, range from 5 to 25 cfs in most years.

The Lower Clear Creek watershed (below Whiskeytown Dam) is approximately 49 square miles. The current release schedule from Whiskeytown Dam to Clear Creek is 50 cfs (January through October) and 100 cfs (November and December).

The Deer Creek watershed is approximately 200 square miles. The creek itself is 60 miles long. The lower 10 miles of the creek passes through the valley floor where most of the flow is diverted. Peak monthly flows in wet winters reach up to 2,600 cfs. In the driest years, winter flows reach only 90 to 110 cfs. Minimum summer and fall base flows are 60 to 80 cfs.

Mill Creek flows for 60 miles draining an approximately 134-square-mile watershed, including several geothermal mineral springs on the southern flanks of Mt. Lassen. From 1929 to 1994, Mill Creek had an average annual runoff of 215,000 ac-ft, equivalent to a mean annual flow of 297 cfs, and a median flow of 175 cfs. There are no storage dams or reservoirs on Mill Creek; however, there are several diversion dams, including Ward Dam and Upper Diversion Dam.

Stony Creek flows for about 66 miles draining an approximately 773-square-mile watershed. According to the United States Geological Survey (USGS), the average discharge of the creek is about 400 cfs and ranges from 50 cfs in drought to 1,000 cfs in wet years. The maximum discharge was 39,900 cubic feet per second on February 24, 1957.

The Yuba River drains about 1,339 square miles with a total storage capacity in four dams of over 1 million ac-ft. The monthly mean flow for the gage station in Marysville on the Yuba River is 2,341 cfs. Flows range from 833 cfs during the summer to 4,740 cfs during the winter and spring. If fall flows in the lower Yuba River drop below 600 cfs, spawning habitat becomes limited.

1.2.1.2 Anthropogenic Water Features

There are many anthropogenic water features within the NSV IRWMP area, including water storage reservoirs, hydroelectric plants, and major water conveyance systems such as the Tehama-Colusa Canal and Glenn Colusa Canal system. Since 1944, the flow of the Sacramento River and its tributaries has been managed to a significant degree by the facilities of the Central Valley Project (CVP) and State Water Project (SWP), a system of reservoirs and conveyance facilities that help to deliver river water to users both within and outside the Sacramento River Basin. Flows in the Sacramento River are influenced by the operation of Shasta, Trinity, and Oroville Dams and other local projects, by climatic conditions, by land use, and by water rights and contractual allocations that govern the use of surface water and influence groundwater use.

Major CVP facilities Shasta Dam and Trinity Dam are immediately upstream of the NSV IRWMP region northern boundary. The largest SWP facility, Oroville Dam and reservoir, are located in Butte County on the east side of the NSV IRWMP planning area.

1.2.2 Major Water Related Infrastructure

Major water related infrastructure is shown on Figure 1-3 (located at the end of Chapter 1) and includes dams and reservoirs, hydroelectric power plants, and conveyance canals. Much of the infrastructure serves multiple purposes including water supply, flood control, hydroelectric power generation, and silt control. The major lakes and reservoirs, in the IRWMP planning area are listed in Table 1-1 and discussed below along with a discussion of the major conveyance canals.

Table 1-1. Major Lakes and Reservoirs

Name of Lake or Reservoir	Purpose		
	Water Supply/Storage	Hydro Power	Silt Control
Black Butte Reservoir[a]	Y	Y	Y
East Park Reservoir	Y	—	Y
Lake Oroville	Y	Y	Y
Lake Wyandotte	Y	—	Y
Whiskeytown Lake	Y	Y	Y
Paradise Reservoir	Y	—	Y
Stony Gorge Reservoir	Y	Y	Y
Thermalito Reservoir	Y	Y	Y
Spring Creek Reservoir[b]	—	—	—
Keswick Reservoir[c]	—	Y	Y

[a] Black Butte Reservoir is also used for Flood Control.
[b] Water treatment impoundment for Iron Mountain Mine runoff.
[c] Provides flow moderation.

The largest reservoirs of the CVP and SWP systems are discussed below.

1.2.2.1 Dams and Reservoirs

The major water storage reservoirs in the CVP and SWP are Shasta Lake, Trinity Lake, Lake Oroville, and Whiskeytown Lake.

Shasta Dam impounds the Sacramento River to form Shasta Lake, the largest reservoir in the CVP system at a capacity of 4.5 million ac-ft. Though not in the planning area, it provides primary control over Sacramento River Flow.

Trinity Dam impounds the Trinity River to form Trinity Lake, which is the second largest reservoir in the CVP system at 2 million ac-ft. The Trinity River is not naturally a tributary to the Sacramento River, nor is it in the NSV IRWMP planning area. However, water released from Trinity Lake is diverted at Lewiston Dam on the Trinity River into Clear Creek Tunnel that discharges into Clear Creek. Clair A. Hill Dam impounds Clear Creek to form Whiskeytown Lake. Clear Creek is a tributary of the Sacramento River. Thus a portion of the flow from the Trinity River is diverted into the Sacramento River system.

Oroville Dam impounds the Feather River at Oroville to form Lake Oroville, the largest reservoir in the SWP system at 3.5 million ac-ft.

Spring Creek Dam impounds Spring Creek and South Fork Spring Creek to form Spring Creek Reservoir. The U.S. Bureau of Reclamation constructed this impoundment to capture acid mine drainage from Iron Mountain Mine. Dam releases are treated and released to flow into the Sacramento River.

Keswick Dam impounds the Sacramento River to form the 23,800 ac-ft Keswick Reservoir. The purpose of this CVP dam is to regulate peaking power releases from Shasta Dam.

There are numerous smaller reservoirs in the NSV IRWM Region, including Black Butte, Stony Gorge, and East Park Reservoirs.

1.2.2.2 Conveyance Canals

The two major water conveyance systems are the Tehama-Colusa Canal and the Glenn Colusa Canal system. These canals, and several smaller canal systems, are shown on Figure 1-3 (located at the end of Chapter 1).

The Tehama Colusa Canal (TCC) is located on the west side of the Sacramento Valley and originates at the Red Bluff Diversion Dam. The TCC is operated by the Tehama Colusa Canal Authority (TCCA), located in Red Bluff. Paraphrasing from the TCCA website, the TCCA is a Joint Powers Authority comprised of 17 CVP water contractors. The service area spans four counties (Tehama, Glenn, Colusa, and Yolo) along the west side of the Sacramento Valley, providing irrigation water to farmers growing a variety of permanent and annual crops. TCCA operates and maintains the 140 mile Tehama-Colusa and Corning canals irrigation water supply system. The service area is approximately 150,000 acres, producing over $250 million in crops per year, and contributing $1 billion to the regional economy annually.

The Glenn Colusa Canal system is located between the TCC and the Sacramento River and originates at its main pump station on the Sacramento River northwest of Hamilton City. The Glenn Colusa Canal is operated by the Glenn Colusa Irrigation District (GCID), located in Willows. Paraphrasing from the GCID website, GCID is the largest district in the Sacramento Valley. The district boundaries cover approximately 175,000 acres; of which 153,000 acres are deeded property and 138,800 are irrigable. There are 1,076 landowners in the district and an additional 300 tenant water users. An additional 5,000 acres of private habitat land and winter water supplied by GCID to thousands of acres of rice land provide valuable habitat for migrating waterfowl during the winter months. GCID's 65-mile long Main Canal conveys water into a complex system of nearly 1,000 miles of canals, laterals and drains, much of it constructed in the early 1900s.

There are several other, smaller canal systems on both sides of the Sacramento River. These canal systems are also shown on Figure 1-3 (located at the end of Chapter 1).

1.2.3 Flood Management Infrastructure

Flood control structures mainly consist of levees along the major rivers and tributaries, weirs and bypass channels. The major flood control infrastructure is shown on Figure 1-4 (located at the end of Chapter 1).

The Sacramento River Flood Control Project (SRFCP) was developed in the early 1900's to control flooding along the Sacramento River. According to the DWR Division of Flood Management Fact Sheet, there are ten overflow structures in the SRFCP (six weirs, three flood relief structures, and an emergency overflow roadway) that serve as pressure relief valves in a water supply system. Weirs are defined as lowered sections of levees that allow flood flows in excess of the downstream channel capacity to escape into a bypass channel or basin.

Of the six SRFCP weirs, three are located within the NSV IRWM planning area; the Moulton Weir (completed in 1932), the Colusa Weir and Bypass (completed in 1933), and the Tisdale Weir (completed in 1932). The Fremont Weir (completed in 1924) is located on the south levee of the Sacramento River, south of the IRWM region. The two remaining weirs, the Sacramento Weir, and the Cache Creek Weir, are outside of the IRWM Planning area, but also appear on Figure 1-4 (located at the end of Chapter 1).

All overflow structures except the Sacramento Weir pass floodwaters by gravity once the river reaches the overflow water surface elevation. The Sacramento Weir has gates on top of the overflow section that hold back floodwaters until opened manually by the DWR Division of Flood Management.

Four other relief structures are concentrated along 18 river miles between Big Chico Creek (River Mile 194) and the upstream end of the east bank levee of the SRFCP (near River Mile 176). These structures function like weirs but are not called weirs because they do not have unique structural characteristics. All of these relief structures convey water into the Butte Basin (a natural trough east of the river) upstream of the levee system designed to guide the flood waters.

1.2.4 Major Land Use Divisions

Major land use divisions are shown on Figure 1-5 (located at the end of Chapter 1) and summarized in Table 1-2.

Table 1-2. Major Land Use Divisions

Land Use Type	Approximate Area, square miles	Approximate Area, acres
Agriculture[(a)]	1,382	884,000
Barren/Other	43	28,000
Conifer Forest	1,978	1,266,000
Hardwood Forest	2,161	1,383,000
Herbaceous (Annual Grassland)	1,817	1,163,000
Rice	764	489,000
Shrub	985	631,000
Urban	207	132,000
Water	104	66,000
Total	9,441	6,042,000

[(a)] Not including Land Use Types identified as rice.

As shown on Figure 1-5 (located at the end of Chapter 1), and listed in Table 1-2, the majority of the IRWM planning area (approximately 63 percent) is either forest or grassland with the second largest division being the various agricultural land use types.

A short description of each major land use division, based on descriptions in the Butte County General Plan Environmental Impact Report (EIR) and the USGS National Land Cover Data (NLCD) 92 Land Cover Class Definitions is provided below.

1.2.4.1 Agriculture and Rice

The vast, flat floodplain of the Sacramento River is one of the best agricultural areas in the world. Within the valley, agriculture is the largest land use, with the majority of farmland aggregated in the flat, rural areas of the region. The farming environment in Sacramento Valley is rich with high quality soils that, together with the temperate Mediterranean climate, support a variety of crops, including fruits and nuts, field, seed and vegetable crops. Other agricultural goods, such as livestock, apiary, nursery plants and timber, are also produced. The five most land-intensive crops in the region are rice, almonds, olives, peaches, and English walnuts.

1.2.4.2 Barren/Other

Barren/Other areas are characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

1.2.4.3 Conifer Forests

Conifer forest types are dominated by conifers but vary in the dominant species and elevations at which they occur. The conifer forest types in the NSV IRWMP area include:

- Montane hardwood-conifer forests at elevations below 4,000 feet. This forest type generally has little understory except in areas of disturbance.
- Ponderosa pine forests generally occur at elevations below 7,000 feet. Stands also may include a shrub and herbaceous layer.
- Sierran mixed conifer forests occur in areas of greater precipitation than ponderosa pine forest. Many species of shrubs, grasses, and forbs occur in the understory of this forest type.
- Red fir forests occur between 6,000 and 9,000 feet in elevation and are generally dominated by red fir with few other species and little understory because of the dense shade and thick layer of dropped needles on the ground.
- Subalpine conifer forests occur at the highest elevations. The understory is usually sparse, consisting of shrubs, grasses, and annuals.

1.2.4.4 Hardwood Forests

Hardwood forests, mostly oak woodlands and riparian forests, are scattered throughout the region but are concentrated in the transition area between the lower valley and higher elevations of the region and along most of the drainages in the study area. Oak woodland community types are described as follows:

- Valley oak woodland can vary from savannas of annual grasslands with few trees to dense stands of trees. Annual grasses and forbs dominate the herbaceous layer.
- Blue oak woodland occurs in the Sierra Nevada, Cascade, and coast range foothills of the region and is dominated by blue oak, with interior live oak and valley oak as associates. The understory of blue oak woodland is often mostly annual grasses with low densities of several shrub species forming clumps in this landscape. Dominant shrub species include poison oak (*Rhus diversiloba*), ceanothus (*Ceanothus sp*.), redberry (*Rhamnus crocea*), California coffeeberry (*Rhamnus californica*), and California buckeye (*Aesculus californica*).
- Blue oak–foothill pine is co-dominated by foothill pines (*Pinus sabiniana*) and blue oaks and occurs at slightly higher elevations than blue oak woodland. The understory of blue oak–foothill pinewoodlands often contains shrub species, including manzanita (*Arctostaphylos sp*.), ceanothus, redberry, California coffeeberry, poison oak, toyon (*Heteromeles arbutifola*), and California buckeye, interspersed with smaller areas of annual grassland than is typical in the lower elevation blue oak woodland.
- Riparian woodlands are typically dominated by a mixture of trees and shrubs, including Fremont cottonwood (*Populus fremontii*), valley oak (*Quercus lobata*), Oregon ash (*Fraxinus latifolia*), Himalayan blackberry (*Rubus spp*.), and a variety of willows (*Salix spp*.).

1.2.4.5 Herbaceous (Annual Grassland)

Annual grasslands occur throughout the NSV IRWMP region and are typically used as non-irrigated, seasonal grazing pastures for livestock. Annual grasslands encompass vernal pool terrains and also form the understory for oak woodland and occur as vacant parcels in developed areas. Annual grasslands are dominated by nonnative annual grasses with intermixed annual and perennial forbs.

1.2.4.6 Shrub

Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall, with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.

1.2.4.7 Urban

Areas characterized by a high percentage (30 percent or greater) of constructed materials (*e.g.* asphalt, concrete, buildings, *etc*.).

1.2.4.8 Water

Areas of open water or permanent ice/snow cover.

1.2.5 Water Resources

To document the water resources available to the NSV IRWM region, a conceptual, water balance model was developed as an illustrative example of how surface water, precipitation, and groundwater inflows and outflows from the region. This illustrative water balance, based on WY 2010 data, is discussed below, followed by a description of the status of groundwater monitoring in the NSV IRWM region and other available water resources such as recycled water.

1.2.5.1 Surface Waters

When considering surface water resources in the NSV region, stream flows into the region and stream flows out of the region must be considered along with precipitation within the area. It is important to note, however, that much of our surface water resources originate in the forested areas in the upper watershed. Although sparsely populated, these areas make up 63 percent of the NSV region and play a key role in maintaining a healthy water supply.

Streamflow measurements for regional inflow and outflow points for WY 2010 were obtained from the California Data Exchange Center (CDEC) maintained by the DWR. The sites measuring surface stream inflows to and outflows from the valley floor on major rivers and creeks are shown on Figure 1-6 (located at the end of Chapter 1) and listed in Tables 1-3 and 1-4. Many of these are USGS streamflow gages.

Table 1-3. Surface Inflow Sites and Total Volumes for WY2010

ID	Station	Total Volume, ac-ft
KES	Keswick Reservoir	4,781,929
FTO	Feather River at Oroville	1,775,558
TFR	Thermalito Forebay	1,159,240
MRY	Yuba River Near Marysville	1,011,911
COT	Cottonwood Creek Near Cottonwood	779,111
COW	Cow Creek Near Millville	507,878
IGO	Clear Creek at Igo	393,800
BAT	Battle Creek Below Coleman Fish Hatchery	330,563
THO	Thomes Creek at Paskenta	269,923
MLM	Mill Creek Near Los Molinos	260,805
BCK	Butte Creek Near Chico	209,745
DCV	Deer Creek Near Vina	208,191
BLB	Black Butte	208,162
BIC	Big Chico Creek Near Chico	96,010
BRW	Bear River Near Wheatland	88,658
ECP	Elder Creek Near Paskenta	67,217
	Estimate of Ungaged Inflows[(a)]	2,000,000
	Total	14,148,701

[(a)] Ungaged inflows were estimated by the USGS for the Central Valley Hydrologic Model using the USGS Basin Characterization Model.

Table 1-4. Surface Outflow Sites and Total Volumes for WY2010

ID	Station	Total Volume, ac-ft
VON	Sacramento River at Verona	11,559,780
SBP	Sutter Bypass at RD 1500 Pump	911,034
	Total Surface Outflow Volume	12,470,815

Based on the data presented in Tables 1-3 and 1-4, for WY2010, approximately 1.7 million ac-ft of water was consumptively used or recharged to the groundwater basin.

Based on the estimated natural runoff for the Sacramento Valley, WY 2010 was designated as a "Below Normal" water year by DWR[2]. It must be emphasized that surface water supplies must be analyzed over multiple years before conclusions can be drawn with regards to water supply sustainability. DWR has defined five year types for the Sacramento River. Over the past 30 years, 16 years were considered wet or above normal, and 14 years were considered below normal, dry, or critically dry (Table 1-5). Summary statistics of estimated inflows from the sites in Table 1-3 complied by the USGS for Central Valley Hydrologic Model (CVHM) are also provided for each year type. It is interesting to note that a "Normal" year is not defined (even though many analysts try to define a normal year for planning purposes). Total inflows ranged from a low of 7.3 million ac-ft to a high of 36.5 million ac-ft, or approximately five times the lowest annual value, over the 30 year period. Other resources also describe the range of water supply in the Sacramento River[3]. This variability in supply presents a substantial challenge for water managers. Variability in supply is accommodated through various factors including but not limited to reservoir operations and conjunctive management of surface water and groundwater supplies.

Table 1-5. Summary of Surface Inflow Volumes for Water Years 1974-2003

Year Type/ Sacramento River Index		Total Inflows USGS CVHM Model Water Years 1974 – 2003, ac-ft			
		No. Years	Minimum	Average	Maximum
Wet	W	11	18,700,586	26,196,021	36,494,678
Above Normal	AN	5	14,874,016	17,656,116	20,514,478
Below Normal	BN	1	12,174,781	12,174,781	12,174,781
Dry	D	6	11,008,973	12,048,831	13,018,998
Critically Dry	C	7	7,334,635	9,720,390	12,206,400
	Total	30			

1.2.5.1.1 Sacramento River

The Sacramento River is the largest river in California, receiving inflows from several large watersheds. The Upper Sacramento, the McCloud River and the Pitt River are impounded by Shasta Dam to form Shasta Lake. At the point where it enters the Redding Basin at the north end of the NSV Region, the flow in the Sacramento River is controlled through releases from Shasta Dam and through regulation at Keswick Dam, 9 miles downstream. USGS gage 11370555, Sacramento River at Keswick Dam, has been in operation since October 1938.

[2] DWR Sacramento River Index (http://www.water.ca.gov/) is calculated based on a 40-30-30 weighting of runoff that occurs in October-March and April-June, and the previous year's index, respectively.

[3] Meko, D. M. 2001. Reconstructed Sacramento River System Runoff From Tree Rings. Report prepared for the California Department of Water Resources, July 2001.

The Sacramento River receives substantial tributary inflow as it flows south through the Sacramento Valley. These tributaries – listed from north to south – are each briefly described below, along with associated stream gages[4].

1.2.5.1.1.1 Cow Creek

Cow Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank about 23 miles downstream from Shasta Dam and 4 miles east of the Town of Anderson at river mile (RM) 277. USGS flow gage 11374000, Cow Creek near Millville, has been in operation since October 1, 1949 and is located approximately 2.9 miles upstream of the mouth of the creek.

1.2.5.1.1.2 Battle Creek

Battle Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank at RM 269. USGS flow gage 11376550, Battle Creek below Coleman Fish Hatchery, has been in operation at this location since October 1, 1961, except for November and December 1996.

1.2.5.1.1.3 Cottonwood Creek

Cottonwood Creek flows from the Coast Range and enters the Sacramento River on the west bank at approximately RM 272. USGS flow gage 11376000, Cottonwood Creek near Cottonwood, has been in operation at this location since October 1, 1940. The USGS stream gage is located about three river miles upstream of the mouth.

1.2.5.1.1.4 Paynes and Sevenmile Creeks

Paynes Creek and its tributary Sevenmile Creek flow from the Sierra Nevada foothills and enter the Sacramento River on the east bank at RM 250, between the Red Bluff Diversion Dam and Bend Bridge. Flow data for these creeks has not been available since the USGS flow gage was shut down in 1966.

1.2.5.1.1.5 Antelope Creek Group

Antelope Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank at RM 232. No flow gage has been available for this location since 1982. Inflow from this creek has been estimated at the boundary and included as ungaged inflow.

1.2.5.1.1.6 Mill Creek

Mill Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank at RM 228. USGS flow gage 11381500, Mill Creek at Los Molinos, has been in operation since October 1928 approximately 5.5 river miles upstream of the mouth.

[4] Data and information about the stream gauges have been provided if they were available at the time of writing.

1.2.5.1.1.7 Elder Creek

Elder Creek flows from the Coast Range and enters the Sacramento River on the west bank at RM 229. USGS flow gage 11379500, Elder Creek near Paskenta, has been in operation at this location since October 1948.

1.2.5.1.1.8 Thomes Creek

Thomes Creek flows from the Coast Range and enters the Sacramento River on the west bank at approximately RM 225. Since USGS flow gage 11382000, Thomes Creek near Paskenta, discontinued operation in September 1996, measured flow data is not available. Inflow from this creek has been estimated and included as ungaged inflow.

1.2.5.1.1.9 Deer Creek

Deer Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank at RM 218. USGS flow gage 11383500, Deer Creek near Vina, provides flow data for Deer Creek.

1.2.5.1.1.10 Stony Creek

Stony Creek flows from the Coast Range and enters the Sacramento River on the west bank at RM 190. Regulated flows released from East Park Reservoir, completed in 1910, flow into Stony Gorge Dam, completed in 1928, and then into Black Butte Dam, completed in 1963. Inflow data for 2012 is the reported Black Butte reservoir releases (USACOE 1990-2010).

1.2.5.1.1.11 Big Chico Creek

Big Chico Creek flows from the Sierra Nevada foothills and enters the Sacramento River on the east bank at RM 196. USGS flow gage 11384000, Big Chico Creek near Chico, was in operation from October 1930 through September 1986 approximately 14 miles upstream of the mouth. The USGS site was decommissioned and later re-activated and operated by DWR.

1.2.5.1.1.12 Butte and Little Chico Creeks

Butte and Little Chico Creeks flow from the Sierra Nevada foothills on the east side of the Sacramento Valley. Little Chico Creek joins Butte Creek, which flows into Butte Slough, which then flows to the Sutter Bypass. USGS flow gage 11390000, Butte Creek near Chico, has been in operation since October 1930 providing flow data on Butte Creek.

1.2.5.1.2 Feather River

The Feather River flows from the Sierra Nevada on the east side of the Sacramento Valley, and its flows are regulated through controlled releases from Oroville Dam (constructed under the State Water Project and completed in 1968). Several tributary inflows augment the Feather River prior to joining the Sacramento River.

The Feather River flows from the Sierra Nevada and enters the Sacramento River near RM 80. Inflow data represents releases from Oroville Dam and the Thermalito complex. USGS gage 11407000, Feather River at Oroville, has been in operation since October 1901. CDEC includes manually entered monthly volumes for water flowing from Oroville Dam into the Thermalito Forebay. Total inflow is the sum of the flows at USGS gage 11407000 and flow into the Thermalito complex.

Tributaries to the Feather River – listed from north to south – are each briefly described below, along with their measurement and gaging facilities.

1.2.5.1.2.1 Yuba River

The Yuba River flows from the Sierra Nevada on the east side of the Sacramento Valley and enters the Feather River near RM 27. Inflow data represents releases from Englebright Dam after completion, plus flows from the tributaries, Deer Creek and Dry Creek, which enter the Yuba River below Englebright Dam. USGS flow gage 11421000, Yuba River near Marysville, was operated by the USGS until 2003 when the Yuba County Water Agency assumed operations and installed a datalogger.

1.2.5.1.2.2 Bear River

The Bear River flows from the Sierra Nevada Mountains and enters the Feather River near RM 12. Inflow data represents releases from Camp Far West Reservoir after dam completion. USGS flow gage 11424000, Bear River near Wheatland, has been in operation since October 1928 and is jointly operated and maintained by USGS and DWR.

1.2.5.1.3 Sacramento River Outflows

The Sacramento River flows out of the NSV region near Verona. The Sacramento River at Verona gaging station is operated by the USGS and DWR. The station is used to quantify surface outflows from the NSV region. Just upstream of the site, some flow in the Sacramento River can be shunted into the Sutter Bypass under flood conditions. To ensure all outflow from the NSV region is accounted for, the flow at the Sutter Bypass at Road 1500 pump is additionally included as an outflow. This site is operated by DWR.

1.2.5.2 Precipitation

The substantial variability in Sacramento River inflows described previously has its roots in the temporal variability in precipitation within the region. Annual precipitation volumes were estimated for the IRWMP region as a whole and for the valley floor area using the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system[5].

[5] http://www.prism.oregonstate.edu/

Based on the PRISM datasets, average annual precipitation over the whole IRWMP region ranged from 20.7 inches to 73.2 inches between 1981 and 2010 (Table 16). Table 1-6, also presents precipitation for the mountain region (IRWMP region, not including the valley floor), and for the valley floor. Substantial spatial variability in precipitation is found throughout the region. Based on average precipitation for the 30-year period, precipitation increases across the region from south to north and also as elevation increases from the valley floor up the slopes of the Sierra Nevada and Coastal mountain ranges (Figure 1-7[6] - located at the end of Chapter 1). In general, given that the portion of the Coastal Range in the IRWMP region is on the leeward side of the mountains, precipitation is less than for the Sierra Nevada mountain area.

As indicated in Table 1-6, precipitation in the valley floor area ranged from 13.0 inches to 47.8 inches between 1981 and 2010. As described above, precipitation is generally less on the valley floor than in mountain areas, and increases across the region from south to north. The valley floor area received a total of 5.4 million ac-ft of precipitation in the 2010 water year. The spatial variability of precipitation on the valley floor for WY2010 is shown on Figure 1-8[7] (located at the end of Chapter 1).

1.2.5.3 Groundwater

The water resources of the Sacramento Valley are substantially supplemented by groundwater. In addition, there are numerous, smaller groundwater basins in the IRWM region that are being used by local residents and irrigators, and available groundwater quality and quantity data from these smaller groundwater basins may be limited. The focus of this section of the region description is to provide a general description of groundwater conditions over the NSV region as a whole. This discussion focuses on the two main groundwater basins. The two main groundwater basins are the Sacramento Valley Groundwater Basin and the Redding Groundwater Basin. The Sacramento Valley Groundwater Basin contains 12 subbasins that underlie approximately 4,200 square miles within the valley floor area (Figure 1-9 - located at the end of Chapter 1). The Redding Area Groundwater Basin contains six subbasins covering 600 square miles within the valley floor area. Tables 1-7 through 1-11 summarize the available information for the 18 subbasins.

The IRWMP region includes six counties in the NSV Valley: Shasta, Tehama, Glenn, Butte, Colusa and Sutter. Many of the underlying groundwater subbasins extend across boundaries of multiple counties and, in some cases, extend into counties that are not included in the IRWMP region. For these instances, no attempt has been made to divide the descriptive data associated with the subbasins by county. Table 1-7 provides a listing of the 18 groundwater subbasins, the counties they underlie, and the associated surface area.

[6] PRISM annual precipitation shown on the figure has been resampled to 250 meter resolution from 800 m resolution using bilinear interpolation for purposes of display.

[7] PRISM annual precipitation shown on the figure has been resampled to 250 meter resolution from 4 km resolution using bilinear interpolation for purposes of display.

Table 1-6. Summary of PRISM Annual Precipitation for the IRWMP Region, Mountain Area, and Valley Floor, 1981 to 2010

Year	SRI Year Type[a]	Annual Precipitation, inches			Annual Precipitation, million ac-ft		
		IRWMP Region	Mountain Area	Valley Floor Area	IRWMP Region	Mountain Area	Valley Floor Area
1981	D	47.9	61.2	29.9	24.2	17.7	6.5
1982	W	45.0	56.7	29.3	22.7	16.4	6.3
1983	W	73.2	92.3	47.8	37.0	26.7	10.3
1984	W	27.5	35.6	16.9	13.9	10.3	3.6
1985	D	21.6	27.3	14.0	10.9	7.9	3.0
1986	W	38.9	49.4	24.6	19.6	14.3	5.3
1987	D	32.4	41.5	20.5	16.4	12.0	4.4
1988	C	27.6	35.3	17.6	14.0	10.2	3.8
1989	D	27.4	35.6	16.7	13.9	10.3	3.6
1990	C	22.3	28.3	14.3	11.3	8.2	3.1
1991	C	28.4	35.3	18.9	14.3	10.2	4.1
1992	C	36.1	45.3	24.2	18.3	13.1	5.2
1993	AN	43.3	53.9	29.2	21.9	15.6	6.3
1994	C	27.7	34.2	19.1	14.0	9.9	4.1
1995	W	60.9	77.1	39.1	30.8	22.3	8.5
1996	W	50.0	65.7	29.0	25.3	19.0	6.3
1997	W	34.5	43.6	22.5	17.5	12.6	4.9
1998	W	62.1	76.4	42.9	31.4	22.1	9.3
1999	W	27.4	36.6	15.2	13.9	10.6	3.3
2000	AN	36.7	45.6	24.6	18.5	13.2	5.3
2001	D	40.1	49.1	28.1	20.3	14.2	6.1
2002	D	33.2	42.5	20.6	16.8	12.3	4.5
2003	AN	37.9	46.7	25.9	19.1	13.5	5.6
2004	BN	33.9	41.1	23.9	17.1	11.9	5.2
2005	AN	45.5	57.0	29.9	23.0	16.5	6.5
2006	W	38.4	49.1	24.2	19.4	14.2	5.2
2007	D	20.7	26.6	13.0	10.5	7.7	2.8
2008	C	24.5	30.4	16.6	12.4	8.8	3.6
2009	D	28.2	35.3	18.5	14.2	10.2	4.0
2010	BN	45.2	56.7	29.7	22.8	16.4	6.4
	Minimum	20.7	26.6	13.0	10.5	7.7	2.8
	Maximum	73.2	92.3	47.8	37.0	26.7	10.3
	Average	37.3	47.1	24.2	18.8	13.6	5.2
	Wet Year Average	45.8	58.3	29.1	23.2	16.9	6.3
	Above Normal Year Average	40.8	50.8	27.4	20.6	14.7	5.9
	Below Normal Year Average	39.5	48.9	26.8	20.0	14.2	5.8
	Dry Year Average	31.4	39.9	20.2	15.9	11.5	4.4
	Critically Dry Year Average	27.8	34.8	18.5	14.1	10.1	4.0

[a] SRI denotes Sacramento River Index. Note that the SRI is based on a water year (Oct. - Sept.), whereas the PRISM precipitation totals are reported on a calendar year basis.

Table 1-7. Inventory of Subbasins and Corresponding Surface Areas within the Sacramento Valley and Redding Groundwater Basins (DWR Bulletin 118, 2003)

Subbasin Name	Subbasin Number	County	Surface Area	
			Acres	Square Miles
Redding Area Groundwater Basin				
Bowman	5-6.01	Tehama	85,330	133
Rosewood	5-6.02	Tehama	45,230	71
Anderson	5-6.03	Shasta	98,500	154
Enterprise	5-6.04	Shasta	60,900	95
Millville	5-6.05	Shasta	67,900	106
South Battle Creek	5-6.06	Tehama	32,300	50
Sacramento Valley Groundwater Basin				
Red Bluff	5-21.50	Tehama	266,750	416
Corning	5-21.51	Tehama, Glenn	205,640	321
Colusa	5-21.52	Colusa, Glenn, Tehama, Yolo[a]	918,380	1,434
Bend	5-21.53	Tehama	20,770	32
Antelope	5-21.54	Tehama	18,710	29
Dye Creek	5-21.55	Tehama	27,730	43
Los Molinos	5-21.56	Tehama, Butte	33,170	52
Vina	5-21.57	Tehama, Butte	125,640	195
West Butte	5-21.58	Butte, Glenn, Colusa	181,560	284
East Butte	5-21.59	Butte, Sutter	265,390	415
Sutter	5-21.62	Sutter	234,400	366
North American	5-21.64	Sutter, Placer[a], Sacramento[a]	351,000	548
		Totals	3,039,300	4,744

[a] These counties are not within the IRWMP boundary.

Groundwater levels have remained relatively steady within the basin; however, subbasins with heavy groundwater pumpage for agricultural, potable and industrial uses (North American, West Butte, Vina) have shown generally decreasing trends in water levels over time. (Table 1-8). Typically, areas with plentiful surface water rely less on groundwater than those areas with limited or unpredictable surface water.

Table 1-8. Groundwater Level Trends and Storage Capacity for Subbasins within the Sacramento Valley and Redding Groundwater Basins (DWR Bulletin 118, 2003)

Subbasin Name	Subbasin Number	County	Groundwater Level Trends	Groundwater Storage	
				Specific Yield[(a)], %	Storage Capacity, ac-ft
Redding Area Groundwater Basin					
Bowman	5-6.01	Tehama	Seasonal flux of 5 feet for normal and dry years	No published info available	No published info available
Rosewood	5-6.02	Tehama	Seasonal flux of 5-10 feet for normal and dry years	No published info available	No published info available
Anderson	5-6.03	Shasta	Seasonal flux of 1-10 feet for normal and dry years	No published info available	No published info available
Enterprise	5-6.04	Shasta	Seasonal flux of 5-15 feet for normal and dry years	No published info available	No published info available
Millville	5-6.05	Shasta	Seasonal flux of 2-8 feet for normal and dry years	No published info available	No published info available
South Battle Creek	5-6.06	Tehama	None	No published info available	No published info available
Sacramento Valley Groundwater Basin					
Red Bluff	5-21.50	Tehama	None	7.9	4,208,851
Corning	5-21.51	Tehama, Glenn	None	6.7	2,752,950
Colusa	5-21.52	Colusa, Glenn, Tehama, Yolo[(b)]	None	7.1	13,025,887
Bend	5-21.53	Tehama	No GW level monitoring is conducted	No published info available	No published info available
Antelope	5-21.54	Tehama	None	7.2	269,179
Dye Creek	5-21.55	Tehama	None	6	331,620
Los Molinos	5-21.56	Tehama, Butte	None	6	397,740
Vina	5-21.57	Tehama, Butte	10-15 ft decline since 1950s	5.9	1,468,239
West Butte	5-21.58	Butte, Glenn, Colusa	10-15 ft decline since 1950s	7.7	2,794,330
East Butte	5-21.59	Butte, Sutter	Variable	5.9	3,128,959
Sutter	5-21.62	Sutter	None		5,000,000
North American	5-21.64	Sutter, Placer[(b)], Sacramento[(b)]	Decreasing	7	4,900,000

(a) Specific yield is the ratio of the volume of water a rock or soil will yield by gravity drainage to the total volume of the rock or soil (DWR, 2003).

(b) These counties are not within the IRWMP boundary.

A groundwater budget, prepared as part of DWR Bulletin 118 (Table 1-9) and provided here as background information, provides groundwater extraction data for agricultural, municipal, industrial and environmental uses based on surveys conducted by DWR. On average, groundwater accounts for approximately 31 percent of total water use within the region (DWR, 2003). A portion of this extracted groundwater (typically between 15 percent to 25 percent) eventually ends up recharging the groundwater basin through the deep percolation of this applied water. Groundwater is also typically recharged through rainfall and stream flow. The amount of recharge varies from subbasin to subbasin depending on subbasin conditions.

Table 1-9. Groundwater Extraction Summary for Municipal, Industrial, Environmental and Agricultural Uses, by Subbasin (DWR Bulletin 118, 2003)

Subbasin Name	Subbasin Number	County	Groundwater Budget, ac-ft			
			Extraction for Agricultural Use	Extraction for Municipal & Industrial Uses	Extraction for Environmental Wetland	Deep Percolation of Applied Water
Redding Area Groundwater Basin						
Bowman	5-6.01	Tehama	350	9	N/A	1,500
Rosewood	5-6.02	Tehama	680	990	N/A	1,200
Anderson	5-6.03	Shasta	3,000	20,000	N/A	5,700
Enterprise	5-6.04	Shasta	4,449	4,127	N/A	3,788
Millville	5-6.05	Shasta	250	1,273	N/A	912
South Battle Creek	5-6.06	Tehama	1,300	310	N/A	860
Sacramento Valley Groundwater Basin						
Red Bluff	5-21.50	Tehama	81,000	8,900	N/A	20,000
Corning	5-21.51	Tehama, Glenn	152,000	6,600	N/A	54,000
Colusa	5-21.52	Colusa, Glenn, Tehama, Yolo[(a)]	310,000	14,000	22,000	64,000
Bend	5-21.53	Tehama	220	120	N/A	340
Antelope	5-21.54	Tehama	17,000	2,100	N/A	3,800
Dye Creek	5-21.55	Tehama	9,300	680	N/A	3,200
Los Molinos	5-21.56	Tehama, Butte	5,900	1,000	N/A	3,000
Vina	5-21.57	Tehama, Butte	130,000	20,000	N/A	30,000
West Butte	5-21.58	Butte, Glenn, Colusa	161,000	10,000	4,600	64,000
East Butte	5-21.59	Butte, Sutter	104,000	75,500	1,300	126,000
Sutter	5-21.62	Sutter	171,400	3,900	N/A	22,100
North American	5-21.64	Sutter, Placer[(a)], Sacramento[(a)]	289,100	109,900	N/A	29,800
		Totals	1,440,949	279,409	27,900	434,200

[(a)] These counties are not within the IRWMP boundary

Irrigation wells in the northern portion of the region (Redding Area) range in depth from 32 to 700 feet and average 270 feet, while wells in the Sacramento Valley Groundwater Basin range from 22 to 1,340 feet and average 265 feet (Table 1-10).

Table 1-10. Groundwater Well Characteristics by Subbasin (DWR Bulletin 118, 2003)

Subbasin Name	Subbasin Number	County	Well Characteristics					
			Domestic Wells			Municipal/Irrigation Wells		
			Depth Range, ft	Average Depth, ft	No. of Well Completion Reports	Depth Range, ft	Average Depth, ft	No. of Well Completion Reports
Redding Area Groundwater Basin								
Bowman	5-6.01	Tehama	60-700	257	804	112-600	312	27
Rosewood	5-6.02	Tehama	48-398	181	447	65-565	311	15
Anderson	5-6.03	Shasta	11-805	140	2,239	32-558	302	48
Enterprise	5-6.04	Shasta	18-713	139	1970	32-460	180	65
Millville	5-6.05	Shasta	40-650	156	487	50-700	265	8
South Battle Creek	5-6.06	Tehama	80-884	189	18	170-270	227	5
Sacramento Valley Groundwater Basin								
Red Bluff	5-21.50	Tehama	20-780	197	3,293	22-465	207	18
Corning	5-21.51	Tehama, Glenn	24-633	135	1,667	27-780	246	822
Colusa	5-21.52	Colusa, Glenn, Tehama, Yolo[(a)]	11-870	155	2,599	20-1340	368	1,515
Bend	5-21.53	Tehama	20-388	149	102	89-220	144	4
Antelope	5-21.54	Tehama	40-450	104	702	40-600	176	92
Dye Creek	5-21.55	Tehama	19-220	94	432	55-597	188	56
Los Molinos	5-21.56	Tehama, Butte	31-340	92	311	27-740	327	42
Vina	5-21.57	Tehama, Butte	14-754	139	2,215	36-1000	330	715
West Butte	5-21.58	Butte, Glenn, Colusa	15-680	136	1,469	40-920	321	1,038
East Butte	5-21.59	Butte, Sutter	25-639	101	1,477	35-983	285	699
Sutter	5-21.62	Sutter	35-320	121	496	60-672	205	131
North American	5-21.64	Sutter, Placer[(a)], Sacramento[(a)]	50-1750	190	665	77-1025	396	105

[(a)] These counties are not within the IRWMP boundary.

DWR well installation logs from 1977-2010 report approximately 27,994 domestic, 467 municipal, 169 industrial wells and 3,862 irrigation wells within the six-county IRWMP region. On average, from 2005-2009, these wells were estimated to extract 1,565,000 ac-ft of groundwater annually. Of this volume, approximately 1.4 million ac-ft (90 percent) was extracted for agricultural use, 136,000 ac-ft (9 percent) was extracted for municipal and domestic uses and 19,000 ac-ft (1%) was extracted for managed wetlands (Table 1-11). No water was extracted for wetland management in Shasta, Tehama or Sutter Counties during the time period. Due to the DWR Bulletin 118 estimate for the underling subbasins including areas within some basins but outside of the six counties, the estimate in Table 1-11 cannot be directly compared to the previously reported estimate from DWR Bulletin 118.

Table 1-11. Groundwater Extraction Summary for Municipal, Industrial, Wetland and Agricultural Uses, by County

County	Number of Wells		Average Total Groundwater Pumped, TAF, 2005-2009	GW Pumped for Agricultural Use, TAF	GW Pumped for M&I Use, TAF	GW Pumped for Managed Wetlands, TAF
	Irrigation	Urban Use				
Shasta	145	7,609	65	25	40	-
Tehama	614	7,987	259	238	21	-
Glenn	845	1,822	296	284	9	3
Colusa	425	876	248	233	7	7
Butte	1,170	8,834	445	387	49	9
Sutter	663	1,466	252	242	10	-
Totals	3,862	28,594	1,565	1,409	136	19

Source: McManus, D., DWR. 2013. Conjunctive Use: Let's Have a Frank Discussion. Northern Sacramento Valley Groundwater Conditions and Conjunctive Management Opportunities. Presentation, Feb 22, 2013

TAF = Thousand Ac-ft.

1.2.5.3.1 Groundwater Monitoring Programs

For several decades, groundwater levels and quality, and surface water quality have been monitored throughout the Sacramento Valley, primarily by the DWR, U.S. Geological Survey, the California Department of Health Services (now the California Department of Public Health), and local municipalities and/or water purveyors.

Several agencies including counties and cities, the U.S. Geological Survey, the DWR, water purveyors and districts, watershed groups, and others have all been involved in monitoring different parameters of water quality and quantity. Some of these monitoring efforts have been ongoing for many years, and others have been initiated only recently. The status of monitoring in the region is constantly changing as new programs evolve and monitoring wells are drilled, constructed, upgraded, or abandoned. The following provides a brief summary of the status of groundwater monitoring for each county in the NSV IRWMP region.

The website for the DWR groundwater level monitoring data, which applies throughout the NSV IRWMP planning area, can be found at: http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm

The passage of SBx7-6 in 2009 added the requirement that all basins have groundwater elevation monitoring. The law was modified so that some very remote basins, or those without wells, could be periodically evaluated. This information is available at the DWR's CASGEM website at http://www.water.ca.gov/groundwater/casgem/. While this information represents a small fraction of the groundwater available in the planning area, it is a resource that the State compels locals to be interested in.

1.2.5.3.1.1 Butte County

There are presently 164 groundwater monitoring wells in Butte County (Butte County Water Commission, 2005). Groundwater level monitoring in the Sacramento Valley portion of Butte County is conducted by a number of different private and public agencies, although historically, DWR has maintained the most comprehensive, long-term groundwater level monitoring grid. Since 1997, Butte County and DWR have coordinated water level monitoring efforts. Approximately 29 wells are equipped to continuously monitor and record changes in groundwater level, and approximately 60 municipal wells are monitored monthly for level changes in the City of Chico. Butte County is currently developing a basin management objective (BMO) that has a total of approximately 50 monitoring sites. The objective of this program is to perform periodic monitoring of groundwater levels to detect any impacts to groundwater resources due to climatic conditions and/or groundwater use in the area. If impacts are detected, a technical advisory committee analyzes the available data and evaluates whether potential remedial actions are warranted. The county also encourages agricultural irrigation districts supplied by surface water to be involved in the groundwater monitoring program.

1.2.5.3.1.2 Colusa County

The DWR routinely monitors domestic and agricultural wells for groundwater levels and, at a lesser frequency, water quality. Water quality samples are analyzed primarily for naturally occurring heavy metals. The California Department of Public Health also periodically monitors wells for water quality. Additionally, the State Water Board and U.S. Geological Survey have historically done water quality surveys in the county. The DWR water level and quality data are available online at the website provided above. As of 2011, Colusa County had 60 groundwater monitoring stations monitored at least semiannually.

1.2.5.3.1.3 Glenn County

In 2011, 136 groundwater monitoring wells were used to measure groundwater levels across Glenn County. The DWR also conducts short-term specialty groundwater quality studies. Data and reports are available from DWR's regional and field offices. The county monitors a standard network of monitoring wells regularly as part of their BMO program. The objective of this program is to perform periodic groundwater level monitoring to detect any impacts to groundwater resources due to climatic conditions and/or groundwater use in the area. If impacts are detected, a technical advisory committee analyzes the available data and evaluates whether

potential remedial actions are warranted. The results of the BMO program are available on the Glenn County Web site (http://www.glenncountywater.org).

1.2.5.3.1.4 Shasta County

As of 2011, there were 37 active DWR groundwater monitoring stations in the Redding Basin. Since that time, at least 13 additional monitoring wells have been installed in the Anderson-Cottonwood Irrigation District service area, which are monitored by the DWR.

In May 2007, Shasta County adopted a Coordinated AB 3030 Groundwater Management Plan for the Redding Groundwater Basin. In June 2007 Shasta County approved the Redding Basin Water Resources Management Plan to help ensure water supply reliability in the Redding Basin during a drought. Both reports can be found on the Agency's webpage (http://www.co.shasta.ca.us/index/pw_index/engineering/water_agency.aspx).

Shasta County also collects and monitors elevation in Basin 5-50, the North Fork Battle Creek Basin (http://www.water.ca.gov/groundwater/casgem/).

1.2.5.3.1.5 Sutter County

In Sutter County, DWR and other local agencies monitor domestic and agricultural wells for groundwater levels and water quality, primarily naturally occurring heavy metals. The DWR Water Data Library (http://www.water.ca.gov/waterdatalibrary/) currently includes 183 groundwater monitoring stations within portions of the Sutter, North American, and East Butte Groundwater Subbasins located within Sutter County. In the spring of 2004, a total of 99 wells were measured for groundwater levels. Groundwater quality data are available from the DWR Water Data Library for 40 wells within the county with observations between 1998 and 2006. Sutter Extension Water District recently installed nine monitoring wells (three triple-completion wells) as part of their conjunctive use program, and the monitored data from these wells will be provided to the DWR Water Data Library. The California Department of Public Health and their cooperating agencies monitor additional selected wells for drinking water quality.

1.2.5.3.1.6 Tehama County

As of 2011, Tehama County had 115 groundwater monitoring stations, 102 of which are located in the Sacramento Valley Groundwater Basin and 13 of which are located in the Redding Groundwater Basin. To date, the County Flood Control and Water Conservation District (FCWCD) has installed three 1,000-foot-deep multi-completion groundwater monitoring wells in three known areas where depressed groundwater levels have been observed. The FCWCD has secured funding to instrument several existing DWR multiple-completion monitoring wells with pressure transducers and dataloggers to provide real-time water level data. Grant funds will also be used to install additional monitoring wells in areas slated for large-scale residential developments. Hourly groundwater level data, including hydrographs, are available at the Tehama County FCWCD Web site (http://www.tehamacountywater.ca.gov).

1.2.5.4 Recycled Water

As indicated in the water supply and demand sections of this chapter, water supplies and demands are close to being within balance, without much additional capacity available for future growth. One way to balance future water supply needs with the water supply availability would be to expand current recycled water use. The beneficial use of recycled water is very common in Southern California, but its potential has yet to be optimized in Northern California. Recycled water could provide a relatively drought-free water supply to improve the region's water supply portfolio and allow for continued economic growth in the region.

The benefits of water recycling have been evaluated extensively by DWR's Recycled Water Task Force. The task force report, *Water Recycling 2030: Recommendations of California's Recycled Water Task Force* (2003b) identified the potential for 1.5 million af/yr of recycled water statewide. Limited recycling of domestic wastewater for non-potable landscape and irrigation use is currently practiced in the Sacramento Valley, but the potential exists for the development of up to 80,000 af/yr of recycled water from domestic wastewater effluent by the year 2020.

Water recycling strategies are generally implemented at the local level but can have regional and statewide benefits by reducing surface water diversions and making that water available for other urban, agricultural, and environmental uses. Water recycling allows a local agency to reduce the costs of developing, treating, storing, and distributing additional potable supplies. Recycling can also reduce pollutant loads in receiving waters, aid in meeting TMDL requirements, and reduce treatment costs and concerns for downstream water purveyors.

Recognizing their common interests as urban water users and wastewater dischargers, the City of Yuba City, the City of Marysville, and Linda County Water District (the City of Marysville and Linda County Water District are outside of the NSV IRWMP planning area) entered into an MOU in December 2005, to jointly prepare a Regional Recycled Water Master Plan. The goals of the *Yuba-Sutter Regional Recycled Water Master Plan* are to develop a cost effective water recycling program that can accomplish the following seven goals:

1. Improve water supply reliability;
2. Provide a "diversified portfolio" of water supply options;
3. Reduce the costs of developing new water supplies;
4. Reduce the costs of wastewater treatment improvements to meet future surface water discharge limitations;
5. Reduce withdrawals from the Feather River, Yuba River, and local aquifers;
6. Improve water quality in the Feather River; and
7. Increase flows to the Bay-Delta.

The area covered by the *Yuba-Sutter Regional Recycled Water Master Plan* is anticipated to develop; the plan therefore addresses long-term water supply reliability. Cost is a high priority to the member agencies. The three agencies are conducting a market assessment of the potential demand for recycled water and are preparing a cost-benefit analysis to identify high-value water

recycling opportunities within and adjacent to the urban areas. Potential demands include agricultural irrigation, landscape irrigation, industrial and construction uses, and habitat enhancement.

In addition, the City of Shasta Lake has developed water recycling for public and private landscape irrigation as well as some industrial use.

1.2.5.5 Water Conservation

Water conservation can be considered a potential water supply source, and the cost of implementing new water conservation measures should be considered when evaluating potential new water supply sources. Water conservation can be broadly categorized as either urban water conservation or agricultural water conservation.

Senate Bill SB X7-7 2009 (The Water Conservation Act of 2009) requires urban retail water suppliers to collectively reduce water demand by an average of 20 percent by December 31, 2020. For purposes of SB X7-7, "urban retail water suppliers" are those retail water suppliers with more than 3,000 customers, or which deliver more than 3,000 ac-ft of water per year.

Also under SB X7-7, agricultural water suppliers serving more than 10,000 acres are required to prepare and adopt agricultural water management plans by December 31, 2012, update those plans by December 31, 2015, and every five years thereafter. According to SB X7-7, on or before July 31, 2012, agricultural water suppliers shall:

- Measure the volume of water delivered to customers. The DWR will adopt regulations that provide for a range of options that agricultural water suppliers may use to comply with the measurement requirement.
- Adopt a pricing structure for water customers based at least in part on quantity delivered.
- Implement additional efficient management practices.

According to SB X7-7, effective 2013, agricultural water suppliers who do not meet the water management planning requirements established by this bill are not eligible for state water grants or loans.

1.2.5.6 Imported and Desalinated Water

Because of its setting, some forms of water management that are appropriate in other areas of California are not applicable in the NSV IRWM area at this time. Current water rights and water supply availability in the NSV IRWM area do not necessitate importing water, other than through relatively local water transfers within the region. Desalination is generally not a relevant water management strategy for most of the region given the valley's location and the high cost of desalination. Some areas having poor groundwater quality lack other water supply options. Benefit/cost analyses were not completed as part of this study, but the relatively high cost of groundwater desalination and the difficulties of brine disposal may make implementation of desalination projects difficult.

1.2.6 Areas and Species of Special Biological Significance

Several of the major land use divisions discussed above provide cover and habitat for various species, some of which have special biological significance. The NSV region is home to a number of specially managed state and federal parks, forest reserves, wildlife refuges, and special ecological areas vital for the conservation of special-status species and commercially and culturally important fish and wildlife species, including many that are water-dependent.

1.2.6.1 Agriculture/Rice

Special-status wildlife species associated with agricultural lands, such as the northern harrier and giant garter snake, may use adjacent irrigation canals and freshwater marsh vegetation for foraging or breeding. Giant garter snakes have the potential to occur in irrigation canals and can use the adjacent agricultural lands as foraging and basking habitat. Swainson's hawks also will forage in agricultural lands. Irrigated pastures may provide suitable nesting habitat for the northern harrier and short-eared owl.

A managed winter flooding technique for rice straw decomposition practiced throughout the NSV IRWM planning area provides significant feeding, nesting, and loafing habitat for many of the Pacific Flyway's waterfowl and shorebird species that winter in the Central Valley. Additionally, eight national wildlife refuges and six state wildlife areas dedicated to conserving and managing habitat for migratory waterfowl and their associated ecosystems are located wholly or in part within the agricultural districts of the NSV. There are also managed wetlands on private lands. Flooded rice fields also support patches of freshwater marsh, whose potential special-status species are discussed below.

1.2.6.2 Barren/Other

Because of the lack of vegetation, barren ground has a limited use by wildlife. However, some species, such as the western burrowing owl, prefer areas with limited or very low-growing vegetation. In addition, bank swallows dig nesting holes in vertical banks along rivers.

1.2.6.3 Conifer Forests

The largest tracts of conifer forests occur on portions of the four national forests within the upper watersheds of the NSV IRWMP planning area, including the Shasta-Trinity National Forest, Lassen National Forest, Mendocino National Forest, and Plumas National Forest. Special-status wildlife species that may occur in this community type include the bald eagle, northern goshawk, Northern spotted owl, California spotted owl, Sierra Nevada red fox, Pacific fisher, and California wolverine.

1.2.6.4 Hardwood Forests

The importance of oak woodland ecosystems and conservation was recognized in 2001 with the legislative establishment of the Oak Woodland Conservation Program administered under the auspices of the Wildlife Conservation Board. Under this program, three of the six NSV IRWMP member counties, Butte, Colusa, and Tehama, have adopted voluntary Oak Woodland Management Plans that guide voluntary efforts for use of conservation easements, land

improvements, research and education, and restoration to benefit oak woodlands and promote the economic sustainability of farm and ranch operations. These plans qualify the counties to participate in the state-sponsored funding to support actions contributing to sustainable oak woodland management.

Special-status wildlife species that may occur in the oak woodlands of the region include the western spadefoot toad, golden eagle and Townsend's big-eared bat. Rock cliffs in oak woodland provide suitable nesting habitat for the American peregrine falcon and golden eagle.

1.2.6.5 Riparian Habitats

Riparian habitats are considered sensitive natural communities, which are given special consideration because they provide several important ecological functions, including streambank stabilization, water quality maintenance, and essential habitat for wildlife and fisheries resources. Six state parks and seven wildlife areas/ecological reserves and one national wildlife refuge dedicated to conserving and managing riparian habitat and its associated ecosystem values are located along the Sacramento River and its tributaries within the NSV.

Elderberry shrubs, which provide habitat for the federally-listed valley elderberry longhorn beetle, may be present within riparian woodlands. Riparian woodlands also provide nesting habitat for several special-status birds, including the western yellow-billed cuckoo, southwestern willow flycatcher, bald eagle, Swainson's hawk, and white-tailed kite. Cavities within riparian trees along waterways may be used as roosting sites by some species of special-status bats, such as the pallid bat.

1.2.6.6 Herbaceous (Annual Grasslands)

Special-status wildlife species that could breed or nest within annual grasslands include the California horned lizard, northern harrier, western burrowing owl, and American badger. Trees in annual grasslands provide nesting habitat for white-tailed kite, Swainson's hawk, and loggerhead shrike.

Annual grasslands also provide important foraging habitat for special-status resident and wintering birds, including Swainson's hawk, white-tailed kite, northern harrier, golden eagle, and loggerhead shrikes.

1.2.6.7 Shrub

Special-status wildlife species that may occur in shrub and chaparral habitat include the California horned lizard at lower elevations and the Sierra Nevada snowshoe hare at upper elevations.

1.2.6.8 Urban

Urban areas generally have a lower value for wildlife because of human disturbance and alteration of the natural vegetation and landscape features. Special-status species are less likely to occupy urban areas.

1.2.6.9 Water

Special-status wildlife species commonly associated with ponds are the California tiger salamander, California red-legged frog, and western pond turtle.

Special-status fish species that occur in the local rivers and streams include all runs (fall, late-fall, winter, and spring) of Chinook salmon, Central Valley steelhead, green sturgeon, river lamprey and hardhead. Many of the foothill tributary streams of the NSV IRWM planning region also provide habitat for the foothill yellow-legged frog.

Wetlands include freshwater marshes, wet meadows, and vernal pools. Special-status wildlife species, such as the California red-legged frog and giant garter snake, may take cover and forage within freshwater marsh vegetation, in drainages and irrigation canals. Extensive areas of freshwater marsh may also provide suitable nesting habitat for northern harrier, short-eared owl, and tricolored blackbird. Wet meadows may provide suitable habitat for special-status wildlife species including the Cascades frog, Sierra Nevada yellow-legged frog, northwestern pond turtle, and tricolored blackbird. Vernal pools provide habitat for several special-status species, including conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, and western spadefoot toad. Vernal pools are most frequently associated with annual grasslands and oak woodlands throughout the NSV IRWM planning area.

1.3 INTERNAL BOUNDARIES

Internal boundaries and the entities having jurisdiction in the NSV IRWM planning area are shown on Figure 1-10 (located at the end of Chapter 1) and discussed below.

1.3.1 Municipalities

The IRWM planning area includes the following 17 incorporated municipalities (all cities except the Town of Paradise):

1. Anderson
2. Biggs
3. Chico
4. Colusa
5. Corning
6. Gridley
7. Live Oak
8. Orland
9. Oroville
10. Paradise
11. Red Bluff
12. Redding
13. Shasta Lake
14. Tehama
15. Williams
16. Willows
17. Yuba City

The planning area also includes over 400 unincorporated communities and census designated places.

1.3.2 Water, Wastewater, and Flood Control Districts

In addition to the counties within the planning areas there are other entities and agencies with statutory authority over water supply or water management. These entities are listed in Table 1-12, by county, within the planning area. This list includes entities with statutory authority over water supply, water quality management, wastewater treatment, flood management/control, or storm water management by county. As indicated in the table, some of the entities are multi-jurisdictional.

1.3.3 Land Use Agencies

In addition to the 17 municipalities listed above, the following entities have permitting authority in the planning area consistent with their missions:

1. Counties of Butte, Colusa, Glenn, Shasta, Sutter, and Tehama
2. California Department of Fish and Wildlife
3. California Department of Forestry and Fire Protection
4. California Department of Parks and Recreation
5. California DWR
6. California State Lands Commission
7. Central Valley Flood Protection Board
8. Special Districts within the region that have permitting authority
9. Sacramento and San Joaquin Drainage District
10. U.S. Army Corps of Engineers
11. U.S. Bureau of Land Management
12. U.S. Bureau of Reclamation
13. U.S. Fish and Wildlife Service
14. U.S. Forest Service
15. U.S. National Park Service

1.3.4 Tribes

The following Tribes have land within the IRWM region:

1. Berry Creek Rancheria
2. Colusa Indian Community Council
3. Cortina Rancheria
4. Enterprise Rancheria Of Maidu
5. Greenville Rancheria
6. Grindstone Indian Rancheria
7. Mechoopda Tribal Council
8. Mooretown Rancheria
9. Nor-Rel-Muk Nation
10. Paskenta Tribal Council
11. Redding Rancheria

Table 1-12. Entities with Statutory Authority Over Water By County

County	Entity	Provider	Emphasis
Butte	Biggs-West Gridley Water District		Irrigation Supply
Butte/Sutter	Butte Water District		Irrigation Supply
Butte	Richvale Irrigation District		Irrigation Supply
Butte/Glenn	Western Canal Water District		Irrigation Supply
Butte	Thermalito Water and Sewer District		Domestic and Irrigation Supply
Butte	Paradise Irrigation District		Domestic Supply/Water Quality
Butte	City of Biggs		Domestic Supply/Wastewater/Water Quality
Butte	City of Chico	California Water Service, Chico	Domestic Supply/Wastewater/Water Quality
Butte	City of Gridley		Domestic Supply/Wastewater/Water Quality
Butte	City of Oroville	California Water Service, Oroville	Domestic Supply/Wastewater/Water Quality
Butte	South Feather Water and Power		Supply/Water Quality
Butte	Durham Mutual Water Company		Supply
Butte	Durham Irrigation District	California Water Service, Chico	Domestic Supply
Butte	Joint Boards		Supply
	Reclamation Districts		Flood control and Drainage
Colusa/Glenn	Glenn-Colusa Irrigation District		Supply
Colusa	Colusa County Water District		Supply
Colusa	Maxwell Irrigation District		Supply
Colusa	Carter Mutual Water Company		Supply
Colusa	Colusa Drain Mutual Water Company		Supply
Colusa	Mehrhof & Montgomery		Supply
Colusa/Glenn	Princeton-Codora-Glenn Irrigation District		Supply
Colusa/Glenn	Provident Irrigation District		Supply
Colusa/Glenn	Reclamation District 1004		Supply
Colusa/Yolo	Reclamation District 108		Supply
Colusa	Roberts Ditch Irrigation Co.		Supply
Colusa	Sycamore Family Trust		Supply
Colusa	Willow Creek Mutual Water Co.		Supply
Colusa	Maxwell PUD		Municipal
Colusa	City of Colusa Water Company		Municipal
Colusa	Arbuckle PUD		Municipal
Colusa	4-M Water Co.		Supply
Colusa	Cortina Water District		Supply
Colusa	Davis Water District		Supply
Colusa	Glenn Valley Water District		Supply
Colusa	Holthouse Water District		Supply
Colusa	La Grande Water District		Supply
Colusa	Myers-Marsh Mutual Water Company		Supply
Colusa	Westside Water District		Supply
Colusa	City of Williams PUD		Municipal/Wastewater
Colusa	Grimes PUD		Municipal
Colusa	Zumwalt Water District		Supply
Colusa/Glenn	RD 2047		Flood Control/Drainage
Glenn/Colusa	Reclamation District #1004		Supply
Glenn/Colusa	Glenn-Colusa Irrigation District		Supply
Glenn	Princeton-Codora-Glenn Irrigation District		Supply
Glenn	City of Willows	California Water Service, Willows	Domestic Supply/Wastewater/Water Quality
Glenn	Willow Creek Mutual Water District		Supply
Glenn	Kanawha Water District		Supply
Glenn	Glide Water District		Supply
Glenn	City of Orland	City of Orland	Domestic Supply/Wastewater/Water Quality
Glenn	Orland Unit Water Users Association		Supply
Glenn/Butte	Western Canal Water District		Supply
Glenn	Orland-Artois Water District		Supply
Glenn	Provident Irrigation District		Supply
Shasta	Anderson-Cottonwood Irrigation District		Supply
Shasta	Bella-Vista Water District		Domestic and Irrigation Supply
Shasta	Centerville Community Services District		Domestic Supply
Shasta	City of Anderson	City of Anderson	Domestic Supply/Wastewater/Water Quality
Shasta	City of Redding	City of Redding	Domestic Supply/Wastewater/Water Quality
Shasta	City of Shasta Lake	City of Shasta Lake	Domestic Supply/Wastewater/Water Quality
Shasta	Clear Creek Community Services District		Domestic and Irrigation Supply
Shasta	Cottonwood Water District		Domestic Supply
Shasta	Igo-Ono Community Services District		Supply

Table 1-12. Entities with Statutory Authority Over Water By County

County	Entity	Provider	Emphasis
Shasta	Mountain Gate Community Services District		Domestic Supply
Shasta	Shasta Community Services District		Domestic Supply
Shasta	Shasta County Water Agency		Supply
Shasta	Shasta County	Various County Service Areas	Domestic Supply/Wastewater/Water Quality
Sutter	City of Yuba City	City of Yuba City	Supply & Wastewater
Sutter	City of Live Oak	City of Live Oak	Supply & Wastewater
Sutter	Community of Robbins	Water Works District Number One	Supply & Wastewater
Sutter	Community of Sutter	Sutter Community Services District	Supply
Sutter	Community of Rio Ramaza	Rio Ramaza Community Services District	Wastewater
Sutter/Butte	Butte Water District		Supply
Sutter	Meridian Farms Water Company		Supply
Sutter	Sutter Extension Water District		Supply
Sutter/Butte	Biggs-West Gridley Water District		Supply
Sutter	Sutter Mutual Water Company		Supply
Sutter	Pelger Mutual Water Company		Supply
Sutter	Oswald Water District		Supply
Sutter	Tisdale Irrigation District		Supply
Sutter	Natomas Central Mutual Water Company		Supply
Sutter	Pleasant Grove/Verona Mutual Water Company		Supply
Sutter	South Sutter Water District		Supply
Sutter	Gilsizer County Drainage District		Drainage
Sutter	State of California		Drainage & Flood Control
Sutter	Reclamation District 823		Drainage & Flood Control
Sutter	Reclamation District 70		Drainage & Flood Control
Sutter	Reclamation District 1660		Drainage & Flood Control
Sutter	Reclamation District 1500		Drainage & Flood Control
Sutter	Reclamation District 1001		Drainage & Flood Control
Tehama	City of Red Bluff		Domestic Supply/Wastewater/Water Quality
Tehama	Proberta Water District		Supply
Tehama	El Camino Irrigation District		Supply
Tehama	Thomes Creek Water District		Supply
Tehama	City of Tehama		Domestic Supply/Wastewater/Water Quality
Tehama	Gerber-Las Flores CSD		Supply
Tehama	City of Corning		Domestic Supply/Wastewater/Water Quality
Tehama	Corning Water District		Supply
Tehama	Stanford Vina Ranch Irrigation Company		Supply
Tehama	Deer Creek Irrigation District		Supply
Tehama	Los Molinos MWC		Supply
Tehama	Rio Alto Water District		Supply
Tehama	Anderson Cottonwood Irrigation District		Supply
Tehama	Mineral County Water District		Supply
Tehama	Golden Meadows Estates CSD		Supply
Tehama	Los Molinos CSD		Supply
Tehama	Tehama County Flood Control and Water Conservation District		Flood Management and Supply
Tehama	Thomes Creek Water Users Association		Supply

1.4 WATER SUPPLIES AND DEMANDS

Water supplies available to the IRWM region and the existing and projected demands are discussed in this section. Specific topics include:

- 20-year Demand and Supply Projection
- Water Demands to Support Environmental Needs
- Impacts of Climate Change

1.4.1 20-Year Demand and Supply Projection

Agriculture and the environment are the dominant water demands in the predominately rural six county NSV IRWMP Region. This 20-year demand and supply projection focuses on agricultural demands because agricultural demands are substantially greater than urban demands. Environmental demands are discussed in the next section. Multiple agencies supply water to agriculture in the region. The predominate source of supply for these agencies is surface water flowing into the region in streams that originate in the surrounding Coast and Sierra Nevada mountain ranges and the storage reservoirs within the region. Many of these agencies and their water users also have groundwater wells that they use to supplement the surface water supplies depending on the availability of surface water supplies. Many growers outside of water purveyor service areas served by the agencies have installed groundwater wells that are used to meet irrigation demands.

This section describes in general the source of supply, climate variations, population density, type of water use, trends in water use and supply, and projected supply and demand.

1.4.1.1 Source of Supply

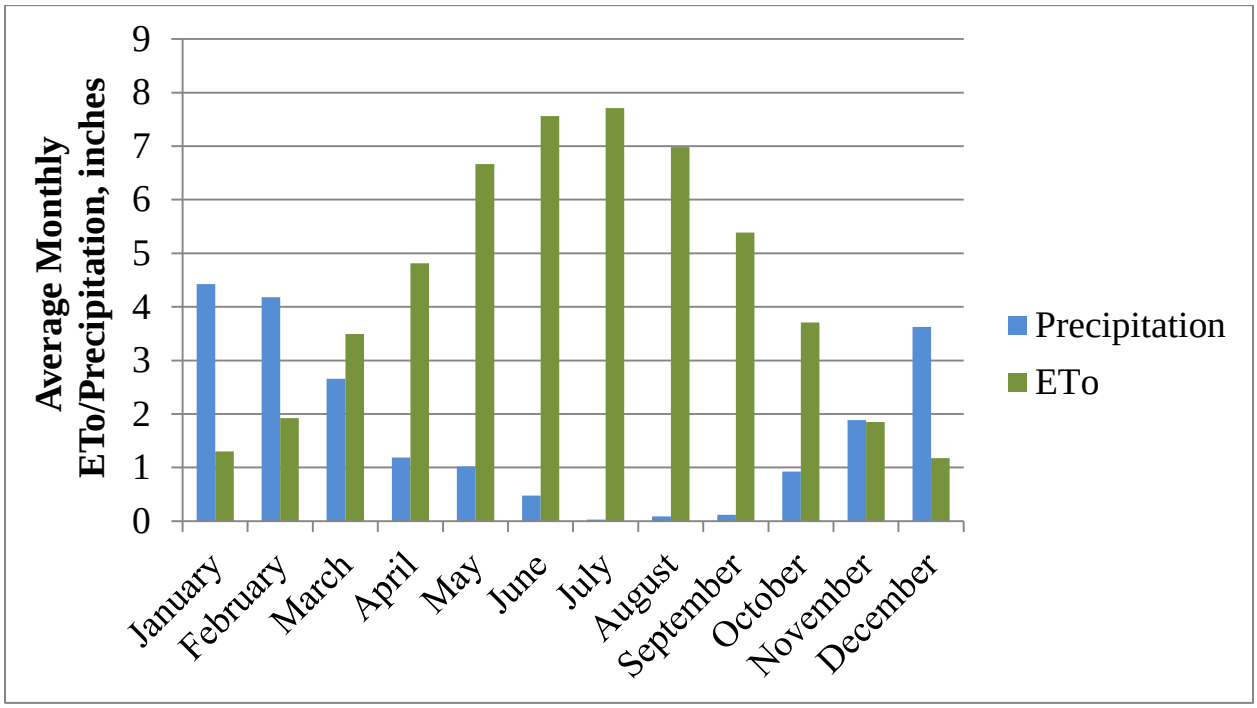
NSV region water agencies rely upon two main sources of water supplies to meet the demands of their customers: surface water supplies and groundwater supplies. Agriculture water suppliers are largely dependent on surface water from the Sacramento River or its tributaries. Most agricultural water suppliers and their customers have developed supplemental groundwater production capacity that they can call on in below normal or dry years. Agricultural water demands outside of surface water supplier areas are met primarily by private groundwater supplies. Most municipalities and rural residential users rely upon groundwater supplies exclusively. Since the reliability of surface water supplies varies depending on water rights and surface water sources, water supply availability differs from agency to agency.

1.4.1.2 Climate

Based on weather observations at the CIMIS stations, DWR has prepared a statewide map of reference evapotranspiration (ET) zones. Two reference ET zones with little difference in annual reference ET are found in the valley floor area of the NSV region. This indicates that the evaporative demand in the agricultural portion of the region is relatively homogenous. As a result, variations in water use within the region are more strongly influenced by cropping, soils and irrigation management. Precipitation varies spatially across the region and over time, decreasing from north to south (see previous precipitation discussion in Section 1.2.5.2). Most of

the precipitation occurs in the winter months while most of the evaporative demand and corresponding irrigation water demand occurs in the summer months. Thus summer irrigation is required to support agricultural production. An example of how most of the precipitation occurs in winter months while most of the evaporative demand and corresponding irrigation water demand occurs in the summer months is shown in Figure 1-11.

Figure 1-11. Example of Monthly Reference ET and Precipitation



1.4.1.3 Projected Supply

A literature search found little information on regional water supply projections. Water planning reports discussed the existing water use and projections of future water requirements without projecting water supplies. Projecting water supplies will be an important component to the NSV IRWMP and an integral part of regional planning. The proposed enlargement of Shasta Reservoir and construction of Sites Reservoir are two proposed increases in storage that may increase water supplies to the NSV and other California regions. However, planning continues for both of these projects and it remains uncertain whether or not the projects will ultimately be approved and built. Small storage projects, in response to local water shortages, may also be developed, but future water demands may exceed supply.

1.4.1.4 20-Year Projected Demands

Changes in regional agricultural water demands are driven primarily by changes in cropped area and cropping patterns, and to a lesser degree by changes in on-farm irrigation efficiency. A recent study of Glenn and Colusa Counties for update of the SacFEM groundwater model[8] found that total cropped area increased by just over 15,000 acres, or 2.2 percent, from 2003 to 2010 (Table 1-13). However, nearly 43,400 acres, or 6.3 percent, of existing cropped areas growing annual crops or pasture and hay converted to orchard or vineyard, indicating more persistent and intensive irrigation demand. These trends lead to increased agricultural water demands.

Table 1-13. Land Use Changes from 2003 to 2010 in Glenn and Colusa Counties[(a)]

Description of Land Use Change	No. Fields	Acres	Percent
No Change in Land Use			
Non-cropped, no change	1,235	131,455	19.00%
Annual/pasture/hay, no change	9,039	391,541	56.50%
Orchard/vineyard, no change	2,049	98,930	14.30%
Subtotal	12,323	621,926	90%
Cropped Converted to Non-cropped			
Annual/pasture/hay converted to non-cropped	113	7,520	1.10%
Orchard/vineyard converted to non-cropped	11	129	0.00%
Subtotal	124	7,649	1.10%
Non-cropped Converted to Cropped			
Non-cropped converted to annual crop or pasture/hay	411	9,431	1.40%
Non-cropped converted to orchard or vineyard	76	5,852	0.80%
Subtotal	487	15,283	2.20%
Annual/pasture/hay converted to orchard/vineyard	772	43,394	6.30%
Orchard/vineyard converted to annual/pasture/hay	164	4,780	0.70%
Land use from DWR survey not assigned	157	598	0.10%
Total	13,870	693,032	100%

(a) DWR 2003 Land Use Survey and 2010 GCID cropping data, Glenn County pesticide reporting and NASS 2010 Crop Data Layer.

All six counties in the IRWMP region report estimated agricultural water usage. The agricultural water usage of the counties for which data was available was 4.4 million ac-ft (Table 1-14). All six counties reported 20-year projected agricultural demands totaling approximately 4.5 million af/yr. The total net 20-year projected agricultural water usage was about 148,000 ac-ft more than current usage. Shasta and Butte counties estimated 20-year projected agricultural water demands

[8] Davids Engineering, Inc. 2011. Technical Memorandum for Glenn Colusa Irrigation District. Preparation of 2010 Glenn and Colusa County Agricultural Land Use Coverage and Associated Attributes.

to be less than current usage, by 20 and 66,700 ac-ft, respectively. Sutter County projected future agricultural water demands to be 98,000 ac-ft greater than current usage. The most recent data available was for Butte County and was from 2005. Tehama County reports an expected 10 percent increase in agricultural water demands due to changes in the permanent cropping patterns in the area. All of these data should be updated in future IRWMP projects.

Table 1-14. Current and 20-Year Projected Agricultural Water Demands by County

County	Current Agricultural Water Usage, ac-ft	Projected Agricultural Water Demands, ac-ft	Projected Additional Agricultural Water Required, ac-ft
Shasta[a]	101,120	101,100	-20
Tehama[b]	308,600	339,460	30,860
Glenn[c]	723,000	806,000	83,000
Colusa[d]	1,066,000	1,066,000	0
Butte[e]	1,006,200	939,500	-66,700
Sutter[f]	1,182,000	1,280,000	98,000
Total	4,383,714	4,532,060	148,346

Data Source:
[a] Shasta County Water Resources master Plan Phase 1, Current and Future Needs
[b] Tehama County FCWCD Water Inventory and Analysis, and correspondence with Tehama County Public Works Director.
[c] Stony Creek Fan Conjunctive Water Management Program Feasibility Investigation (January 2006)
[d] Colusa County General Plan Update 2030.
[e] Butte County IRWMP, 2005
[f] DWR 1998 land use survey data and DWR, 2001 Water Duty

Agricultural water use as described above refers to the amount of water diverted or pumped and applied to a crop to support growth, and generally includes conveyance and application losses. The water actually consumed by the crop is referred to as ET. Water that is not evapotranspired by the crop either runs off the field or percolates through the soil beyond the crop root zone. Water that runs off a field typically flows into a drain, stream or river and thereby returns to the supply system where it may be reused within or flow out of the region. Percolation of water beyond the crop root zone percolates to groundwater and may eventually discharge to a stream or river or may be pumped and used again. Thus, water diverted or pumped for agricultural use is greater than the amount consumed by the crops through ET, but the unconsumed portion is naturally conserved or captured in either the surface water or groundwater systems. This is one of the signature hydrologic characteristics of the Sacramento Valley, leading many to refer to the Sacramento Valley as being a “flow through” system. The only water depleted from the region is that actually consumed by ET.

1.4.1.5 20-year Municipal and Industrial Water Demand Projections

The 20-year municipal and industrial (M&I) water demand projections, based on the most recent water use and population projections available, are summarized in Table 1-15.

Table 1-15. 20-Year Water Demand Projections, Municipal and Industrial

County	Recent Documented Water Use, af/yr	Population Served by Documented Water Use	Per Capita Water Demand, gallons per capita per day	2035 Projected Population for entire County[(a)]	Total County Projected M&I Water Demand, af/yr[(b)]
Butte[(c)]	30,245	107,003	252	305,039	86,105
Colusa[(d)]	3,736	10,316	323	31,219	11,295
Glenn[(e)]	8,709	28,122	276	34,747	10,760
Shasta[(f)]	51,415	177,223	259	232,908	67,571
Sutter[(g)]	47,679	75,263	537	151,452	83,928
Tehama[(h)]	23,100	57,933	356	83,688	33,370
Total	164,884	455,860		839,054	293,029

(a) Projected population from California Department of Finance projections (January 2013).
(b) Projected population multiplied by current per capita water demand.
(c) Documented water use and population served from Butte County 2010 General Plan 2030.
(d) Documented water use, population served, and per capita water demand from 2011 Colusa General Plan 2030 environmental Impact Report.
(e) Population Served and per capita water demand from Willows 2010 UWMP, Chico-Hamilton City 2010 UWMP, and Orland 2003 Water Master Plan.
(f) Documented water use and population served from 2006 Sacramento Valley IRWMP.
(g) Documented water use and population served from 2010 Sutter County 2030 General Plan.
(h) Documented water use and population served from 2003 Water Inventory and Analysis.

Based on California Department of Finance estimates, the current population of the six counties in 2010 is approximately 604,964. As shown in Table 1-15, even though the population is projected to increase by about 40%, to almost 840,000 persons, the projected water demand of 293,029 af/yr is substantially less than the projected total regional water balance discussed above and shown in Table 1-14. Much of the M&I water supply is included in the water balance discussed above. A portion of the M&I water use becomes wastewater that is treated and discharged into surface waters, and is thus also included in the water balance discussed above.

1.4.1.6 Evapotranspiration Demands in the NSV Region

Spatially distributed ET estimates have been developed through application of the SEBAL[9] energy balance algorithm (Bastiaanssen et al. 2005)[10] to MODIS[11] satellite images for the 2010

[9] SEBAL (Surface Energy Balance Algorithm for Land), computes actual ET without the need to know the crop or land use. The energy balance approach inherently accounts for the effects of any stress, such as lack of sufficient water, salinity, disease, pest infestations, or other stressors. SEBAL ET estimates have been compared with various ground based ET measurement/estimation techniques (Eddy covariance, Bowen ratio, Lysimeters, *etc.*,) for different types of landuse and has been found within 5 percent of these ground based techniques. www.sebal.us.

[10] Bastiaanssen, W. G.M., E. J. M. Noordman, H. Pelgrum, G. Davids, B.P. Thoreson, and R. G. Allen, 2005.

water year (WY2010). SEBAL ET estimates were generated using satellite imagery and ground-based CIMIS weather data at a spatial resolution of 250 meters on a weekly basis for the entire Central Valley of California[12]. These estimates represent the total consumption of water by ET in the region, including all agricultural areas, managed wildlife habitat areas and other land areas. The ET estimates are summarized by county and are contrasted between areas inside and outside of water suppliers.

The area averaged weekly ET values were obtained for the regional area and summed to obtain mean monthly ET depths for each month (Table 1-16). The monthly ET depths were multiplied with the water balance area to obtain monthly total ET volumes.

Table 1-16. Average Monthly ET from SEBAL for the Water Balance Area

Month	SEBAL ET, inches	SEBAL ET, ac-ft
October 2009	1.8	398,491
November 2009	1.1	241,731
December 2009	0.4	90,633
January 2010	0.8	169,695
February 2010	2.2	472,891
March 2010	3	656,775
April 2010	3.6	783,569
May 2010	5.3	1,152,919
June 2010	6.3	1,371,866
July 2010	6.5	1,397,989
August 2010	4.9	1,062,152
September 2010	3.5	754,422
Total	39.5	8,553,134

Spatially distributed ET estimates offer unique and informative insights into the consumption of water within the region. Figure 1-12 (located at the end of Chapter 1) shows the spatial distribution of ET within the major agricultural area of the NSV IRWMP water balance area, highlighting the ET differences between areas inside and outside of water suppliers. It is interesting to note that many areas outside of water suppliers have ET as high or nearly as high as the areas inside, suggesting that groundwater provides a widespread and substantial water supply source for irrigation. Another informative regional water management parameter is

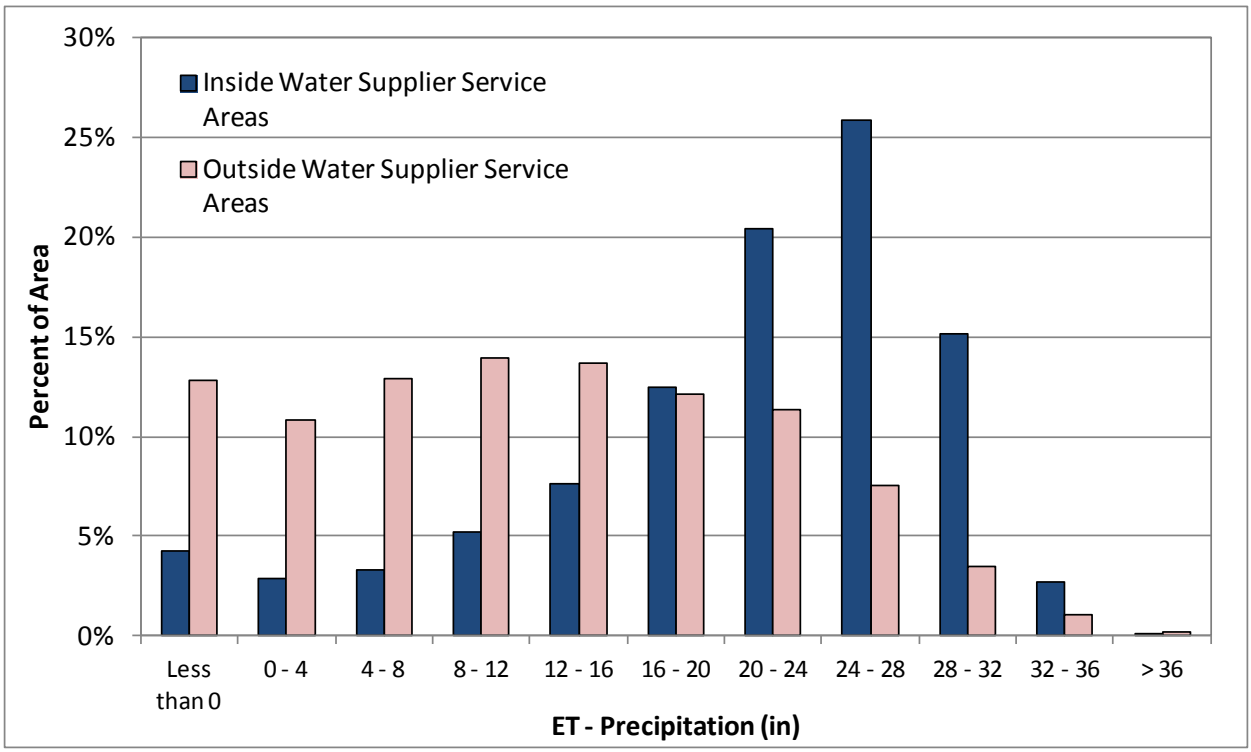
SEBAL model with remotely sensed data to improve water-resources management under actual field conditions. ASCE J. Irrig. Drain Eng. 131(1): 85-93.

[11] MODIS (Moderate Resolution Imaging Spectroradiometer) is an imaging sensor on-board the Terra (EOS AM) and Aqua (EOS PM) satellites. http://modis.gsfc.nasa.gov/about/

[12] Lal D., Clark, B., Thoreson B., Davids G., Bastiaanssen, W. G. M. (2010). Monitoring Near-Real Time Evapotranspiration Using SEBAL®: An Operational Tool for Water Agencies/Growers. The U.S. Society for Irrigation and Drainage Professionals (USCID) 2010 Spring Meeting. Sacramento, CA.

represented by the difference between ET and precipitation (Figure 1-13 - located at the end of Chapter 1). Because precipitation is very low during the summer, areas with ET much greater than precipitation on a water year basis indicate where ET is sustained by sources other than precipitation, primarily by applied irrigation water in most cases but also including sub-irrigated vegetation in areas with shallow groundwater, natural wetlands, and riparian vegetation. Many of the areas outside water supplier service areas exhibit substantially more ET than precipitation, suggesting that groundwater is an appreciable water supply source for irrigation. The histograms in Figure 1-14 below show the differences in the range of ET minus precipitation within water suppliers service areas, compared to outside of water supplier service areas. The relatively concentrated distribution of ET relative to precipitation within water supplier service areas suggests that water is more uniformly available for irrigation and may suggest that cropping patterns are less variable. Many of the water supplier service areas in the region are dominated by rice. In contrast, the distribution of ET relative to precipitation outside of surface water suppliers is wider, reflecting the difference between cropped areas utilizing groundwater and areas of natural vegetation that are sustained solely by rainfall.

Figure 1-14. Relative Frequency Distributions of ET Relative to Precipitation within and outside of Water Supplier Services Areas, WY2010



Total ET within water supplier service areas can be contrasted with total ET outside of water supplier services areas. Observations are generally consistent with the expectation that mean annual ET will be higher in the areas within water supplier service areas and will be less variable; however, the differences in the means by county are not very large. Interestingly, the

maximum single pixel[13] ET in each county is slightly more in areas outside of water supplier service areas. This may be because groundwater is generally available continuously whereas surface water supplied by most districts is available seasonally (typically March through October).

Fifty-seven percent of the total ET in the water balance area comes from areas not served by water suppliers (Table 1-17). Areas served by water suppliers account for more than 50 percent of the ET in Colusa, Sutter and Glenn Counties. Tehama County has the smallest area inside water suppliers, and only seven percent of the ET in Tehama County comes from areas within water suppliers.

Table 1-17. ET Volumes by County Within and Outside Areas Served by Water Suppliers

County	ET Volume, af	ET within Water Balance and Water Suppliers, acres		ET within Water Balance and Outside Water Suppliers	
		ac-ft	Percent	ac-ft	Percent
Tehama County	2,110,834	155,845	7%	1,950,521	92%
Colusa County	1,601,811	1,041,704	65%	553,206	35%
Butte County	1,415,672	603,216	43%	810,978	57%
Glenn County	1,398,053	742,382	53%	652,322	47%
Sutter County	1,345,874	809,518	60%	531,739	40%
Shasta County	724,890	348,320	48%	374,464	52%
Total	8,597,134	3,700,984	43%	4,873,229	57%

1.4.1.7 ET Trends in the NSV Region

As noted previously, agricultural demand is expected to increase slightly over the next 20 years continuing the recent trend of slow conversion of native vegetation and annual crops to permanent crop plantings and increased development of permanent crops on existing agricultural lands. This ongoing expansion of the irrigated area and conversion to permanent, higher value crops also "hardens" demand because permanent crops require water every year and cannot be fallowed in dry years.

Based on the observed change in cropping patterns, some assumptions can be made to estimate the change in agricultural water use based on changes in ET. These assumptions are by their nature speculative and are included only to serve as an example of how cropping trends can be used to estimate future changes in ET. Assuming five percent of the land inside water districts increases evapotranspiration of applied water (ETaw) from 30 to 40 inches, the ET within areas served by water suppliers will increase four percent, or by about 154,000 ac-ft by 2030. Similarly, assuming five percent of the land outside water suppliers increases ETaw from 0 to 40 inches, ET for areas not served by water suppliers would increase 17 percent, or about

[13] A pixel is a square area on the surface of the earth defined by the resolution of a satellite sensor. For SEBAL ET calculated from MODIS satellite images, the pixel is 250 m by 250 m, or roughly 16 acres.

812,000 ac-ft by 2030 to 9.54 million ac-ft (Table 1-18). This will add a total of nearly one million ac-ft to the agricultural ET and corresponding crop water demand by 2030.

Table 1-18. Projected 2030 Agricultural ET

County	ET Volume, af	ET within Water Balance and Water Suppliers, acres		ET within Water Balance and Outside Water Suppliers	
		ac-ft	Percent	ac-ft	Percent
Tehama County	2,437,946	162,339	7%	2,275,608	93%
Colusa County	1,730,515	1,085,108	63%	645,407	37%
Butte County	1,574,491	628,350	40%	946,141	60%
Glenn County	1,534,357	773,315	50%	761,042	50%
Sutter County	1,463,609	843,248	58%	620,362	42%
Shasta County	799,708	362,833	45%	436,875	55%
Total	9,540,626	3,855,192	40%	5,685,434	60%

In closing, as the ET data analysis clearly shows, the NSV is a well balanced region using both surface and groundwater to meet the needs of our people and agriculturally based economy. The region is dependent on conjunctive use/management of both sources of water. It is clear, our water supply is codependent on groundwater and surface water. Should either source be threatened via drought, climate change, or regulatory mandates, the NSV water supply system would be at risk.

1.4.1.8 20-Year Demand and Supply Projection Conclusions

Significant loss of surface water would likely stress the groundwater aquifers and could potentially lead to overdraft, permanent damage, and/or subsidence.

1.4.2 Water Demands to Support Environmental Needs

Environmental water demands in the NSV have not been fully specified for all identified environment uses but primarily consist of demands for fish and wildlife habitat and water quality objectives. Some of the most important environmental water demands within the region are shown in Table 1-19. Any future proposed environmental demands proposed to be met from water supply originating from the NSV region could potentially cause an imbalance to the NSV region's use of available water resources.

Table 1-19. Principal Environmental Water Needs		
Program or Watershed	Description	Source
CVPIA §3406(b)(2) Environmental Water Program	800,000 ac-ft of CVP storage dedicated to fish and wildlife conservation and enhancement purposes is coordinated among the CVP reservoirs, including Shasta and Whiskeytown reservoirs, for use throughout the Central Valley and the Delta; the future of this program is uncertain pending completion of Bay-Delta Plan and the accompanying Bay-Delta Conservation Plan	CVPIA§3406(b)(2) CVP-SWP OCAP Biological Opinion (NMFS 2009; 2011)
Bay-Delta Plan and BDCP objectives for Sacramento River inflows through the NSV region	At Wilkins Slough (Colusa Co.), provide pulse flows of 20,000 cfs for 7 days starting in November through January coinciding with storm events producing unimpaired flows at Wilkins Slough above 20,000 cfs until monitoring indicates that majority of smolts have moved downstream; At Rio Vista, up to 75% of 14-day average unimpaired river flow; Accommodate reservoir management of sufficient coldwater storage to protect salmon spawning habitat in upper Sacramento River	SWRCB (2010) DFG (2010)
CVPIA §3406(d)(1-5) refuge and private wetland water deliveries[(b)]	There is about a 314,673 ac-ft need for existing wetland habitat in the in Butte, Sutter, and Colusa basins; CVPIA currently delivers about 117,810 ac-ft (Level 2) and 155,000 ac-ft (Level 4) could be potentially delivered under existing water market conditions	Central Valley Joint Venture (2006)
North American Joint Venture waterfowl habitat conservation provisions[(b)]	Under a full implementation of the integrated bird habitat objectives and winter agricultural flooding requirements a need exists for 747,986 ac-ft in Butte, Sutter, and Colusa basins	Central Valley Joint Venture (2006)
Fish and Game Code §5937 streamflow below diversion requirement	It is required that the owner of any dam or diversion from a stream shall allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, allow sufficient water to pass over, around, or through the dam to keep in good condition any fish that may exist below the dam	Fish and Game Code §5937
NPDES permit dilution requirements	As the Central Valley Regional Water Board continues its development of TMDLs and adopts control actions for the Sacramento River and its tributaries, discharges and stream flow needs may be revisited to accommodate water quality objectives	SWRCB (2010)
Sacramento River at Keswick Dam (Shasta)	Minimum 3,250 cfs year round; complex and variable seasonal release schedule based on adaptive management of end of September reservoir storage, water year hydrology, water temperature objectives, water demands, and Delta water quality requirements	CVP-SWP OCAP Biological Opinion (NMFS 2009; 2011)
Clear Creek (Shasta)	Minimum of up to 200 cfs year round; two 600 cfs pulse flows (May-June); one 3,250 cfs mean one day channel maintenance flow seven times in 10 years; may change as result of ongoing instream flow study	CVP-SWP OCAP Biological Opinion (NMFS 2009; 2011)
Cow Creek (Shasta)	A minimum fall season flow of 50 cfs at Millville to support adult salmon migration was recommended by the Department of Fish and Wildlife as an interim measure until an instream flow needs study can be conducted. Watershed improvement, including fish passage and instream flow management, is currently be conducted by the local watershed management group.	USFWS (1995)
Battle Creek Salmon and Steelhead Restoration Project (Shasta/Tehama)	The minimum instream flows vary by season and stream reach throughout the watershed and are specified under a phased restoration implementation plan between Pacific Gas and Electric Company, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Fish and Game.	Kier Associates (1999) Battle Creek Salmon and Steelhead Restoration Program Final EIS/EIR (2005)
Mill Creek (Tehama)	The Mill Creek Water Exchange Program was started in the mid-1990s. The Los Molinos Mutual Water Company has worked with the resource agencies to develop and implement the water exchange program. The program trades groundwater for stream diversion water, increasing streamflows and improving fish passage in the lower reaches of the creek. The Water Exchange Program is a three-party agreement between DFW, DWR, and the LMMWC. The WEP is funded by State Water Contractors, DWR, and DFWG. Phase I included the construction of a new well and restoration of an existing well. During critical migration periods, groundwater is used to augment LMMWC's water requirement in exchange for leaving an equivalent amount of water in Mill Creek. This was an improvement but more water was needed during low flow times. Under Phase II a second, on-going renewable agreement was initiated whereby the LMMWC and landowner with priority water rights forgo diversion of 16 cfs from Mill Creek when additional flows are needed for spring-run. This allows the project to provide instantaneous releases of up to 25 cfs. In exchange, the project pays the landowner's cost to operate an irrigation well.	DWR (2005)
Deer Creek (Tehama)	The proposed Deer Creek Flow Enhancement Program will operate from April 1-June 30 and Oct 15-Nov 15 when the Deer Creek flow, as measured below the Stanford Vina Diversion Dam, is equal to or less than 50 cfs, or up on mutual consent of DCID, DFW, and DWR. Upon completion of both phases, DCID may have the additional capacity to provide approximately 15-18 cfs of instream transportation flow while meeting agricultural water demand requirements in the District.	Deer Creek MOU (2007)
Butte Creek (Butte)	In normal and wetter years a minimum stream flow of 100cfs from September - March 14, 80 cfs from March 14 - May, 40 cfs from June - August. In dry years, a minimum stream flow of 75 cfs from September - April, 65 cfs in May, and 40 cfs from June – August.	DFG (2008)
Feather River at Oroville Dam (Butte)	Under the new FERC license for Oroville Dam, an increased minimum flow from the current 600 cfs to a new minimum flow of 700 cfs in the Low Flow Channel during most of the year, but increasing flow to 800 cfs during the Chinook salmon spawning season from September 9 through March 31. The volume of increased flows was determined from the results of instream flow investigations and spawning habitat utilization studies	SWRCB (2010) FERC (2006)
Feather River at Thermalito outlet (Butte)	Provide minimum instream flows in the high flow channel, based on preceding April to July unimpaired runoff > or = 55%: October 1 to March 31—1,700 cfs; April 1 to September 30—1,000 cfs preceding April to July unimpaired runoff < 55%: October 1 to February 28/29—1,200 cfs; March 1 to September 30—1,000 cfs Reduce monthly average minimum instream flows in the high flow channel by not more than 25% if forecast indicates that Lake Oroville will be drawn down to 733 feet	FERC (2006)
Stony Creek (Glenn)	According to DWR 2003 (groundwater study) the minimum instream flow from Black Butte Dam is 30 cfs. According to the NMFS BO, 1) the diversion structure for the TCC will not be installed prior to April 1 of each year and a minimum 40 cfs bypass flow will be maintained at all times while the diversion structure is in place; 2) analysis of the effects of the proposed project anticipates that a minimum of 30 cfs flow will be maintained below the lowest point of diversion not withstanding the above 40 cfs requirement below the active TCC diversion; and 3) analysis of the effects of the proposed project anticipates that the Corps will follow the flood control/ramping rate guidelines described in the BO.	NMFS (2008) DWR (2003)

(a) As identified by regulatory requirements, conservation plans, and water facilities permits and licenses within the Northern Sacramento Valley region.
(b) Includes water demand for wildlife refuges on Federal, State, and private lands.

1.4.3 Potential Effects of Climate Change

Throughout the region there is some skepticism about the existence and/or mechanisms of climate change. The bottom line concern, regardless of how it is characterized, is how the region can respond to changes in hydrology and temperature that go beyond what we have historically experienced. This concern is nothing new to the Sacramento Valley, which has experienced decade-after-decade of extreme variability over the past 150 years. California's largest water projects, including the federal CVP and SWP, were built assuming that water needs would be met during a recurrence of the assumed worst-case drought (similar to the extended 1928-1934 drought), as well as the historic peak floods that existed as of the 1940s, 1950s and 1960s. But we have continued to see new records broken for both drought and flood events. For example, the 1976-1977 drought was short but very severe (1977 is still the driest year in recorded history in the State). The more recent 1987–1994 drought was extreme in its unprecedented duration in modern California history, and saw the development of new water management tools to cope with extended and severe drought. These more recent droughts resulted in more stress on every region of California, including the surface and ground water resources of the NSV region.

Record floods in 1907 and 1909 were the basis for design of the Sacramento River Flood Control Project. With construction of reservoirs in the Sacramento River watershed that provided flood control storage in the second half of the 20th century, the system was able to accommodate flood flows larger than originally envisioned. Record floods in 1983 and 1986 were so extreme that they pushed the entire flood system – levees, bypasses and reservoirs – to maximum capacity and required reevaluation of the operations of flood control facilities throughout California. Evaluation of the extraordinary February 1986 series of storms resulted in changes to flood control plans at major reservoirs in northern California. And yet a decade later in January 1997, the largest Sacramento River flows in the State's history pushed the system beyond capacity and resulted in two major levee breaks in the Sacramento River system. Looking back even further, the last half of the 19th century was a remarkable period of droughts and floods in the Sacramento Valley. The flood issues were captured well in the book *Battling the Inland Sea* which focuses on historic flood control issues in the Sacramento Valley (Robert Kelley, *Battling the Inland Sea*, University of California Press, 1998). The book has a predominant observation that "floods of record" were periodically surpassed to establish new "worst case" conditions. In the 1880s (130 years ago), State Engineer William Hammond Hall essentially said that we will always face larger storms and bigger floods (Kelley, op cit, pages xiii, 205 and 206). An important lesson that this region has learned over the past 150 years is to plan for worst-case conditions, whatever the causes.

As an "area-of-origin" with protections under State law, the NSV region water users have very high priority water rights to its surface water supplies. Even so, there will continue to be water supply, flood and other vulnerabilities associated with varying hydrology and a changing climate. It is important to note that this region's vulnerabilities are far less than would be expected in all other regions of California and most of the areas throughout the western United States. The RWMG has adopted Foundational Objective 1-7, Honor and preserve area-of-origin statutory protections, to emphasize the importance to the NSV region that area-of-origin, watershed-of-origin, and County-of-origin statutory protections be preserved, including, but not limited to, the protections set forth in California Water Code sections 10505, 10505:5, 11128, 11460, 11463, and 12200.

The principal areas of potential vulnerability for our region are water demand, water supplies and flood risk. It is possible that increasing temperatures could slightly increase water demands for irrigated agriculture, but it is difficult to project impacts due in part to agricultural land use changes in some areas of the Sacramento Valley. Nonetheless, it is expected that rice will continue to be a predominant crop supported by surface water diversions. The high priority of rights to surface water in the region act to limit potential adverse impacts of climate change to the adequacy of water supplies to meet future water demands. There could be some problems if demand increases in areas irrigated predominantly with groundwater that do not benefit from conjunctive management with surface water supplies. While most areas in the NSV have adequate-to-abundant groundwater supplies (in part due to investments in surface water acquisition and distribution), a combination of increased pressures on management of groundwater in the region (including historic transfers of water out of the region) and expansion of irrigated agriculture in areas of stressed groundwater aquifers may pose future risks to very long term agricultural production in such areas. It is for these reasons and others that long-term comprehensive groundwater management linked to surface water supplies has been a very high regional priority for the last decade and reflected in this NSV IRWMP.

As the Sacramento Valley has seen over the past 150+ years, flood risk is difficult to assess due to a changing hydrology. One hundred percent protection from flood damages can never be assured, but additional actions can be taken to reduce flood risk and the magnitude of flood damages. While predicting the impacts climate change may have on future flood risk remains inadequate, indications are that peak flood flows could increase to the extent that temperature increases cause more precipitation to fall as rain rather than snow. Large scale flood protection measures for the Sacramento River and its primary tributaries (Feather, Yuba and American Rivers) are the purview of the federal government (with support from the State of California), but local jurisdictions will continue to address flood threats on local streams.

Finally, while there appears to be strong scientific support for global warming and the induced changes to our climate, technical models still have limitations in their ability to forecast climate changes at the local and regional scale. A summary of pros and cons for California regional modeling scenarios was published by DWR in May 2012 (http://wwwdwr.water.ca.gov/climatechange/docs/Strengths-Weaknesses-Criteria- FINAL-5-22-12.pdf). We expect, like many areas of scientific research, that better predictive tools will be available in the future. Updated information as it is developed is expected to be posted by DWR http://wwwdwr.water.ca.gov/climatechange/cctag.cfm) and the Governor's Office of Planning and Research (http://www.opr.ca.gov/s_climatechangefacts.php), among other sources.

A more thorough analysis of climate change vulnerability is included in Chapter 4. Again, due to the regional balance of groundwater and surface water use, additional water supply needs or stressors may cause negative impacts to our current water supply system, and/or the local economy that is dependent on that water supply system.

1.5 WATER QUALITY

A general description of the water quality of the NSV IRWMP region is provided in this section. Existing and potential future water quality conditions, which include descriptions of the water quality protection needs, are discussed. This description of current water quality conditions is based on readily available tools and reports, not on an original review of current, available data. Information sources include the following:

- U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program (http://pubs.er.usgs.gov/publication/cir1215)
- Sacramento River Watershed Program monitoring, 1998-2004 (http://www.sacramentoriver.org/srcaf/library/library_browse.php?subject=Water%20Quality)
- Sacramento River Watershed Program "A Roadmap to Watershed Management" (http://sacriver.org/aboutwatershed/roadmap)
- Sacramento River Watershed Sanitary Survey 2010 update http://www.cityofwestsacramento.org/civica/filebank/blobdload.asp?BlobID=6569
- My Water Quality Portal (http://www.waterboards.ca.gov/mywaterquality/)
- California Integrated Water Quality System Project (http://www.swrcb.ca.gov/ciwqs/)
- U.S. Environmental Protection Agency Watershed Improvement Report (http://www.epa.gov/region9/water/watershed/measurew/feather-sac/2010SacFeatherRiverSP12final-Rpt.pdf)
- Surface Water Ambient Monitoring Program (SWAMP) Lakes Study - Bioaccumulation In Sport Fish (http://www.waterboards.ca.gov/water_issues/programs/swamp/lakes_study.shtml)
- DWR Water Data Library

1.5.1 Water Quality Regulatory Framework

Water quality concerns are identified when monitoring data exceed standards set to protect beneficial uses. Some stream segments are listed as "impaired" by various contaminants (U.S. Environmental Protection Agency, accessed January 2, 2000). Impairment means that a standard of water quality for beneficial uses (for example, as a source of drinking water or for recreation or industrial use) is not being met. The federal Clean Water Act requires states to maintain a listing of impaired water bodies for the purpose of establishing Total Maximum Daily Loads (TMDLs). A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

In the NSV Region, there are 126 water bodies listed as impaired, primarily associated with metals, pathogens and pesticides. The most prevalent listings in the Sacramento River watershed are for organophosphate pesticides and mercury. Eleven listings (six of which are sloughs) are associated with eutrophication (which results in low dissolved oxygen, odors, and loss of water

clarity). The impaired water bodies are mainly affected by nonpoint sources of contaminants from agriculture discharges or abandoned mines. Water-quality objectives are commonly not met only during conditions of stormwater-driven runoff.

1.5.2 Current Water Quality Conditions

Water of the Sacramento River and its major tributaries is generally of good quality; largely melted snow that collects in upstream reservoirs and is released according to various operating rules. Well managed dam operations and diversions of all sizes has improved streamflow, aquatic habitat, fish migration, and stream temperature. The NSV region has worked diligently to maintain high water quality while successfully preventing water shortages and meeting environmental mandates.

1.5.2.1 Reservoirs

The State Water Resources Control Board's SWAMP conducted a lakes survey in 2007-2008. The survey was a preliminary screening of contamination in sport fish (primarily rainbow trout, largemouth bass, and common carp) that are known to accumulate high concentrations of contaminants and are therefore good indicators of contamination problems. This screening study did not provide enough information for consumption guidelines – this would require monitoring a broader array of species, larger numbers of fish, and a much higher level of funding.

Fish tissue concentrations were evaluated using thresholds developed by the California Office of Environmental Health Hazard Assessment (OEHHA) for methylmercury, polychlorinated biphenyls (PCBs), dieldrin, dichlorodiphenyltrichloroethanes (DDTs), chlordanes, and selenium, and a State Water Resources Control Board threshold for mercury in tissue that is being used for identification of impaired water bodies. Based on these thresholds, methylmercury was determined to pose the most widespread potential health risk to persons who consume fish caught in California lakes, exceeding thresholds of concern in approximately one quarter of lakes surveyed statewide. However, in northern California, low concentrations were commonly observed in fish from high elevation lakes in the Sierra Nevada and Trinity Alps. Photodemethylation in the very clear water column of high-elevation lakes may be a mechanistic process that contributes to the low methylmercury concentrations in these areas, which underscores the importance of maintaining low turbidity in these reservoirs.

1.5.2.2 Wetlands and Irrigated Agriculture

The Sacramento Valley supports about 2 million acres of irrigated agriculture. Rice is the number one crop in the valley, accounting for approximately a quarter of the harvested acres. Chemicals used on irrigated farmland vary by crop, pest, weather and other factors. As reported in the 2002 California Department of Pesticide Regulation Pesticide Use Report Database, a total of 1,329 different insecticides, herbicides and fungicides were used in crop production in the region. The potential threat to surface water quality posed by each of these pesticides can vary widely and is based on physical characteristics of the pesticide, application method, time of year applied, and weather conditions during application, among other factors.

Wetland resources in the Sacramento Valley are separated into three broad categories: unmanaged, seasonally managed and permanently managed. Because unmanaged wetlands are not irrigated, they are not monitored under the Irrigated Lands Regulatory Program. The waiver refers directly to irrigated lands and includes both seasonal and permanent duck marshes for a total of approximately 65,104 acres. The majority of the managed wetlands in the watershed are seasonal with flood-up occurring in late September or October with draw-down in February or March. However, some managed wetlands are flooded permanently or semi-permanently and may hold water all year or may be drained in late summer for vegetation and water quality management. Water quality on and discharged from seasonal wetlands can vary substantially depending on how the wetland's hydrology, habitat, and vegetation are managed. Even a particular wetland will exhibit substantial variability depending on climate (sunlight, wind, and temperature), hydrology (depth, duration, and frequency of flooding), waterfowl use, and vegetation type and state (growing, senescing or decomposing).

The Northern California Water Association partners with over 200 agricultural representatives, natural resource professionals, wetlands managers and local governments throughout the Sacramento Valley to improve water quality for Northern California farms, cities and the environment. The Sacramento Valley Water Quality Coalition (Coalition; http://www.svwqc.org/) is composed of more than 8,600 farmers and wetlands managers encompassing more than 1.1 million irrigated acres and supported by local farm bureaus, resource conservation districts, County Agricultural Commissioners, and crop specialists with the University of California Cooperative Extension. The Coalition's Annual Monitoring Reports identify water quality exceedances associated with agricultural and managed wetlands discharges to the Sacramento River Basin. From October 2010 through September 2011 (see http://www.svwqc.org/pdf/2011_Annual_Water_Quality_Summary.pdf), the Coalition and its partners collected and analyzed a total of 206 water column samples at 24 sites (yielding a total of 6,710 chemistry analyses). As in past years, more than 97% of all pesticide analyses performed by the Coalition were below detection. There were 137 water samples tested for toxicity (351 toxicity results from 19 sites), with only six of these samples (4.4%) showing statistically significant toxicity. Again in 2011, concentrations of nutrients in Coalition's samples were low, with only one exceedance of water quality objectives for nitrate in 160 samples tested, and no exceedances of water quality objectives for ammonia in 130 samples tested. Total dissolved solids concentrations exceeded drinking water thresholds in 10% of samples, but no agricultural drains are sources of drinking water. Similarly, 20% of samples exceeded thresholds for E. coli bacteria indicators of fecal contamination, but most agricultural drains are not intended for contact recreation.

1.5.2.3 Abandoned Mines

A number of abandoned mines, especially those near Lake Shasta, were identified in the 1990s by the U.S. Geological Survey as having elevated concentrations of trace metals. Acid mine drainage has been a serious environmental problem in the northern portion of the Sacramento River watershed. Several streams are listed as impaired because of high concentrations of metals such as cadmium, copper, lead, and zinc. Fortunately, the SRWP found in the early 2000s that metals were generally not a problem in the watershed, which led to discontinuing monitoring of most metals (except mercury). Documented mercury mines in the Coast Range are almost

exclusively in the Cache Creek and Putah Creek watersheds to the south, which are within the Westside IRWM Region.

1.5.2.4 Municipal Wastewater Discharges

Several NPDES-permitted municipal wastewater facilities and many more industrial facilities operate in the region. A cursory review of self-reported permit violations (http://www.swrcb.ca.gov/ciwqs/) in years 2008-2012 found several hundred instances, but essentially all were minor concerns (*e.g.*, a temporary turbidity exceedance).

1.5.2.4.1 Urban Runoff

Urban runoff is a potential source of contaminants in waterways downstream of urban areas. Several municipalities in the region are regulated for stormwater discharges under a statewide general permit. The statewide general permit does not require water quality monitoring. Consequently, no relevant data of urban runoff water quality have been found. Permit revisions underway may include discharge and receiving water monitoring requirements.

1.5.2.5 Key Water Quality Issues

Key water quality issues for the NSV region are described briefly below, in general order of higher to lower concern.

1.5.2.5.1 Mercury

Mercury is generally considered the most serious water-quality problem in the Sacramento River, some tributaries of the Sacramento River, and downstream waterbodies including the Sacramento-San Joaquin Delta and San Francisco Bay. Methylmercury is the most toxic and bioaccumulative form of mercury. At much higher dosages than commonly experienced in the region, methylmercury in humans has been found to affect the immune system, alter genetic and enzyme systems, and damage the nervous system, including coordination and the senses of touch, taste, and sight. Lower doses, both to humans and wildlife, still have subtle negative effects.

Mercury can enter streams or aquatic systems through either atmospheric deposition or transport from geological or human sources. Several processes contribute to the subsequent bioaccumulation of mercury in fish tissue. Because of the presence of mercury in the tissue of certain fish species, fish consumption advisories have been posted for several water bodies within the NSV region[14].

[14] Available online at http://oehha.ca.gov/fish.html.

1.5.2.5.2 Aquatic Toxicity

Beyond these descriptions of water quality based on individual or classes of pollutants, another metric is toxicity to aquatic organisms. Aquatic toxicity is measured by subjecting sensitive test organisms to ambient water samples. The results of aquatic toxicity monitoring in the Sacramento River Watershed over the period 1998-2004 found significant toxicity to test organisms occurred in surface waters throughout the watershed.

DWR monitored sites on the Sacramento River and Feather River more recently and found similarly high incidences of toxicity, but follow-up tests to determine the cause of the toxicity were unsuccessful. These data are not available online.

1.5.2.5.3 Pesticides

Pesticide (a term used here generally to include algaecides, herbicides, fungicides, and plant/ insect growth regulators) use within the Sacramento Valley is high and application occurs during as much as 75 percent of the year. Pesticides can be transported from the fields to surface water by irrigation and winter storm runoff or to ground water by percolation of rain or irrigation water. Three classes of pesticides have been applied in the region over the last several decades (in chronological order):

- PCBs and legacy organochlorine pesticides, such as DDT, were banned in the 1970s yet continue to be detected in streambed sediments and the tissues of aquatic organisms because of their persistent and bioaccumulating characteristics. However, no controllable sources have been identified.
- Organophosphate (OP) insecticides such as diazinon, chlorpyrifos, and malathion are toxic at low concentrations to some aquatic organisms. OP concentrations were a significant problem downstream of irrigated farmland and urban areas, but have significantly decreased in recent years as their use has been phased out.
- In 2006, there were 161 pesticides applied in amounts of five hundred kilograms or more (active ingredient) within the larger San Francisco Estuary watershed[15], most of which have never been monitored in water. Most (although not all) of the current-use pesticides can be grouped into classes of similar structures and properties. The classes include carbamates, thio- and dithiocarbamates, chlorinated hydrocarbons (some are still being used), organophosphates, phenoxy and benzoic acid herbicides, pyrethroids, triazines, and ureas.

[15] Kuivila KM, Hladik ML. 2008. "Understanding the occurrence and transport of current-use pesticides in the San Francisco Estuary Watershed." San Francisco Estuary and Watershed Science 6(3): article 2. Available from: http://repositories.cdlib.org/jmie/sfews/vol6/iss3/art2.

1.5.2.5.4 Nutrients

Infants below six months in age who drink water containing excessive concentrations of nitrate could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome. Nitrate, added as a fertilizer, can drain off fields or seep below the root zone to contaminate surface and groundwater supplies. Nutrient concentrations such as nitrate are generally low throughout the Sacramento River watershed, and drinking-water standards for nitrate are not exceeded in surface waters.

Excess algal growth, which is usually related to higher-than-normal nutrient inputs to streams, is a water-quality concern when the algae affect the aquatic community (because of dissolved oxygen depletion), reduce recreational values, or contribute to taste and odor problems in drinking water. Such effects are not widely reported in the Sacramento River or its major tributaries.

1.5.2.5.5 Drinking Water Constituents of Concern

Drinking water sources that contain elevated concentrations of dissolved organic carbon or bromide can produce unsafe (carcinogenic) levels of trihalomethanes and haloacetic acids if chlorinated for drinking water. Because levels of organic carbon are generally low in the watershed, trihalomethanes are not a significant concern in the region. The main stem of the Sacramento River and its major tributaries (the Yuba, Feather and American rivers) consistently meet water quality goals and objectives for drinking water-related pathogens. Turbidity, a measure of filter-clogging suspended solids in the water, is also generally low.

1.5.2.5.6 Salts

Accumulation of salts in groundwater can impact drinking water quality, while accumulation of salts on crop lands can reduce agricultural productivity. The amount of dissolved solids in the Sacramento River and its major tributaries is generally low. Higher concentrations of dissolved solids tend to occur in agricultural irrigation drains such as Sacramento Slough and Colusa Basin Drain.

1.5.3 Potential Future Water Quality Conditions

This section speculates how water quality conditions in the IRWM region could change in the future based on climate change, larger-scale management efforts, and IRWMP project implementation. Potential effects of IRWMP projects are addressed qualitatively for categories of projects rather than quantitatively for any particular project. For a description of the IRWMP projects, refer to Chapter 5 Potential Projects and Prioritization.

1.5.3.1 Potential Water Quality Changes Caused by Climate Change

Much of the landscape surrounding the major reservoirs of the NSV region, including Shasta Lake, Whiskeytown Lake, Lake Oroville, Englebright Reservoir, New Bullards Bar Reservoir, and Black Butte Reservoir, is dominated by oak and conifer woodlands and grasslands. These reservoirs are located in the steep foothill and mountainous terrain of the Sierra Nevada, Klamath Mountains, and Coast Ranges where large wildfires are common and

where wildfire suppression is a major challenge. Wildfires could be exacerbated by future climate change. In the short term, wildfires can lead to increased sediment loads and turbidity, which require increased filtration at water treatment plants. In the long term, increased debris and sediment entering reservoirs after wildfires will reduce a reservoir's lifespan. Increased erosion associated with increased wildfires will increase ambient turbidity (decreasing predation for site feeders) and sediment loads (covering fish beds with sediments).

The North Fork Feather River is currently listed as impaired by high temperatures. Higher regional temperatures will reduce reservoir operational flexibility needed to meet fisheries habitat criteria, decrease equilibrium dissolved oxygen concentrations, and decrease available nutrients.

Over the past 100 years, the fraction of the annual runoff that occurs during April-July has decreased by 23 percent in the Sacramento River watershed (California Climate Change Center, 2009. "The Future is Now: An Update on Climate Change Science Impacts and Response Options for California." May. http://www.energy.ca.gov/2008publications/CEC-500-2008-071/CEC-500-2008-071.PDF). Lower summer-season flows decrease a waterbody's assimilative capacity by both reducing the diluting flow volume and reducing the ambient water quality.

1.5.3.2 Regional Water Quality Management Efforts

Three ongoing Central Valley-wide efforts may impact water quality management in the region in the future:

- CV-SALTS (www.cvsalinity.org/) aims to develop a workable, comprehensive plan to address salinity, including nitrates, throughout the region in a comprehensive, consistent, and sustainable manner.
- Drinking Water Policy Workgroup (www.waterboards.ca.gov/rwqcb5/water_issues/drinking_water_policy/) is developing a drinking water policy for surface waters in the Central Valley.
- Statewide Mercury Policy (www.waterboards.ca.gov/water_issues/programs/mercury/) regulators from around the state are working to develop a regulatory program to address mercury contamination in California reservoirs, as part of a larger policy to control mercury in all of the state's waters.

The impacts that these multi-regional programs may have on key water quality issues is listed in Table 1-20.

Table 1-20. Potential Water Quality Impacts of Multi-Region Programs, by Key Water Quality Issue

Key WQ Issue	CV-SALTS	Drinking Water Policy Workgroup	Statewide Mercury Policy
Mercury			+
Aquatic toxicity			
Pesticides			
Nutrients	+	+	
Drinking Water Constituents of Concern	+	+	
Salts	+	+	

Note: "+" indicates likely benefits and blank indicates minimal impacts.

1.5.3.3 Water Quality Effects of IRWMP Projects by Resource Management Strategy

A survey of the most often cited Resource Management Strategies (RMSs) is discussed in Chapter 4. The top five RMSs are:

- Watershed Management (55 projects)
- Ecosystem Restoration (52 projects)
- Pollution Prevention (36 projects)
- Conveyance – Regional/Local (34 projects)
- Agricultural Water Use Efficiency (33 projects)

The purpose of this section is to discuss the potential impacts that projects implementing these general categories of RMSs may have on water quality in the IRWM region.

The top five RMSs and their potential relationship to the key water quality issues summarized above are shown in Table 1-21. Where, what type, and how much benefit would be generated—or impact cause—by any particular project depends on its nature, location, and scale.

Table 1-21. Potential Water Quality Impacts of Major RMS, by Key Water Quality Issue

Key WQ Issue	Watershed Management	Ecosystem Restoration	Pollution Prevention	Conveyance – Regional/ local	Agricultural Water Use Efficiency
Mercury	+	+/–	+		
Aquatic toxicity	+	+	+		+
Pesticides	+		+		+
Nutrients	+		+	+/–	+
Drinking Water Constituents of Concern	+	+/–	+	+/–	+
Salts			+/–	+/–	+/–

Note: "+" indicates likely benefits, "+/-" indicates impacts would be project-dependent, and blank indicates minimal impacts.

Additional descriptions of the potential impacts of the top five RMSs are provided below, in order of frequency cited.

1.5.3.3.1 Watershed Management

The objective of watershed management as a resource strategy is to improve conditions in the watershed for various benefits. In general terms, watershed projects that encourage native land cover and stabilize erodible soil will reduce sediment loads to streams. Reduced sediment loads may positively impact several key water quality issues: nutrients, pesticides, and mercury.

1.5.3.3.2 Ecosystem Restoration

The objective of ecosystem restoration as a resource strategy is to improve habitat value regardless—or in spite—of water quality conditions. Nonetheless, restoration projects could benefit water quality by improving floodplain connectivity (trapping sediments and sequestering or degrading toxic compounds). A potentially significant negative impact of increased wetland-type habitat is increased methylmercury production[16].

1.5.3.3.3 Pollution Prevention

The concept of pollution prevention is to start at the source: prevent pollution from entering the environment rather than trying to remove it downstream. Success of this strategy depends on current, controllable human actions being the dominant sources. In urban areas, pollution prevention practices typically address household, industrial, municipal and construction/development activities. Pollutants commonly controlled by pollution prevention measures in urban areas include sediment, pesticides, hydrocarbons, and heavy metals.

In rural areas, pollution prevention measures typically address fertilizer and pesticide applications, which enter waterways by excessive spraying or runoff. Major sources of mercury pollution include natural geothermal mineral springs by Mt. Lassen, abandoned gold mines in the Sierra Nevada, and in the Trinity Mountains, and native soils in the Coast Range. Adequately controlling such sources is a monumental challenge.

1.5.3.3.4 Conveyance – Regional / Local

Conveyance as a resource strategy involves re-routing water from its natural course to another area where it can be used more beneficially. Conveyance structures may improve water quality in the area receiving its water. Insofar as the dilution of downstream pollution sources would be reduced by a diversion of high-quality water, downstream water quality could be impacted.

[16] Brumbaugh, W.G., D.P. Krabbenhoft, D.R. Helsel, J.G. Wiener, and K.R. Echols. 2001. A national pilot study of mercury contamination of aquatic ecosystems along multiple gradients: Bioaccumulation in fish: U.S. Geological Survey USGS/BRD/BSR-2001-0009, 26 pp.

1.5.3.3.5 Agricultural Water Use Efficiency

Projects that improve agricultural water use efficiency will reduce agricultural runoff volumes and seepage (recharge) into groundwater basins. Reduced runoff volumes generally lead to reduced loads of salts (including nitrate), sediment (with associated pesticides, nutrients, and mercury), and organic carbon discharged to receiving waters. A potential negative impact of efficiency is increased salt content on farmland, which could reduce agricultural productivity.

An additional concern is management of agricultural irrigation tailwater. Project ID 21 – Irrigated Cropland Water Efficiency Projects includes investigations to improve water efficiency including tailwater management.

1.5.3.3.6 Other RMS Projects

In addition to the top five RMSs, some of the three conditions mentioned above (urban runoff, abandoned mines, and municipal wastewater discharges) are also addressed by the selected projects. Thirteen projects have identified the Urban Runoff Management RMS as being achieved. As mentioned above, the Spring Creek Dam impounds Spring Creek and South Fork Spring Creek to form Spring Creek Reservoir. The Bureau of Reclamation constructed this impoundment to capture acid mine drainage from the Iron Mountain Mine. The water is treated and released to flow into the Sacramento River. No projects selected at this time specifically identify management of abandoned mines. Seven projects identify the Recycled Municipal Effluent RMS as being achieved.

In addition, Projects 43 (North Sac Valley Regional Water Quality Assessment Project) and 97 (Water Quality Assessment of NSV Watersheds), sponsored by the California Urban Streams Alliance and the CSU Chico Research Foundation – Aquatic Bioassessment Laboratory, both look to improve water quality. Project 43 would accomplish this through studying watershed health and management and ecosystem restoration. Project 97 would accomplish this through augmentation of the State Water Board's Perennial Streams Assessment.

1.5.4 Monitoring and Reporting

Various current monitoring and reporting efforts are noted in this section. All of these activities operate at a larger geographic scale than the NSV IRWM region, thus providing some inter-regional context.

1.5.4.1 Irrigated Agricultural Runoff Monitoring

There are two main regulatory programs related to irrigated agriculture in the watershed, the Rice Pesticides Program and the Irrigated Lands Regulatory Program, which includes a *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*. The Rice Pesticides Program, which focuses on the herbicide thiobencarb, prohibits discharge of rice field drainage unless specific management practices are implemented. The California Rice Commission monitors rice drains at key locations in the lower rice-producing areas. The Sacramento Valley Water Quality Coalition monitors for other irrigated agriculture.

1.5.4.2 Data Interpretation

The California "My Water Quality Portal" (http://www.waterboards.ca.gov/mywaterquality/) provides a convenient set of web-based tools for answering basic questions about local water quality. This website is a work in progress being led by the California Water Quality Monitoring Council. The questions posed on the website and the status of the data include:

- Is our water safe to drink? Status - Not yet available.
- Is it safe to swim in our waters? Status - Only Shasta County within the six-county region has data presented.
- Is it safe to eat fish and shellfish from our waters? Status - Shows fish consumption advisories, fish contaminant data, and fish consumption-related impaired waters and TMDLs for each county.
- Are our aquatic ecosystems healthy? Status - addresses wetlands and streams/rivers/lakes separately. Estuaries and Ocean to be added in the future.
- What stressors and processes affect our water quality? Status - Not yet available.

1.5.4.3 Sacramento River Watershed-wide Regional Monitoring Program

The Sacramento River Watershed Program is launching an effort to develop a sustainable, coordinated regional monitoring program (RMP) for the entire Sacramento River watershed. The RMP could have multiple objectives, including to:

- Communicate and coordinate participants' monitoring activities to prioritize and focus efforts;
- Monitor ambient water quality and conduct special studies within the watershed in a science-based, watershed approach and contribute those data to a comprehensive water quality and sediment monitoring database;
- Provide regular, integrative assessment reports and program evaluations; and
- Respond to new information and changing priorities to inform decision-makers and program managers.

An RMP could serve many purposes for the NSV region, including to:

- Determine background pollutant concentrations for permitting and assessing compliance with water quality standards;
- Understand pollutant sources, transport, and transformations, linking water quality to beneficial uses and sources to impairment;
- Establish baseline conditions for water quality, sediment quality, biodiversity and ecological health;
- Evaluate emerging (currently unregulated) contaminants; and,
- Evaluate status and trends in conditions over time.

1.6 SOCIAL AND CULTURAL MAKEUP

General descriptions of the counties, the prevalence of disadvantaged communities, economic conditions and trends, and involvement of Tribal communities are described in this section.

1.6.1 General Descriptions

General descriptions of the counties' demographics are provided below.

1.6.1.1 Butte County

Butte County has a strong economy based in its agricultural, commercial, industrial, educational and professional industries. The County encourages economic development within these industries, and the development and enrichment of new industries that are job-creating and environmentally sustainable.

As of January 2009, the population of unincorporated Butte County was approximately 83,900 people. Although the population of the unincorporated portion of Butte County has generally been declining since 1990, the total county population has been increasing. The root cause for the unincorporated population decrease is annexation to Butte County's municipalities.

The median age of unincorporated Butte County residents is approximately 40 years, which is higher than the overall county and statewide median age of approximately 35 years. This higher median age in the unincorporated area is attributable to a relatively high percentage of the population that is over 55 years of age, as retirees find Butte County an appealing retirement home location. Over 83 percent of the total county's population is white. People who identify themselves as two or more races or a race that is not listed by the Census make up about 10 percent of the population, and the remaining 7 percent consists of African American, American Indian, Asian, Native Hawaiian and other Pacific Islander people.

1.6.1.2 Colusa County

The Colusa County General Plan EIR indicates that Colusa County encompasses approximately 1,156 square miles in north central California, of which 1,151 square miles are land and six square miles are water. The eastern part of the county is located in the Sacramento Valley, with the Sacramento River flowing along the eastern edge of the county; the western portion is in the Klamath/North Coast Range.

Existing land uses in Colusa County are primarily agricultural. Colusa County houses some of the richest rice-producing land in the country, as well as important waterfowl habitat along the Pacific Flyway. Major commodities include rice, almonds, processing tomatoes and seed crops. The land use pattern is typical of rural counties of the Sacramento Valley. A checkerboard of large acreage farms dominates the eastern half of the County, with land ownership and road alignments mostly following square mile section lines. The land is generally flat and is covered by fields of rice, orchards, and row crops. Views are expansive, framed only by the rolling foothills of the Coast Range on the west and jagged peaks of the Sutter Buttes on the east. As one moves west through the county, cultivated fields give way to vast rangeland, and the flat terrain transitions into rolling hills and upland valleys. Further west, the land becomes yet more rugged

and wild, as it climbs into the Coastal Mountain Range, until finally reaching the summit of Snow Mountain in the wilderness area at 7,000 feet above the valley floor.

There are two incorporated cities in Colusa County: Colusa and Williams, and the unincorporated communities of Arbuckle, College City, Grimes, Maxwell, Princeton, and Stonyford.

The 2010 United States Census reported that Colusa County had a population of 21,419. The racial makeup of Colusa County was 13,854 (64.7 percent) White, 195 (0.9 percent) African American, 419 (2.0 percent) Native American, 281 (1.3 percent) Asian, 68 (0.3 percent) Pacific Islander, 5,838 (27.3 percent) from other races, and 764 (3.6 percent) from two or more races. Hispanic or Latino of any race were 11,804 persons (55.1 percent).

1.6.1.3 Glenn County

With over 1,188 farms, agriculture remains the primary source of Glenn County's economy. Major commodities include rice, almonds, walnuts, milk products, prunes and livestock. Glenn County was incorporated on March 5, 1891. The County seat, Willows, was created March 11, 1891. Glenn County was developed out of the northern portion of Colusa County and was named for Dr. Hugh J. Glenn, who was the largest wheat farmer in the state during his lifetime, and a man of great prominence in political and commercial life in California.

As of 2010, it had a population of 28,122. The racial makeup of Glenn County was 19,990 (71.1 percent) White, 231 (0.8 percent) African American, 619 (2.2 percent) Native American, 722 (2.6 percent) Asian, 24 (0.1 percent) Pacific Islander, 5,522 (19.6 percent) from other races, and 1,014 (3.6 percent) from two or more races. Hispanic or Latino of any race were 10,539 persons (37.5 percent).

1.6.1.4 Shasta County

The cities of Anderson, Redding and Shasta Lake along the I-5 corridor are the primary trade and commerce center for the far north central and northeastern portion of California. Indicators of sustained growth in the cities and County as a whole include increases in education employment accompanied by expansion of the construction, services, retail trade, and manufacturing industries.

Outdoor recreation is also an important part of the Shasta County economy. Visitors enjoy a variety of outdoor activities and a configuration of dams provides year-round hydroelectric power and water supply for agricultural and industrial production.

Strawberries, a major crop in Shasta County, are exported internationally. Apiary products, exported to Canada, and orchard crops are just a few of the important sources of the County's agricultural income. Vast private and public timberlands provide jobs in the timber and wood products industry. Continued job growth is expected in all economic sectors, except lumber and wood products. Expansion of the services and retail sales sectors are expected to continue domination of the Shasta County economy in the near future, while lumber and wood products are expected to continue to decline.

The 2010 United States Census reported that Shasta County had a population of 177,223. The racial makeup of Shasta County was 153,726 (86.7 percent) White, 1,548 (0.9 percent) African American, 4,950 (2.8 percent) Native American, 4,391 (2.5 percent) Asian, 271 (0.2 percent) Pacific Islander, 4,501 (2.5 percent) from other races, and 7,836 (4.4 percent) from two or more races. Hispanic or Latino of any race were 14,878 persons (8.4 percent).

1.6.1.5 Sutter County

From the Sutter County General Plan, Sutter County is located in north central California within the Sacramento Valley and is part of the six-county greater Sacramento region. The entire County, including incorporated cities, covers approximately 607 square miles with the unincorporated area totaling approximately 592 square miles. Sutter County's jurisdictional boundaries are generally defined by Yolo and Colusa counties to the west, Butte County to the north, Yuba and Placer counties to the east, and Sacramento County to the south. Sutter County was one of the original twenty-seven counties of California, created in 1850 at the time of statehood. Sutter County is a general law county.

Sutter County's landscape is dominated by extensive agricultural areas, significant natural and recreational resources, and relatively low population density. The County can generally be divided into two distinct geographic areas: the valley floor and the Sutter Buttes. The valley floor covers a majority of the County and is primarily flat, dominated by farming related operations and including the County's cities and rural communities. The Sutter Buttes, often referred to as the world's smallest mountain range, rise out of the valley floor in the northern portion of the County and are the symbolic focal point of the County.

Sutter County has experienced moderate growth over the last two decades, with its incorporated cities, Yuba City and Live Oak, receiving the majority of that growth. Similar to other areas in the region, Sutter County is encountering new growth pressures. These pressures are reflective of the County's quality of life, relative affordability, and attractiveness to people and businesses relocating from the Bay Area and Sacramento.

The 2010 United States Census reported that Sutter County had a population of 94,737. The racial makeup of Sutter County was 57,749 (61.0 percent) White, 1,919 (2.0 percent) African American, 1,365 (1.4 percent) Native American, 13,663 (14.4 percent) Asian, 281 (0.3 percent) Pacific Islander, 14,463 (15.3 percent) from other races, and 5,297 (5.6 percent) from two or more races. Hispanic or Latino of any race were 27,251 persons (28.8 percent).

1.6.1.6 Tehama County

From the Tehama County General Plan, Tehama County's location in the upper Sacramento Valley has cultivated its development as an agrarian and rural community. As of January 2008, the County boasted a population of approximately 62,419 people, as estimated by the California Department of Finance (DOF), ranking it 41st among the 58 counties in California. In 2000, the County boasted a population of approximately 55,918, as estimated by the DOF. Since 2000, the population of Tehama County has grown by approximately 6,501 people, resulting in an average annual increase of 928.7 people (1.48 percent).

A large part of the County's population, approximately 34 percent (21,054 persons according to the DOF), reside in the Cities of Red Bluff and Corning, with the remainder distributed throughout the City of Tehama and several unincorporated communities and rural areas throughout the County.

Tehama County's strong agricultural background grew from the fertile valley lands along the Sacramento River and the expansive foothills where grazing activities are prevalent. Development and growth over the years were possible due to the ability to move goods up and down the Sacramento River and, in more recent times, Interstate 5. Recently, growth pressures from outlying counties have spurred new housing and commercial developments.

The 2010 United States Census reported that Tehama County had a population of 63,463. The racial makeup of Tehama County was 51,721 (81.5 percent) White, 406 (0.6 percent) African American, 1,644 (2.6 percent) Native American, 656 (1.0 percent) Asian, 76 (0.1 percent) Pacific Islander, 6,258 (9.9 percent) from other races, and 2,702 (4.3 percent) from two or more races. Hispanic or Latino of any race were 13,906 persons (21.9 percent).

1.6.2 Disadvantaged Communities

Large portions of the NSV region are "disadvantaged" according to DWR's Proposition 84 median household income threshold level of 80 percent of the Statewide average. According to IRWM Guidelines, the DAC threshold is $48,706, based on American Community Survey data for the years 2006-2010. Therefore, many of the projects in the NSV IRWMP will serve DACs. To quantify the number and location of DAC's in the IRWM region, the NSV RWMG used GIS tools to plot published census data from 2000 indicating mean household income relative to the defined poverty level. The mapped data were then used by the planning staff in each County to define DACs for which focused outreach was conducted. The identified DACs are shown on Figure 1-15 (located at the end of Chapter 1). Additional census data from 2007 shows that five of the six counties in the NSV region have a higher percentage of individuals living below the defined level of poverty than the statewide average of 12.4 percent. The average for each county is shown in Table 1-22.

Table 1-22. Comparison of Countywide Poverty Level to Statewide Average

County	% of Individuals Living Below the Poverty Level (2007 Census Data)	Above or Below the Statewide Average (12.4%)
Butte	17.1	Above
Colusa	12.7	Slightly Above
Glenn	15.8	Above
Shasta	12.7	Slightly Above
Sutter	12.2	Slightly Below
Tehama	19.3	Above

The NSV IRWMP members are committed to identifying, inviting, and encouraging DACs to participate in the planning process. As shown on Figure 1-15 (located at the end of Chapter 1), DACs are located in the foothill and intermountain areas, in addition to the valley floor. Foothill and intermountain areas exhibit different resource management issues or priorities than the valley floor due to differences in climate, geology, hydrology, and socio-economic factors. The NSV IRWMP members are cognizant of these potential differences and are committed to ensuring a balance across the planning leadership, in the advisory and public input processes, and engagement of DACs.

On a more specific level, three counties have made significant prior efforts to engage DACs within their county. Examples from Butte, Shasta, and Tehama Counties are described below.

1.6.2.1 Butte County

Butte County implemented a "go-to-them" strategy for the Climate Action Plan (CAP) project. To reach out to disadvantaged citizens who have never been involved in the process, the County utilized approaches that had proven successful during the General Plan 2030 process:

- Work with County staff to identify groups and organizations active in the community
- Create a presentation template that County staff can use when speaking to these groups.
- Expand the web presence for the project using social networking web sites such as Facebook and Twitter
- Develop notices and flyers for distribution through various channels including schools, churches, community centers, libraries, local businesses, non-profits, faith organizations, and newspapers.
- Hold two community workshops, four public meetings and public hearings throughout the process of developing the CAP.

1.6.2.2 Shasta County

Shasta County has conducted significant outreach to DACs. All DACs in Shasta County were approached during preparation of Shasta County's 1997 Water Resources Master Plan Phase 1 Report: Current and Future Water Needs. During development of this NSV IRWM Plan, the Shasta County TAC members gave presentations to the governing boards of most water districts. Many of the water districts are coincident with a particular disadvantaged community. These water district meetings were moderately attended. Additional outreach was conducted in the City of Shasta Lake, Redding and Anderson City Council meetings.

Shasta County has also conducted a successful outreach program for long-term land use planning using resources in the County's Department of Public Health. For example, the County has translation services that can be used to gather survey data from Mien and Spanish speaking individuals. The County's translation resources are used where there is a nexus between a particular planning effort and public health.

1.6.2.3 Tehama County

Tehama County is rural, with approximately 70,000 residents in 13 communities with their own zip codes plus additional smaller communities. Nearly all of the identified communities in Tehama County are economically disadvantaged.

These communities have a variety of water resource management issues and priorities due to substantial differences in their geographic, hydrologic, climate, and economic settings. There are approximately 50 Community Service Districts within Tehama County that provide drinking water to its residents.

The County has already engaged many DACs in water resource planning processes, and has identified a number of critical water resource management issues. Some issues are listed here to illustrate how working effectively with DACs and addressing the needs of DACs will be critical to the success of the NSV IRWMP:

- The Ponderosa Sky View Water District Development is in need of additional drinking water resources.
- The community of Mineral derives its drinking water from a spring system, and needs to address associated supply limitations and vulnerabilities.
- The community of Manton must address water supply reliability. A 2008 proposal titled "The Big Idea" was introduced by members of the Manton community to achieve multiple benefits such as more reliable water supplies for potable use, irrigation, and fire protection; and to stimulate the local economy; through integrated surface water and groundwater management, including elements of water use efficiency, conjunctive water management, possible water transfers, and others.
- The Rio Alto Water District provides water and wastewater services in Lake California, and is currently under a Cease and Desist Order related to their effluent discharge to the Sacramento River. It is high priority for the community to develop an alternative means of managing the community's wastewater.
- The community of Los Molinos is a small but densely populated community that relies on groundwater for domestic use. The entire community housing depends upon septic systems and there is potential need for a wastewater treatment facility to better meet the community's needs and to protect groundwater and surface water quality.

1.6.3 Economic Conditions and Trends

Agriculture has had a major influence on the landscape and its economy, and was the area's primary industry in the nineteenth and twentieth centuries. Manufacturing and service industries also flourished during the twentieth century, as exemplified by canning, lumber and wood-processing enterprises.

Agriculture generates considerable economic activity and trends indicate that agriculture will continue to maintain a strong position within the IRWMP area's economy. Agriculture also supports other industrial sectors, such as manufacturing, transportation and warehousing, which

all generate a significant portion of the total sales volume in unincorporated areas. Other strong sales sectors in unincorporated areas are construction, wholesale and retail trades, and educational services.

Beginning in 2008, and continuing at the time that this IRWMP is published, the IRWMP area, like the rest of the state and country, has been experiencing a significant economic downturn. This recession affects virtually all of the business sectors in the area, and has caused significant fiscal strains.

1.6.4 Outreach to Tribal Communities

Consistent with the 2009 Update to the California Water Plan, the NSV IRWMP uses the term "California Native American Tribe" to signify all indigenous communities of California, including those that are non-federally recognized and federally recognized. In addition to the separate efforts related to tribal notification and overall stakeholder outreach, the IRWMP process worked with DWR's Government and Community Liaison to develop questions and focused support including emerging changes to Tribal coordination. Coordination, interaction and other responsibilities related to federal, state and local governmental programs are undergoing great changes as they relate to water issues. The locations of the California Native American Tribes with lands within the NSV Region are shown in Figure 1-16 (located at the end of Chapter 1).

The DWR Tribal Communication Committee's Tribal Communication Plan addresses the importance of Tribal knowledge of and engagement in water planning processes, including those at the local level such as IRWMPs. The 2009 Update to the California Water Plan includes a specific recommended action related to participation of Tribes in local water planning, including IRWMPs.

The NSV RWMG recognizes the importance and uniqueness of engaging Tribes that exist within the boundaries of the NSV RWMG. The NSV RWMG has notified Tribes of the NSV IRWM planning process as suggested by the IRWM Guidelines. The TAC employed the Office of Planning and Research's procedures for tribal consultation for General Plans and Specific Plans as guidance. The TAC first confirmed which tribes have traditional lands located within the NSV region by working with the Native American Heritage Commission (NAHC).

The TAC notified Tribes of the IRWMP process and invited them to participate in the stakeholder input meetings. The NSV RWMG also attempted to involve Tribes in more direct participation in the NSV IRWMP process, including an initial meeting with Tribal representatives in three different places throughout the region. Initial meeting locations were in Colusa, Butte, and Shasta counties. A higher level of outreach than past planning efforts was completed, both with Tribes and all water interests in the NSV region. Tribal participation is low, however, a representative from the Colusa Indian Community Council is a member of the NSV IRWMP TAC and has been attending the NSV Board Meetings. A representative from the Cortina Rancheria also frequently attends meetings.

California Native American Tribe Notification is part of DWR's CEQA review for projects requesting funding under Proposition 84. All applicable projects adopted under the NSV IRWMP will follow the formal notification required by PRC 75102.

1.7 MAJOR WATER RELATED OBJECTIVES AND CONFLICTS

The major water related objectives and conflicts that have been identified by the NSV RWMG are described in detail in Chapter 2 – Objectives, and summarized below.

1.7.1 Goals and Objectives

As a basis for the broad category goals and specific objectives identified in this IRWMP, the following statement of intent was established for the NSV IRWMP:

> *To establish a regional collaborative structure with the objective of ensuring an affordable, sustainable water supply that supports agricultural, business, environmental, recreational, and domestic needs of the NSV.*

The IRWMG developed six primary goals to be accomplished through execution of the IRWMP. The six goals are:

- Water Supply Reliability
- Flood Protection and Planning
- Water Quality Protection and Enhancement
- Watershed Protection and Management
- Integrated Regional Water Management Sustainability
- Public Education and Information Dissemination

The IRWMG then developed specific objectives for each of these goals. Each goal and objective is drafted to support and further the region's statement of intent for the IRWMP. As context for the detailed goals and objectives that follow, it is important to understand that this IRWMP was created by local entities within the region for the benefit of those living, operating, and recreating within the region, as defined in the IRWMP. Increasing water demands and limited supplies outside the NSV region have resulted in pressure to export water from the NSV Region. To protect the NSV water supplies, the RWMG adopted twelve Objectives associated with the first Goal, Water Supply Reliability. The Objectives associated with this first Goal are discussed in detail in Chapter 2. Several of the Objectives directly relate to the protection of surface and groundwater resources for local use, development of out-of-region water transfer protocols that recognize the NSV region as having first priority for use. Other Objectives emphasize maintaining statutory protections for water rights, including, but not limited to, the protections set forth in California Water Code sections 10505, 10505:5, 11128, 11460, 11463, and 12200.

1.7.2 Implementation Strategies

To accomplish the goals, the IRWM team developed procedures for project solicitation and selection. One of the processes was the creation of an NSV Board Project Review (PR) Subcommittee. The PR Subcommittee developed an online submission process to solicit project and program proposals for possible incorporation into the NSV IRWM Plan. The Proposal Instructions provided detailed step-by-step directions regarding the submittal and review process, and informed potential project proponents that the submittal application requires the submittal of information regarding the proposed project, to provide reviewers sufficient information to determine if the project met criteria for potential inclusion into the IRWMP projects and programs database.

Factors that were considered in the project review included:

- Number of NSV IRWMP Objectives addressed
- Multi-Benefit (multiple goals, partners, and/or counties)
- Readiness to proceed/project status
- Local contribution to cost share
- Benefits to Disadvantaged Communities
- Benefits to Tribes
- Economic feasibility
- Number of statewide priorities addressed
- Number of resource management strategies utilized
- Ability of the project to assess vulnerabilities to climate change, adapt to the effects of climate change, or mitigate climate change

The development of the project submittal, review, and acceptance process is described in detail in Chapter 5 – Potential Projects and Prioritization. Procedures for soliciting, submitting, reviewing, and adding projects in the future, after adoption of this IRWMP, are also discussed in Chapter 5.

As described in Chapter 5, the project selection process was developed to ensure that the NSV IRWMP is in line with local water planning documents in the NSV region since the regional plan should not supersede local planning, but instead compile and incorporate the pertinent points of local plans, including groundwater management plans, Urban Water Management Plans, water supply assessments, agricultural water management plans, City and County general planning, and other resource management planning.

1.7.3 Implementation Projects

The projects that were selected for inclusion in this NSV IRWMP were grouped into the following five categories:

1. Shovel-Ready, Discrete Projects (includes hard project permitting, construction/implementation - may include mitigation monitoring associated with implementation)
2. Planning Projects (includes plans, studies, design, environmental permitting/documentation)
3. New Programs/Projects, Education and Research (includes Concepts, Feasibility Studies, Research and Education Programs)
4. Continuing/Ongoing Existing Projects/Programs (includes maintenance, monitoring)
5. Staffing/Support

The projects are described in detail in Chapter 5. A total of 75 projects were ranked for inclusion in the IRWMP. In addition, 34 projects were listed as "Projects-to-Track". "Projects-to-Track" were solicited to be included in the NSV IRWMP to simply acknowledge projects in the region that may be on the horizon for future consideration, but at this time are only concept projects, and are not yet developed or defined sufficiently to be ranked according to the criteria of the prioritization process. Some of these projects will not be seeking funding and are listed because they may affect the NSV IRWM region.

1.7.4 Technical Analysis

The objectives of this IRWMP and the other information contained within it are based on a variety of existing technical information, technical informational gaps, and technical analyses.

1.7.4.1 Technical Information

The technical information relied upon for the development of this IRWMP includes population data, groundwater level data obtained through DWR, surface and groundwater use estimates, water quality information, water demands, land use information obtained through DWR, demographic information, infrastructure details and general descriptions from water purveyors.

1.7.4.2 Technical Information Gaps

Despite the collection of available technical information, there are still gaps in technical information that prevent optimal water resources management. The lack of technical information led to the development of several of the foundational NSV IRWMP objectives. For example, Objectives 1-1 (Document baseline conditions and trends for surface water and groundwater resources) and 1-2 (quantify current and future water demands), which are discussed in Chapter 2, were established due to the need for more technical information related to the baseline water resource and demand conditions. Without this information, many of the other important objectives cannot be achieved – or at least can't be quantitatively measured.

The specific technical gaps that need to be filled before other IRWMP objectives can be achieved include documentation of surface and groundwater supplies, trends, and use as well as more information on groundwater levels, groundwater recharge, groundwater quality, inelastic land subsidence, flood risks, region-wide water quality, and scientific information on aquatic, riparian, and watershed resources. In addition there is a need for regional water transfer guidelines based on technical information. Currently water transfers are considered by county-level jurisdictions and don't necessarily take into consideration the region-wide water resource implications of water transfers.

1.7.4.3 Technical Analyses

The primary technical method that was used to assess the quantitative water resource picture of the region was the development of a region-wide water balance, discussed above. Based on the outcomes of this water balance, it has become clear that the water management needs of the region, over the next 20 years, center on decreasing the amount of water flowing out of the region.

The technical methodologies used to analyze other technical information and data sets are shown in Table 1-23, below. As evident from this table, much of the information was analyzed visually through GIS mapping. Due to the large area covered by the region's boundaries, GIS mapping proved to be an efficient and effective way to view data and data trends in the region.

Table 1-23. Technical Analyses Used in IRWMP

Data or Study	Analysis Method	Results/Derived Information	Use in IRWMP	Resource or Source
Population Growth Study	Statistical analysis	Future population	Used to estimate future water demand	
Data Collection Study	Interview of County and Irrigation District staff	Summary of data currently collected in the region	Data Management section	County and Irrigation District staff
Land Use Data	GIS mapping	Summary of current land use patterns in the region	Region Description section	California DWR
Demographics Data	GIS mapping	Median household income and identification of disadvantaged communities	Region Description and Finance section	U.S. Census Bureau via California Department of Finance
Geology Data	GIS mapping	Location of different geologic formations and deposits throughout the region	Region Description section	Helley and Harwood's 1985 "Geologic Map of Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California" and California DWR Bulletin 118 - "California's Groundwater"
Irrigation Water Source Data	GIS mapping	Surface versus groundwater source of irrigation water throughout region	Region Description section	California DWR Land use Survey Program
Groundwater Level and Capacity Study			Region Description section	

1.8 HISTORY OF IRWMP REGIONAL BOUNDARY

Since the inception of DWR's IRWMP grant program, DWR has encouraged and supported the formation of self-determined IRWM planning regions. However, DWR recognizes that IRWM regions are dynamic and therefore may evolve over time as more information becomes available and different partnerships are formed as a result of additional research.

In response to the challenges associated with a cookie-cutter approach to IRWM, DWR developed the Regional Acceptance Process (RAP) as a mechanism to evaluate and accept both existing and developing IRWM regions for the purposes of the Proposition 84 IRWM Program (California Water Code (CWC) §10541 (f) effective March 1, 2009. The RAP guidelines include the definition of a region as, "At a minimum, a region is defined as a contiguous geographic area encompassing the service areas of multiple local agencies; is defined to maximize the opportunities to integrate water management activities; and effectively integrates water management programs and projects within a hydrologic region as defined in the California Water Plan, the Regional Water Quality Control Board (RWQCB) region, or subdivision or other region specifically identified by DWR (Public Resources Code §75026.(b) (1))." These guidelines are in response to SB1 (Perata, Stats. 2008, ch.1; eff. March 1, 2009), also known as the "Integrated Regional Water Management Planning Act," which provided guidelines to DWR about what an IRWM must contain and what it should contain. SB1 was signed by the Governor, in September 2008 and codified as CWC §10530 *et seq).*

The IRWMP regional boundary described herein grew out of historical regional resource management discussions. The original planning area included the counties of Butte, Colusa, Glenn, and Tehama. As the planning area became more defined, Sutter County and a portion of Shasta County were added to the planning area. The development of the planning area boundary is described below, followed by an explanation of why the current boundary is the most appropriate for this IRWMP.

1.8.1 How it was determined

The Counties of Butte, Colusa, Glenn and Tehama worked together on resource management issues for many years. This relationship was formalized through the Four County MOU in early 2006 and the participants became known as the Four County Group.

In 2009, a RAP application was developed in response to the DWR requirements to define the way that neighboring and/or overlapping IRWMPs will work together in the management of water and other natural resources throughout the State. During this RAP application process, Sutter County was added to the regional planning group.

In early 2010, as the emerging NSV RWMG began meeting to discuss governance options, Shasta County expressed interest in joining the effort. In the summer of 2010, all five existing Boards and the Shasta County Board approved Addendum Four to the MOU adding Shasta County to the NSV RWMG. Subsequent to that action, the Four County planning group became the NSV Integrated RWMG.

The portion of southern Shasta County that was added to this IRWMP region was added in response to DWR comments to make sure that neighboring IRWM planning areas did not overlap while providing coverage for contiguous areas. Northern Shasta County (north/upstream of Shasta Dam) is included in a neighboring IRWM area (Sacramento-McCloud), but, prior to joining the NSV IRWMP, southern Shasta County was not included in any State-defined IRWM areas.

1.8.2 Why Appropriate for IRWM Planning

Many opportunities exist within the IRWM planning area to develop creative multi-beneficial projects through the integration of resource management tools. An example of why Integrated Regional Water Management Planning is necessary to avert conflicts on a project would be the Deer Creek Watershed Conservancy project entitled "Lower Deer Creek Restoration and Flood Management" in Tehama County. The project involves native spring and fall run salmon, a federal levee on both sides of the creek, high upper watershed snowmelt issues, channel migration, private property owners, the Tehama County Flood Control and Water Conservation District (District), among others. The project brought together agencies such as the District, DWR, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Department of Fish and Wildlife, the Deer Creek Watershed Conservancy, private property owners, and others to discuss and resolve many conflicting issues which resulted in a win-win situation. The project will increase flood capacity, improve channel migration for fisheries, improve ecosystem restoration, and provide for a more reliable levee system. The IRWMP strives to create and enhance projects such as this one, with multiple benefits and ample support from the community.

As the IRWMP planning group (first the Four County Group that now includes all or portions of six counties) continued to meet and share ideas and strategies. They have developed a solid framework for cooperation and collaboration that has the support of the Boards of Supervisors and other stakeholders within the region.

The following list summarizes the rationale for supporting this regional effort:

- Each of these six counties is primarily rural in nature with centralized pockets of urban development. In addition, each of these counties is currently experiencing growth demands and therefore an increased demand on shared water resources with limited funding to address critical resource management issues that may impact the environmental and water supply issues. This scenario serves to increase the advantages of working together collaboratively on water resource management issues.
- The IRWMP group has demonstrated that they can successfully work together on the shared management of their water resources and have a history of implementing projects and programs in a collaborative manner for the benefit of the region as a whole.
- Portions of the NSV region overlie the Sacramento River Basin and Redding Area groundwater basins. Specifically, portions of Shasta County overlie the Anderson, Enterprise and Millville sub-basins. Portions of Tehama County overlie the Bowman, Rosewood and South Battle Creek sub-basins. Entities in the NSV region often draw water supplies from the same aquifer systems to meet their cumulative water needs.

In addition, each county also has surface water supplies made available through the State Water Project, the Central Valley Project and individual diversions from the Sacramento River and/or its tributaries. There are also many small groundwater sub-basins unique to each county.

- The IRWMP is defined not only by the geographic characteristics of the shared watersheds, tributaries and groundwater basin, but also by emerging water resource concerns such as urban growth; eco-system preservation and enhancement; flood management; public access and recreation and groundwater and surface water supplies and quality.
- The IRWMP region is defined as the area within the boundaries of the Counties of Butte, Colusa, Glenn, Sutter and Tehama, and portions of Shasta County in the NSV. The shared water resources enjoyed by this region, both surface and groundwater, do not recognize political boundaries making it both logical and more efficient to manage these resources in a collective and collaborative manner to better meet the needs of the region.
- The IRWMP members are prepared to work with and support the needs of neighboring regions in meeting the resource management needs of the larger Sacramento River watershed. As discussed below, the IRWMP members will continue to work collaboratively with the Upper Feather River IRWM, the Cosumnes American Bear Yuba (CABY) IRWM, the Westside IRWM, as well as the other IRWMPs within the Sacramento River Funding Area (SRFA).
- There are forested areas throughout the IRWM region that are part of the upper watersheds and are important factors in preserving water quality and water supply.

1.9 NEIGHBORING/OVERLAPPING IRWM EFFORTS

There are several neighboring and overlapping IRWM efforts. Both the neighboring and overlapping IRWM efforts are shown on Figure 1-16 (located at the end of Chapter 1) and discussed below.

1.9.1 Other IRWM Efforts

Representatives from the NSV RWMG have been participating in meetings with other IRWM planning regions throughout the Sacramento River Hydrologic Area in an attempt to coordinate all efforts throughout the larger region. This group of RWMGs met several times to discuss an approach to integrated planning that would provide for the needs of all potential participants within the SRFA.

As the process has moved forward and additional partnerships have been formed, some of these RWMGs have experienced changes and consolidations, much like the expansion of the NSV RWMG. For instance, Lake, Napa, Solano and Yolo Counties, along with a portion of Colusa County have consolidated into the Westside-Sacramento IRWMP. The NSV RWMG has continued to cooperate and collaborate with these entities throughout the various transitions that have taken place and anticipates continuing to do so into the future.

Known overlapping and adjacent IRWM efforts are shown on Figure 1-16 (located at the end of Chapter 1) and listed in Table 1-24. In this regard, NSV RWMG coordinated with the following IRWMPs between 2008 and 2010 with the intent to facilitate a regional approach to water management and funding distribution that would be equitable for all parties. As a result of these meetings, the various RWMGs decided to compete with each other for implementation funding.

As indicated in Table 1-24, several of the neighboring IRWM efforts are in watersheds other than the Sacramento River, or represent Sacramento River tributaries that enter the Sacramento River downstream of the NSV IRWM region.

Table 1-24. Neighboring and Overlapping IRWM Efforts

IRWM Effort Name	Notes
American River Basin IRWMP	Neighboring Downstream[(a)]
Cosumnes American Bear Yuba (CABY) IRWMP	Neighboring Downstream[(a)]
Lake County IRWMP	Superseded[(b)]
Napa-Berryessa IRWMP	Superseded[(b)]
North Coast IRWMP	Neighboring Adjacent[(c)]
Sacramento Valley IRWMP	Superseded[(b)]
Upper Feather IRWMP	Overlapping Upstream[(d)]
Upper Pit River IRWMP	Neighboring Upstream[(e)]
Upper Sacramento-McCloud IRWMP	Neighboring Upstream[(e)]
Westside-Sacramento (Yolo, Solano, Napa, Lake, Colusa) IRWMP	Overlapping Downstream[(f)]
Yolo County IRWMP	Superseded[(b)]
Yuba County IRWMP	Neighboring Upstream[(e)]

(a) "Neighboring Downstream" means the neighboring IRWM watershed enters the Sacramento River downstream of the NSV IRWM region.
(b) "Superseded" means the existing IRWM effort has been incorporated into this or other current IRWM efforts.
(c) "Neighboring Adjacent" means the NSV IRWM region and the neighboring IRWM watersheds are adjacent and do not naturally come together.
(d) "Overlapping Upstream" means the NSV IRWM watershed overlaps with another IRWM effort, which also continues upstream of the NSV IRWM effort watershed.
(e) "Neighboring Upstream" means the neighboring IRWMP effort incorporates the Sacramento River or a tributary upstream of the NSV IRWM region.
(f) "Overlapping Downstream" means the NSV IRWM region watershed overlaps with another IRWM effort, which also enters the Sacramento River downstream of the NSV IRWM boundary.

1.9.2 Strategies to Promote Cooperation

The IRWMPs in the SRFA cover a large geographic area and need to address a wide range of issues including: water supply, surface and groundwater management, land use and environmental stewardship. Although there are many similarities throughout the larger region, due to the vast geographic area included in the SRFA, there are many different approaches to the management of resources that make each planning area unique.

The NSV IRWM planning area has a shared interest in many common resources. One of most significant resources shared by the participants in this planning area is the Sacramento River. Each of these counties access and/or have streams that are tributary to the Sacramento River. One of the other commonalities of the planning area is a mutual groundwater basin. Current research indicates that this planning area shares portions of the Tehama and Tuscan aquifer systems that have varying linkages to one another throughout the landscape.

The discussion below describes how the NSV IRWM effort interacts with adjacent and overlapping areas within the greater Sacramento River Hydrologic Region.

The neighboring and overlapping IRWM efforts that are most critical to the NSV IRWM effort are the:

- Upper Feather River
- Westside Sacramento River

The relationships between the NSV IRWM effort and the two IRWM efforts listed above, as well as the relationship with the SRFA are discussed below.

1.9.2.1 Relationship with Upper Feather River IRWMP

The NSV IRWM has an overlapping area with the Upper Feather River Region IRWM in the portion of Butte County that includes the Upper Feather River watershed. Both planning areas consider the overlap area to be an important and appropriate part of their respective IRWM regions for a number of reasons:

1. The Upper Feather River region is based on a watershed boundary which encompasses the entire Feather River watershed upstream of Lake Oroville.
2. It is important to include Lake Oroville and the bottom portion of the watershed in the regional boundary because Lake Oroville provides a discrete point where management actions in the Upper Feather region can be monitored and measured on a macro scale. Since the Feather River watershed supplies the State Water Project's primary storage facility at Lake Oroville, monitoring and measuring effects on the watershed scale is an important means of quantifying benefits and directing watershed investment in collaboration with DWR and the State Water Project Contractors.
3. The Plumas National Forest, which is one of the key partners in the Upper Feather IRWM program, and manages nearly half of the land in the Upper Feather River watershed, includes areas that extend into Butte County in the vicinity of Lake Oroville.

Butte County and the Upper Feather River IRWM agree that coordination of projects within this overlap area is appropriate and plan to address the means of coordination through an MOU. The MOU will address planning and management in the overlap area, determine areas of responsibility, and provide for appropriate consultation on certain matters. For example, the communities of Paradise, Magalia, and Concow are located on the western edge of the watershed

in Butte County. For purposes of municipal water and wastewater services, any integrated management issues would best be addressed by those communities coordinating with Butte County, the NSV IRWM and the other population centers in the valley. For forest management and Fire Safe activities, there is already coordination between the Plumas National Forest and the Butte County Fire Safe Council, which will be enhanced through the MOU.

1.9.2.2 Relationship with Westside Sacramento (Yolo, Solano, Napa, Lake, Colusa) IRWMP

The NSV IRWMP has an overlapping area with the Westside Sacramento IRWMP in the portion of Colusa County that includes the Bear Creek watershed, which is tributary to the Cache Creek watershed. Both planning areas consider the overlap area to be an important and appropriate part of both the NSV IRWMP and the Westside IRWMP for a number of reasons. For example, the Westside IRWMP is based on a watershed boundary which encompasses the entire Putah and Cache Creek watersheds. It is important to include the Bear Creek watershed in the Westside IRWM boundary because Bear Creek is tributary to Cache Creek. At the same time, Colusa County is a part of the NSV IRWMP because of the NSV IRWMP basis on political and jurisdictional boundaries. The NSV entities, which have clearly defined governance structures and regulatory authorities, recognize the value derived from coordination of activities, objectives and strategies of common regional participants. In addition, the NSV entities also recognize the value of their independent utility on specific activities and participants, which may or may not be included in the Westside IRWM plans for the Bear Creek watershed. For example, the local governments that make up the NSV IRWMP have fiduciary and regulatory responsibilities in the following areas which cannot legally be abdicated to non-governmental agencies:

1. Water supply;
2. Water quality;
3. Environmental stewardship;
4. Flood management;
5. Internal drainage;
6. Drought preparedness;
7. Wastewater collection, treatment and discharge;
8. Domestic water treatment and distribution;
9. Watershed management;
10. Recycled water;
11. Groundwater management;
12. Land use;
13. Natural habitat and conservation;
14. Conjunctive use; and
15. Emphasis on reduced dependence on imported water.

Although the NSV IRWM region includes the entirety of Colusa County, it collaborates and coordinates with the Westside IRWMP. Colusa County, the Westside IRWMP, and the NSV IRWMP agreed early on that coordination of projects within this overlap area is appropriate. To that end, an MOU between the Westside IRWMP and Colusa County Resource Conservation District has been developed. The MOU addresses planning and management in the overlap area, determines areas of responsibility, and provides for appropriate consultation on certain matters. For example, for purposes of municipal water and wastewater services in the Bear Creek watershed, any integrated management issues are addressed by Colusa County through the NSV IRWMP. However, for ecosystem management in the Bear Creek watershed, integrated management issues are addressed by the Colusa County Resources Conservation District in collaboration with the Westside IRWMP.

1.9.2.3 Relationship to the Sacramento River Funding Area

The NSV IRWM region is engaged in coordination and planning with all of the IRWM regions in the SRFA. DWR's map of IRWM funding regions identifies eight planning efforts in the SRFA: American River Basin, CABY, NSV, Upper Feather River, Upper Pit River, Upper Sacramento-McCloud, Westside-Sacramento, and Yuba County Water Agency.

Beginning in June of 2008, representatives from each of the then 10 Regions (American River Basin, CABY, Four Counties (now NSV), Sacramento Valley (now superseded by NSV, American River Basin, and Westside), Lake County (now superseded by Westside), Napa-Berryessa (now superseded by Westside), Solano (now superseded by Westside), Upper Feather River, Yolo County (now superseded by Westside), and Yuba County Water Agency) met to discuss common interests and have met on five subsequent occasions through 2010. The six meetings were focused on communication and collaboration, identifying joint projects and several specific objectives, which include:

- Ensuring that adjacent or overlapping regions define an appropriate level of coordination,
- Recognizing the need for additional planning, and the need for state funding to support it, in all of the independent regions,
- Exploring the concept of an equitable funding distribution among regions within the SRFA, for possible proposal to DWR, and
- Sending a common message that the SRFA, as the major source of water for much of the rest of the state, should receive a significant portion of the "interregional" funds.

The various IRWMPs in the region have developed specific agreements or understandings with adjacent plans with which they have a boundary overlap. Over the course of the SRFA meetings the group identified the specific planning needs of each IRWM area based both on the evolution of events within the area and also the then anticipated Proposition 84 guidelines for IRWM update and revision. After the 2010 Prop 84 Planning Grant application process, the group decided that individual IRWM efforts would compete for implementation funds as-needed without specific approval by the SRFA group. As of fall 2012, the now eight IRWM efforts have not convened a joint meeting since 2010. The most recent coordination occurred in January 2013 via email to communicate and coordinate amongst the SRFA IRWM regions who would be applying for Prop 84 Round 2 IRWM implementation funding.

The ongoing coordination throughout the SRFA is expected to continue indefinitely and to be memorialized by an area-wide MOU or other agreement in the future.

1.9.2.4 Neighboring IRWMPs Requiring Minimal Coordination

The Trinity River watershed is the boundary between the NSV IRWM effort and the North Coast IRWM effort is a watershed boundary and water does not naturally flow from one to the other, nor do they share a common groundwater basin. Therefore, coordination between the two IRWM efforts is minimal. However, the Trinity River Project and Central Valley Project are operated by the United States Bureau of Reclamation and Trinity operations send critical cold water to the

Sacramento Valley annually. Should a project in the North Coast IRWM contemplate changing this, more extensive coordination would be required.

The Upper Pit River flows into Shasta Lake upstream of the NSV IRWM watershed and therefore coordinates with the Upper Pit IRWMP. The Shasta County Water Agency also participated in development of that plan.

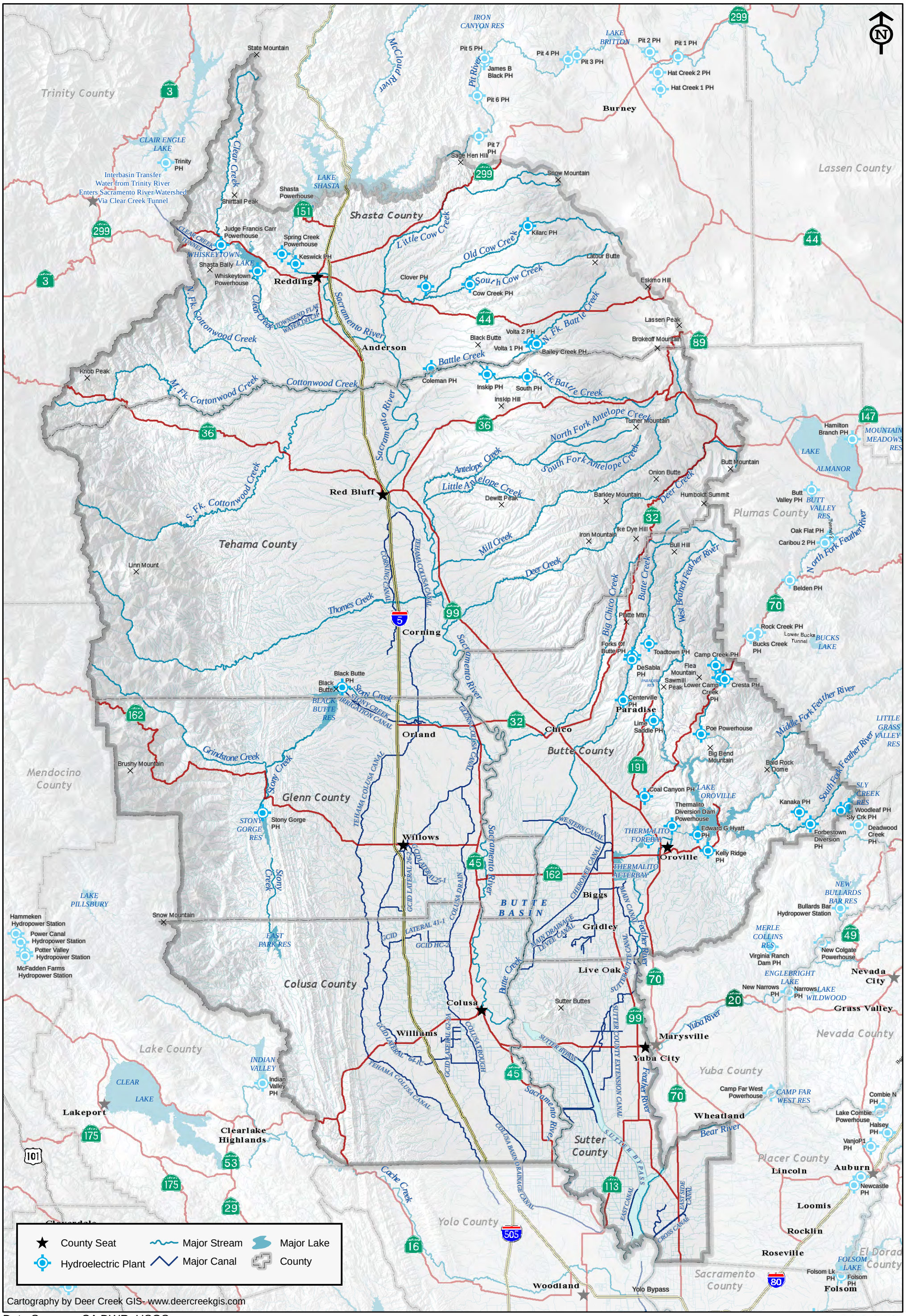
The Upper Sacramento-McCloud IRWMP, immediately upstream of Shasta Dam, has recently begun. Although Shasta County is not directly involved in the Upper Sacramento-McCloud, it is aware of the IRWMP effort and will have an opportunity to comment on the draft IRWMP. Shasta County will ensure that projects in the NSV IRWMP are coordinated with the Upper Sacramento-McCloud IRWMP.

Yuba County, immediately east of Sutter County, developed an IRWMP in 2008. The Yuba County IRWMP was primarily focused on protecting the fisheries and riparian habitat of the Yuba River, which is a tributary of the Feather River, but is not included in the NSV IRWMP planning area.

For a short length, the NSV IRWMP also shares a boundary with the CABY IRWMP, which lies east of the Yuba County IRWMP.

Northern Sacramento Valley Integrated Water Management Plan - Major Water Related Infrastructure

Figure 1-3

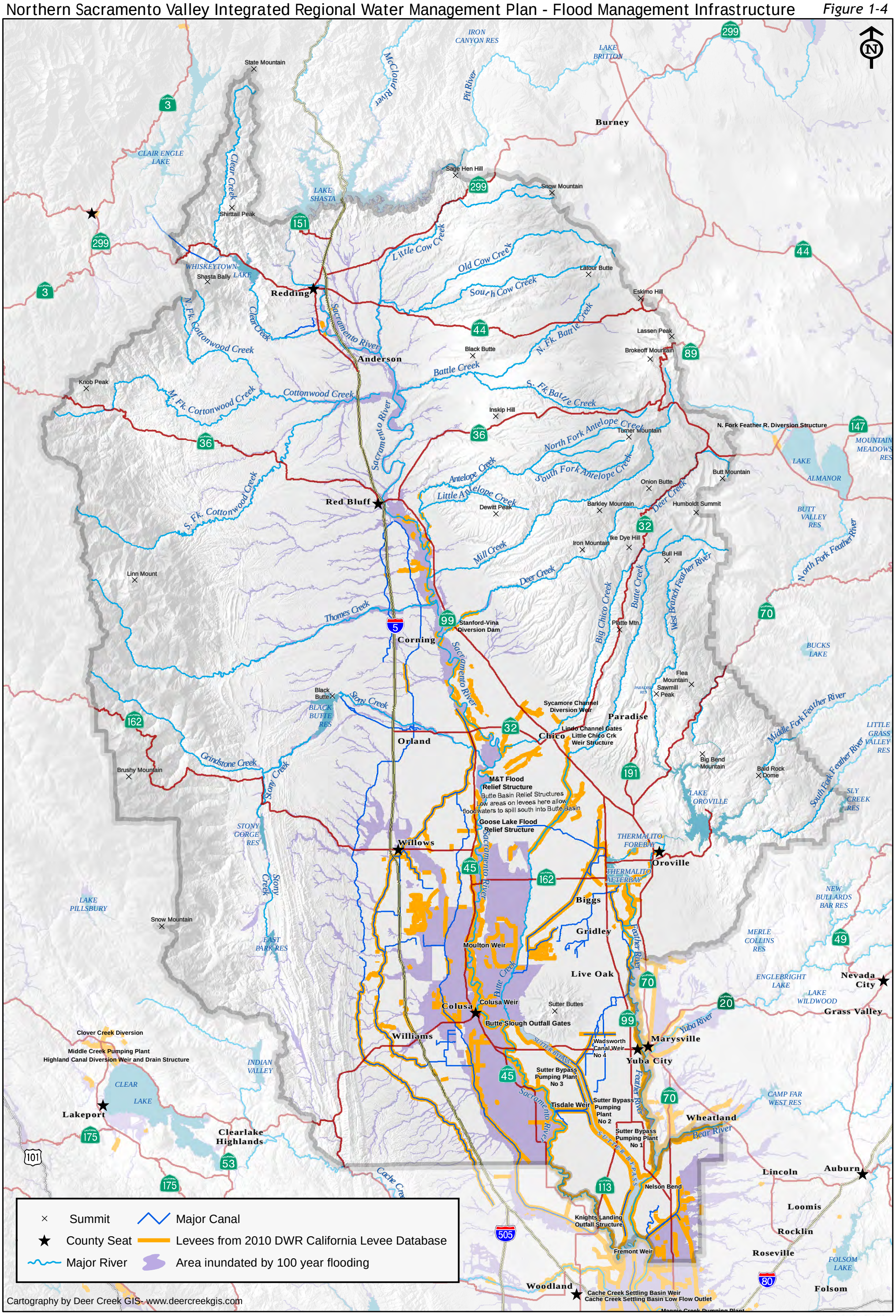


Data Sources: CA DWR, USGS

0 5 10 20 30 40 50

Miles

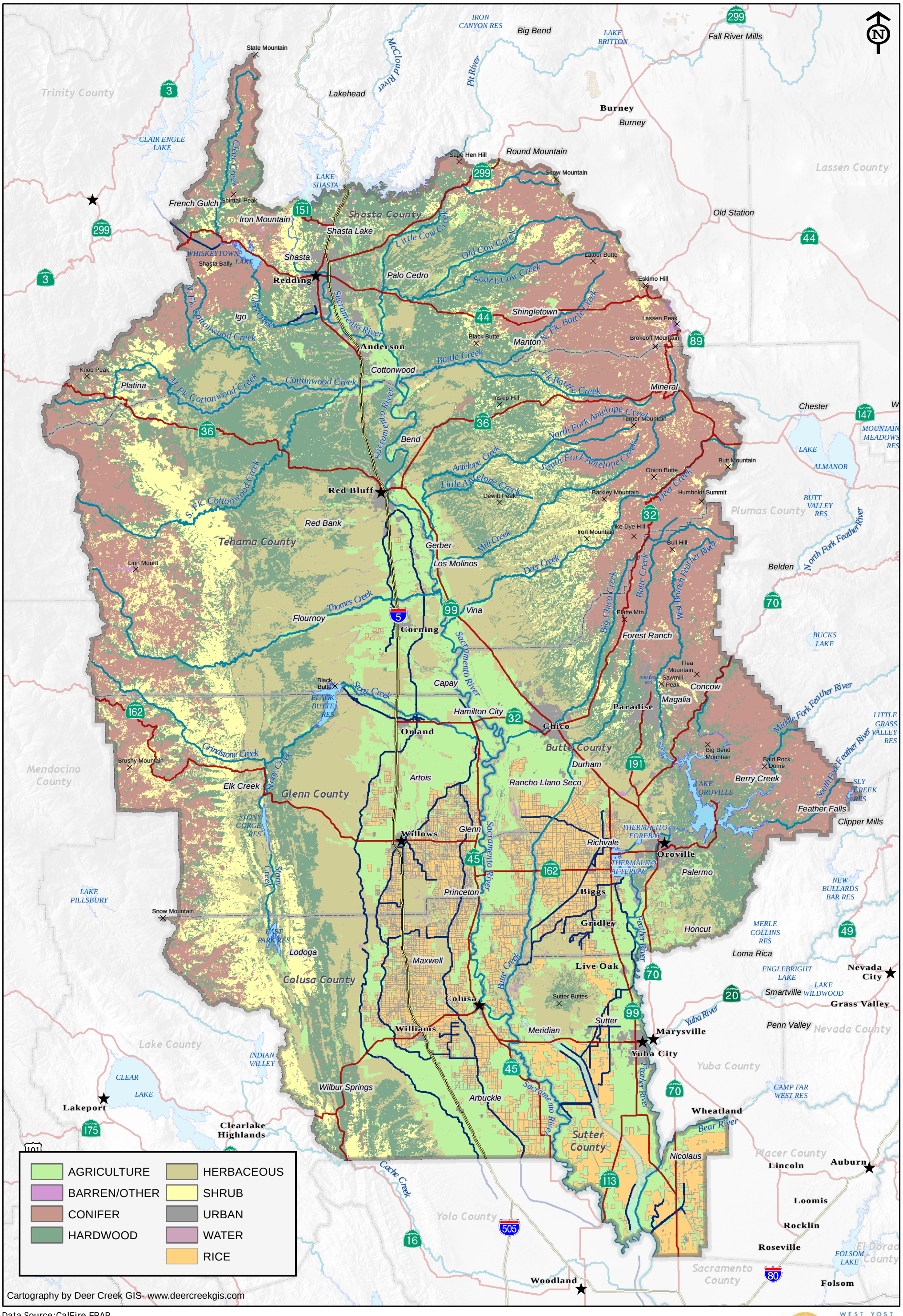
Northern Sacramento Valley Integrated Regional Water Management Plan - Flood Management Infrastructure *Figure 1-4*



Data Sources:
USGS NHD, FEMA flood data
Levees from DWR 2010 California Levee Database
Sacramento Flood Control Structures from
DWR Northern Region

0 5 10 20 30 40 50
Miles

Northern Sacramento Valley Integrated Regional Water Management Plan - Major Land Use Division *Figure 1-5*

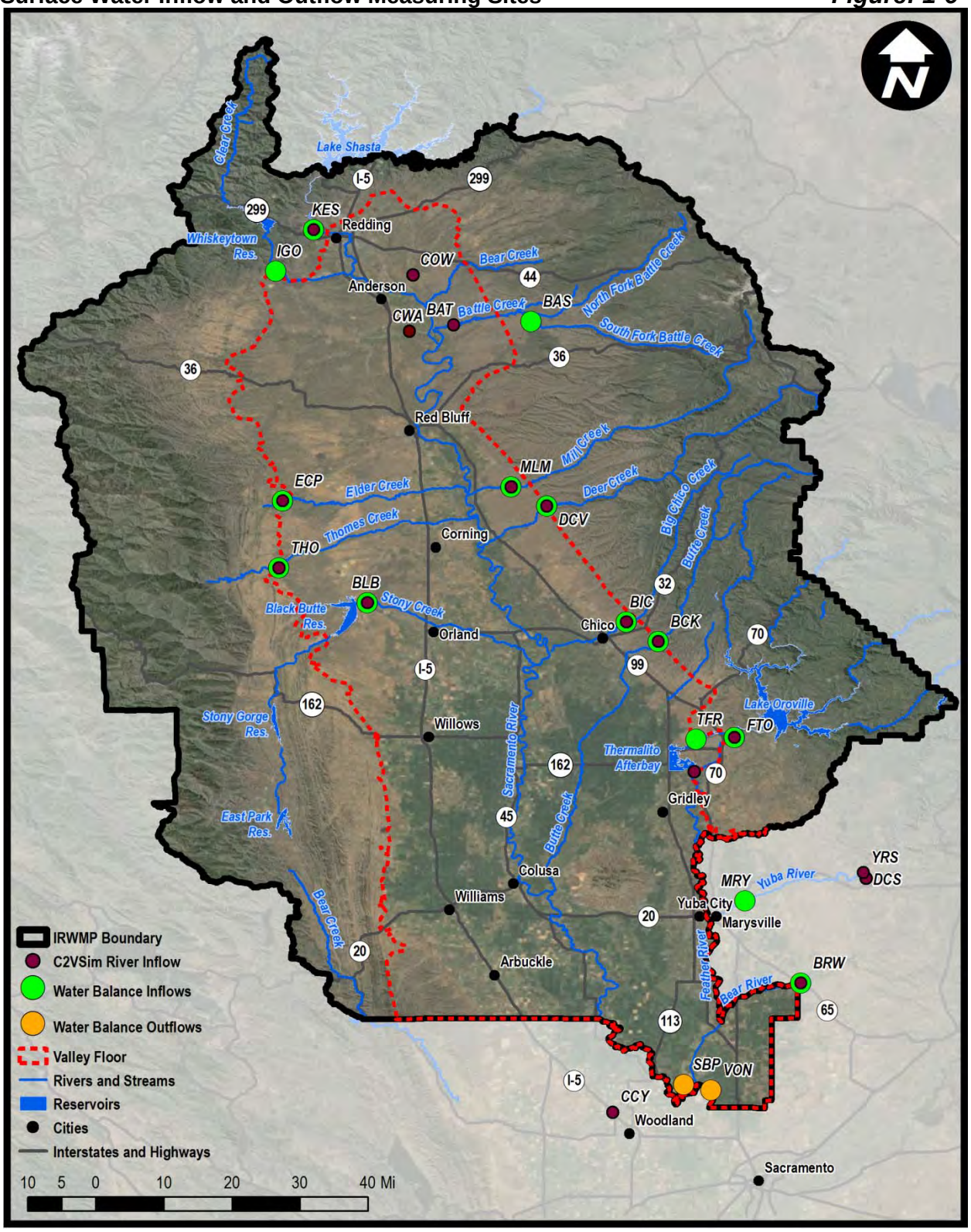


Data Source:CalFire FRAP
Ca. Department of Water Resources, Landuse Survey Program.
http://www.water.ca.gov/landwateruse
Shasta County - 2005, Glenn County - 2003,
Tehama County - 1999, Colusa County - 2003,
Butte County - 2004, Sutter County - 2004

0 5 10 20 30 40 50
Miles

Northern Sacramento Valley IRWM Planning Area

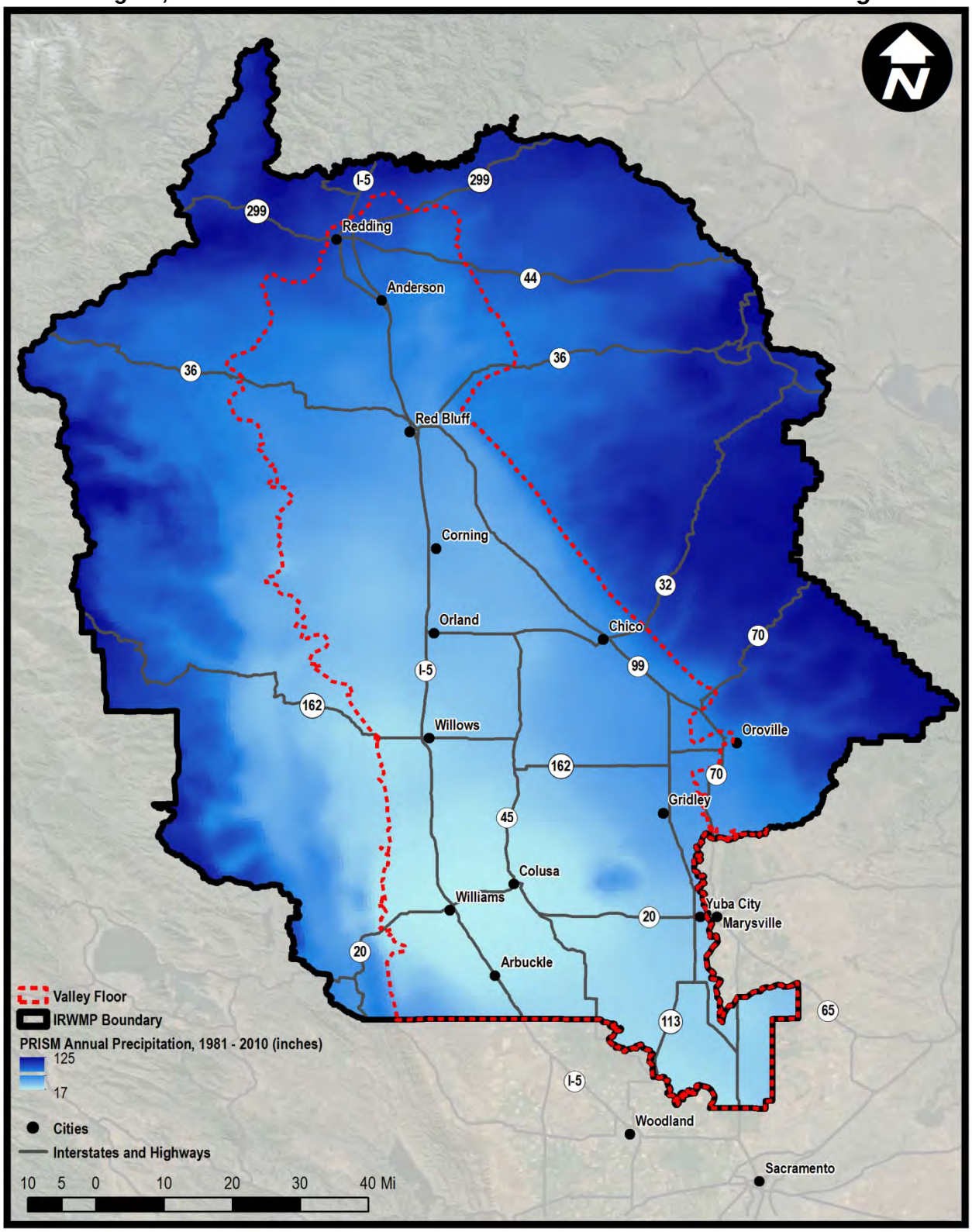
Surface Water Inflow and Outflow Measuring Sites ***Figure: 1-6***



Northern Sacramento Valley IRWM Planning Area

Spatial Distribution of PRISM Average Annual Precipitation for the IRWMP Region, 1981 to 2010

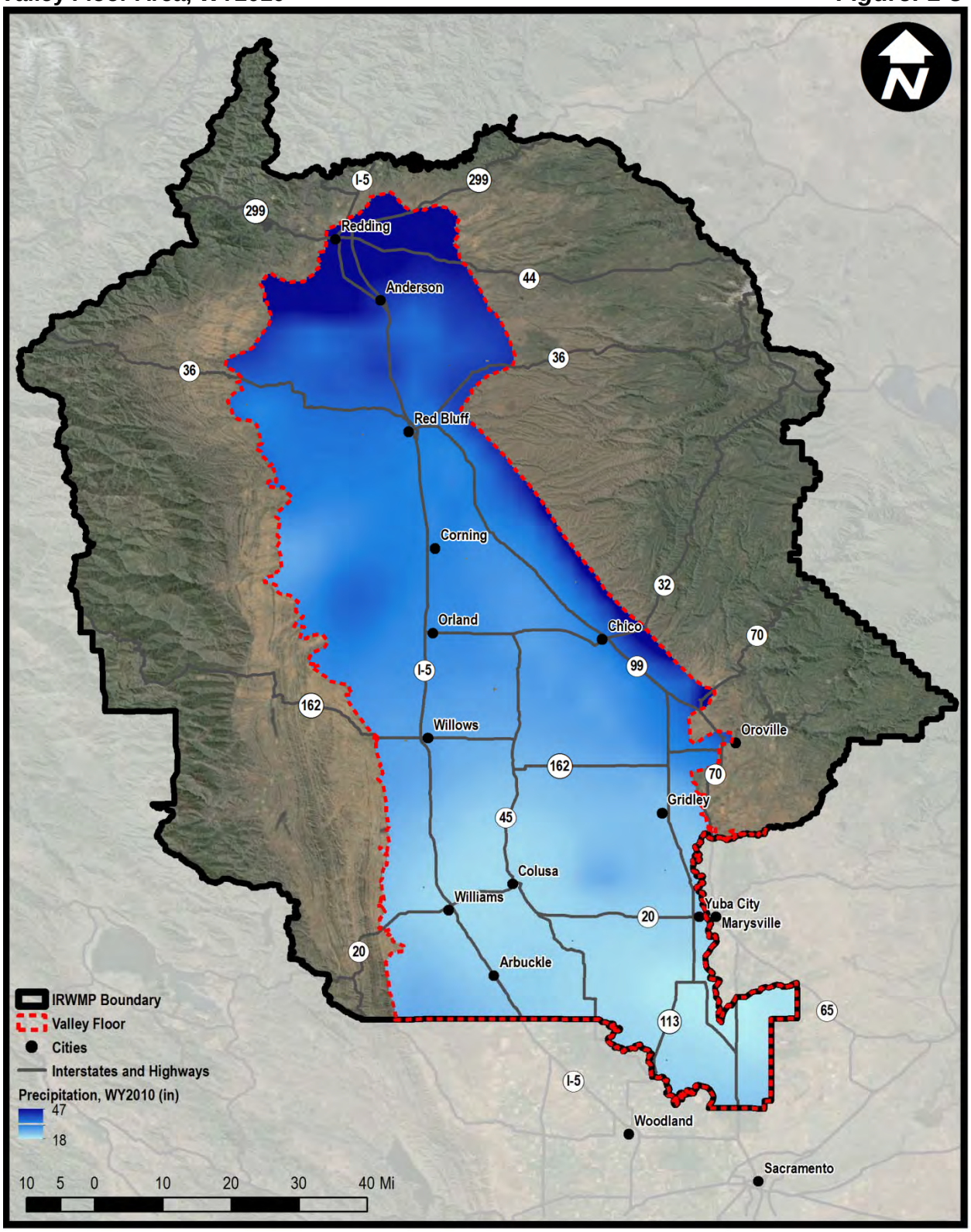
Figure: 1-7



Northern Sacramento Valley IRWM Planning Area

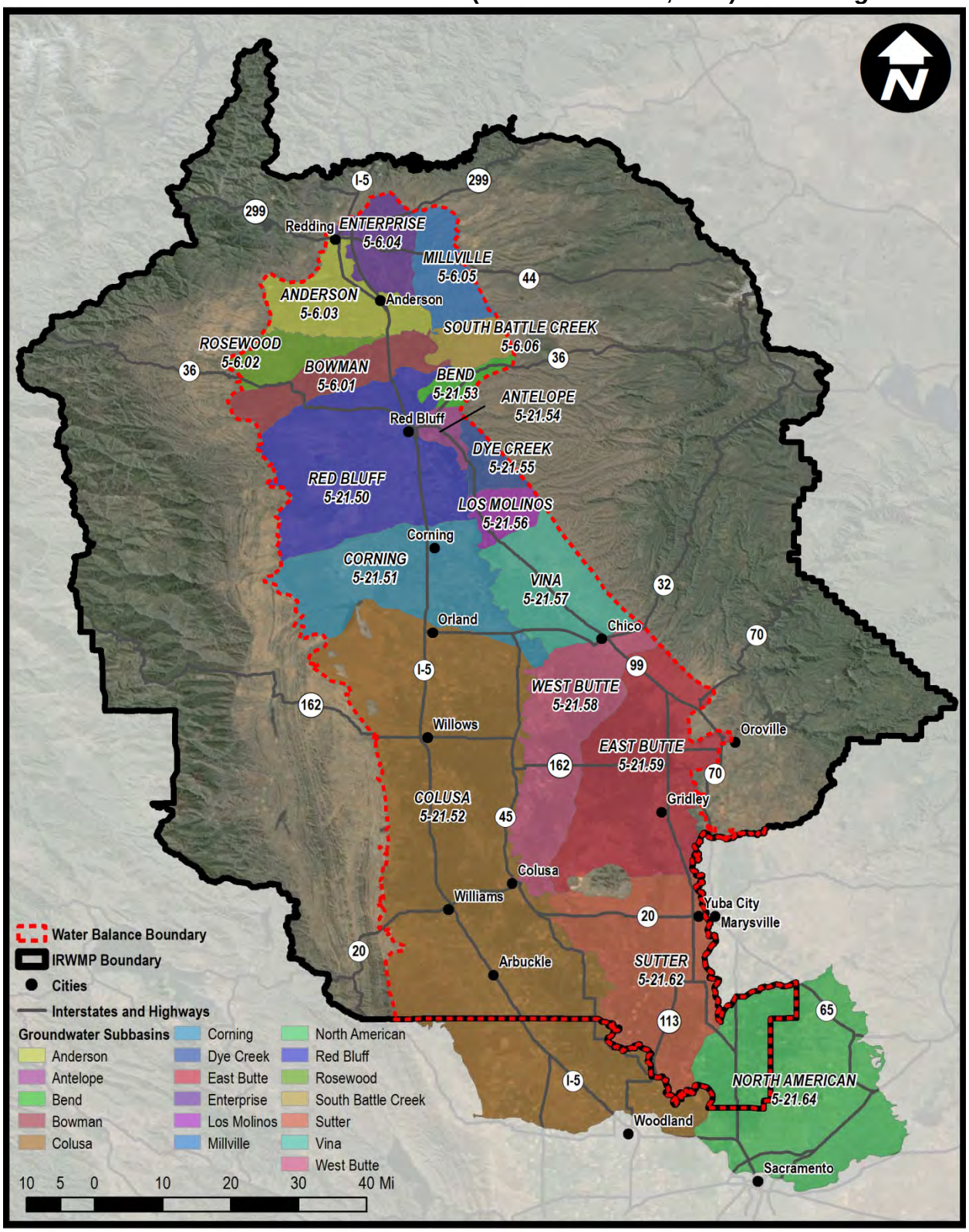
Spatial Distribution of PRISM Annual Precipitation for the Valley Floor Area, WY2010

Figure: 1-8

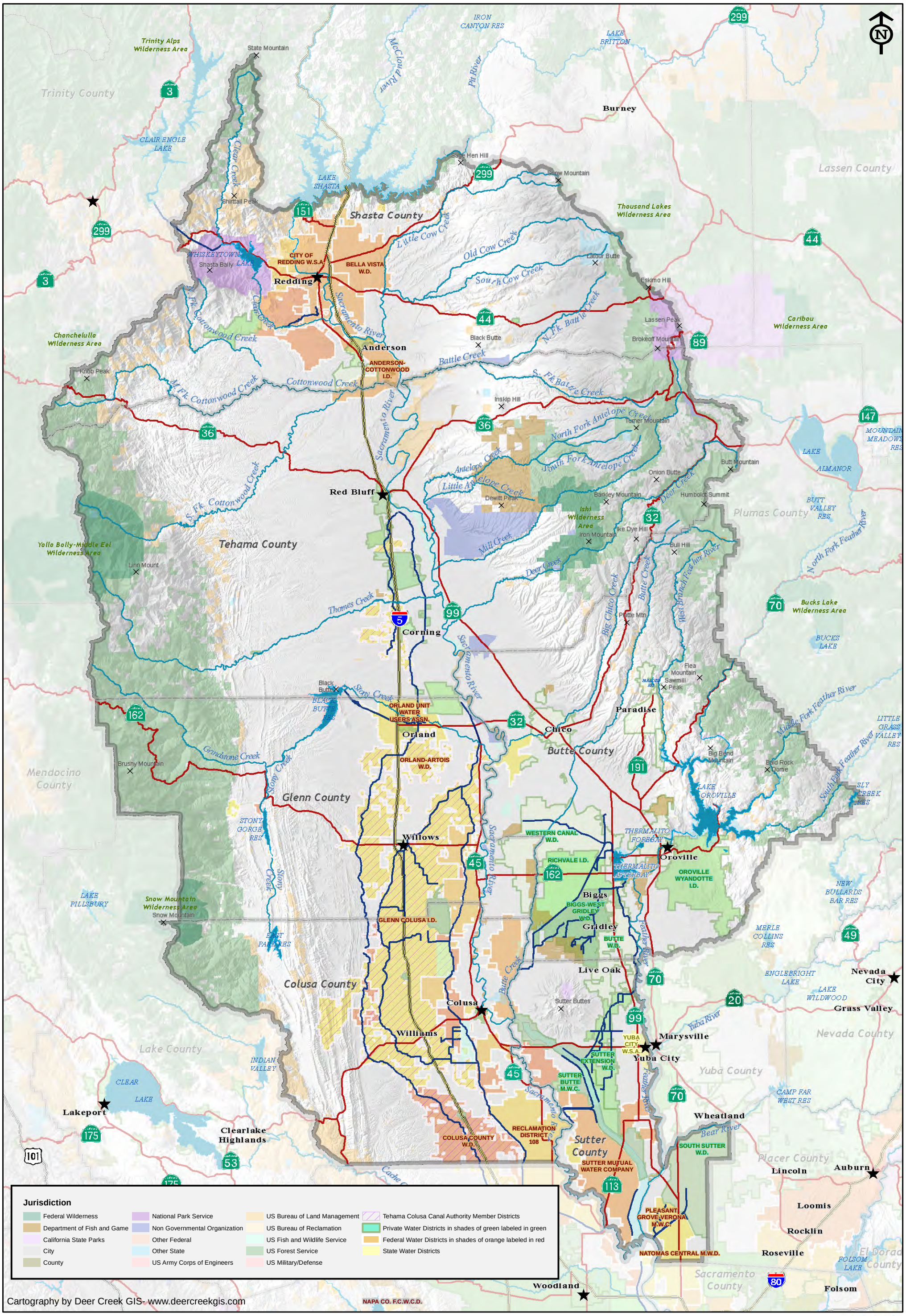


Northern Sacramento Valley IRWM Planning Area

Groundwater Subbasins in the IRWMP area (DWR Bulletin 118, 2003) ***Figure: 1-9***



Northern Sacramento Valley Integrated Regional Water Management Plan - Internal Boundaries *Figure 1-10*



Data Source: CA Department of Water Resources, USGS NHD

0 5 10 20 30 40 50
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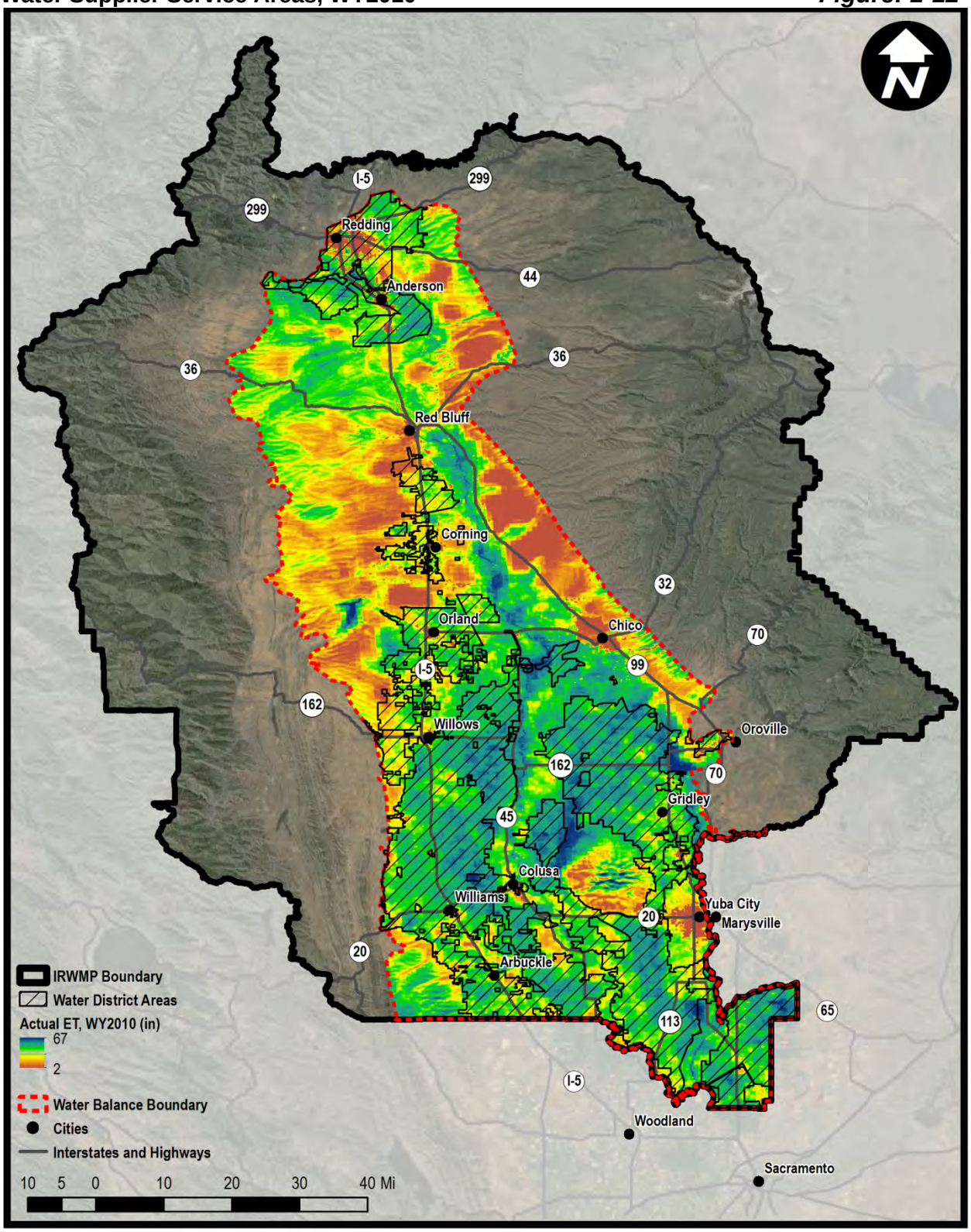
Northern Sacramento Valley IRWM Planning Area

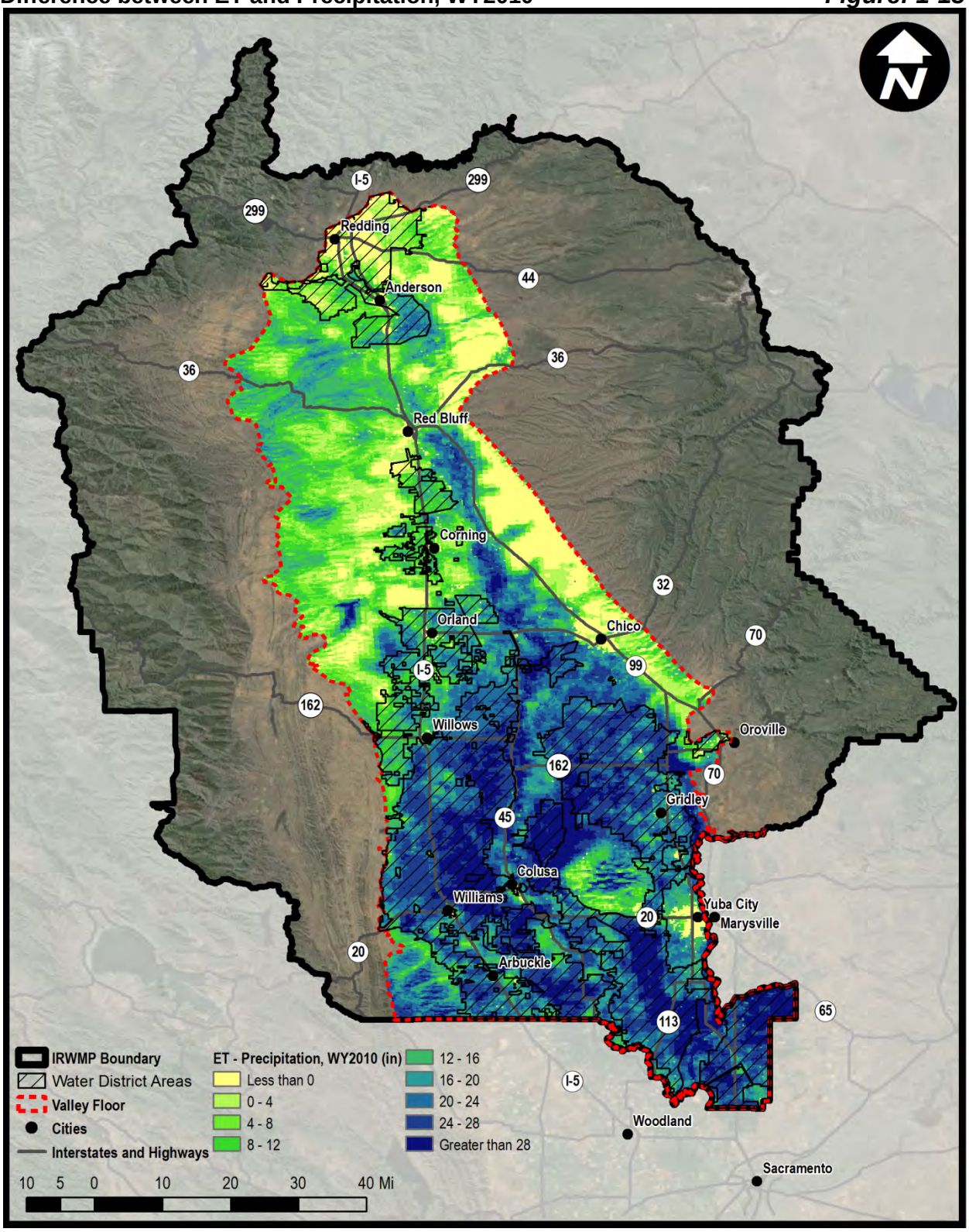
Spatial Distribution of ET within and Outside of Water Supplier Service Areas, WY2010

Figure: 1-12

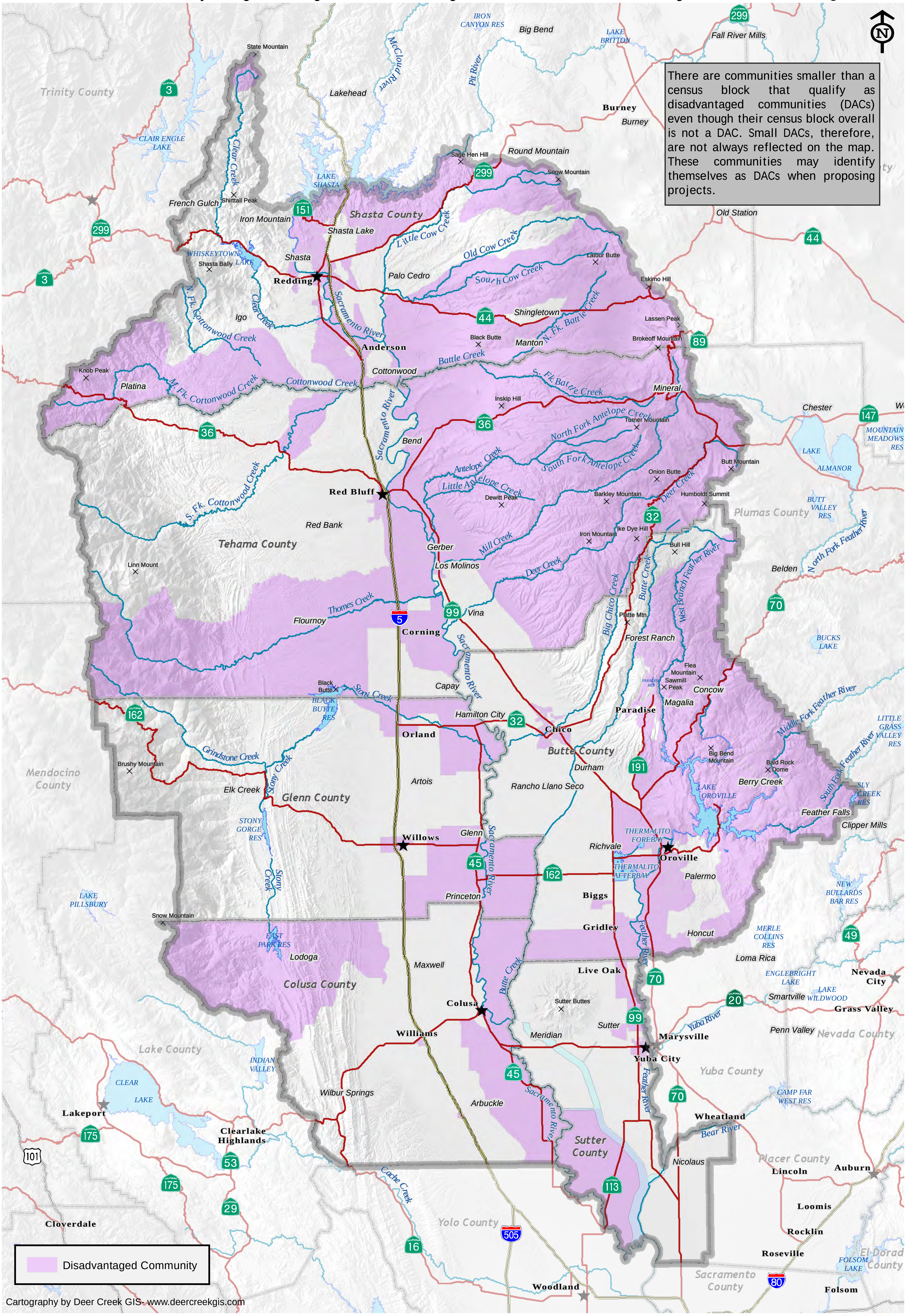


Northern Sacramento Valley IRWM Planning Area

Difference between ET and Precipitation, WY2010 ***Figure: 1-13***



Northern Sacramento Valley Integrated Regional Water Management Plan - DWR Disadvantaged Communities *Figure 1-15*



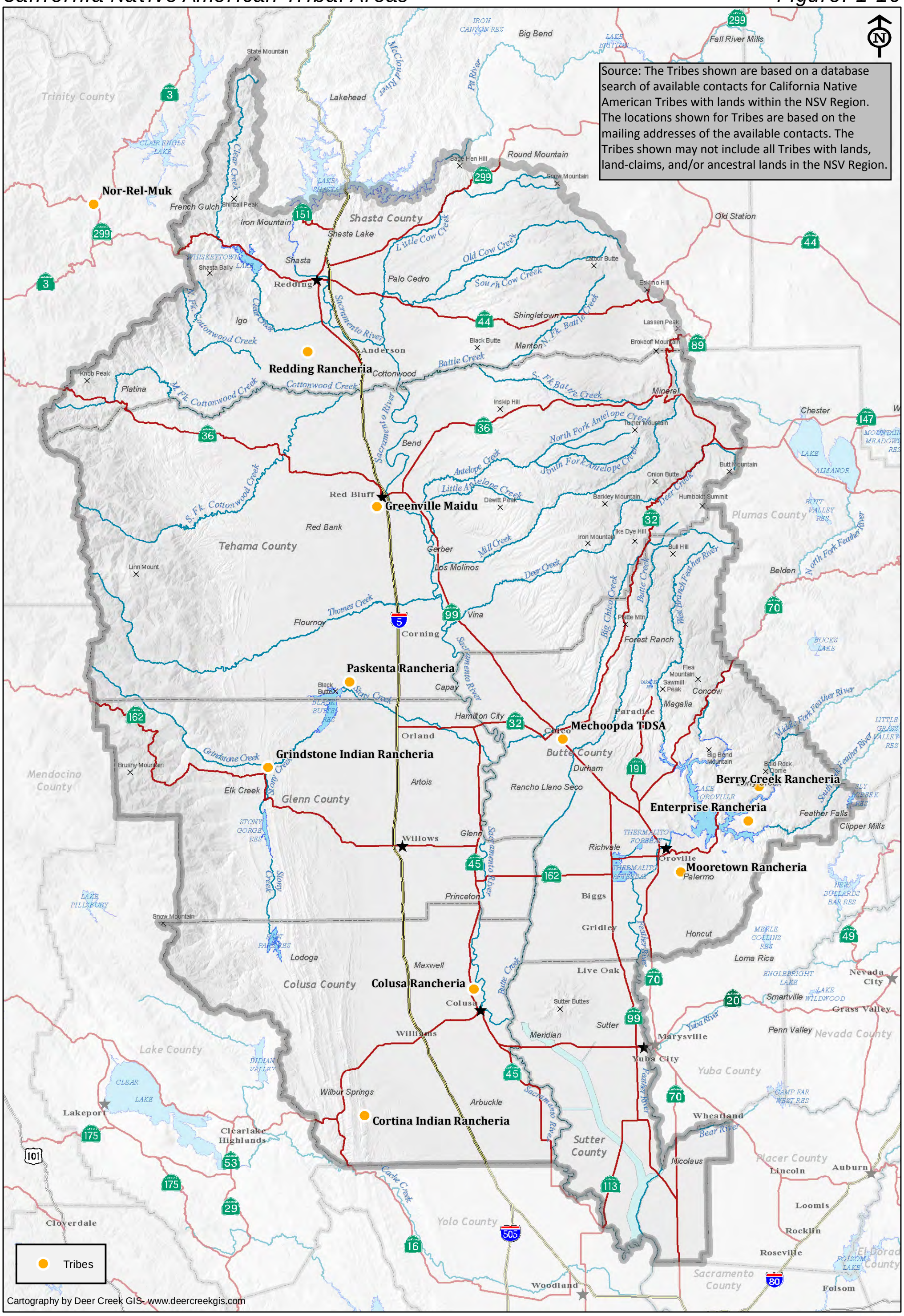
Data Source: Ca. Department of Water Resources.
IRWM Grant Program:http://www.water.ca.gov/irwm/grants/resourceslinks.cfm
DAC status is determined based on the DAC definition provided
in DWR's Proposition 84 and 1E IRWM Guidelines, dated August, 2010.
A MHI of less than $48,706 is the DAC threshold (80% of the Statewide MHI)

0 5 10 20 30 40 50
Miles

Northern Sacramento Valley IRWM Planning Area

California Native American Tribal Areas

Figure: 1-16



Data Source: U.S. Census Department

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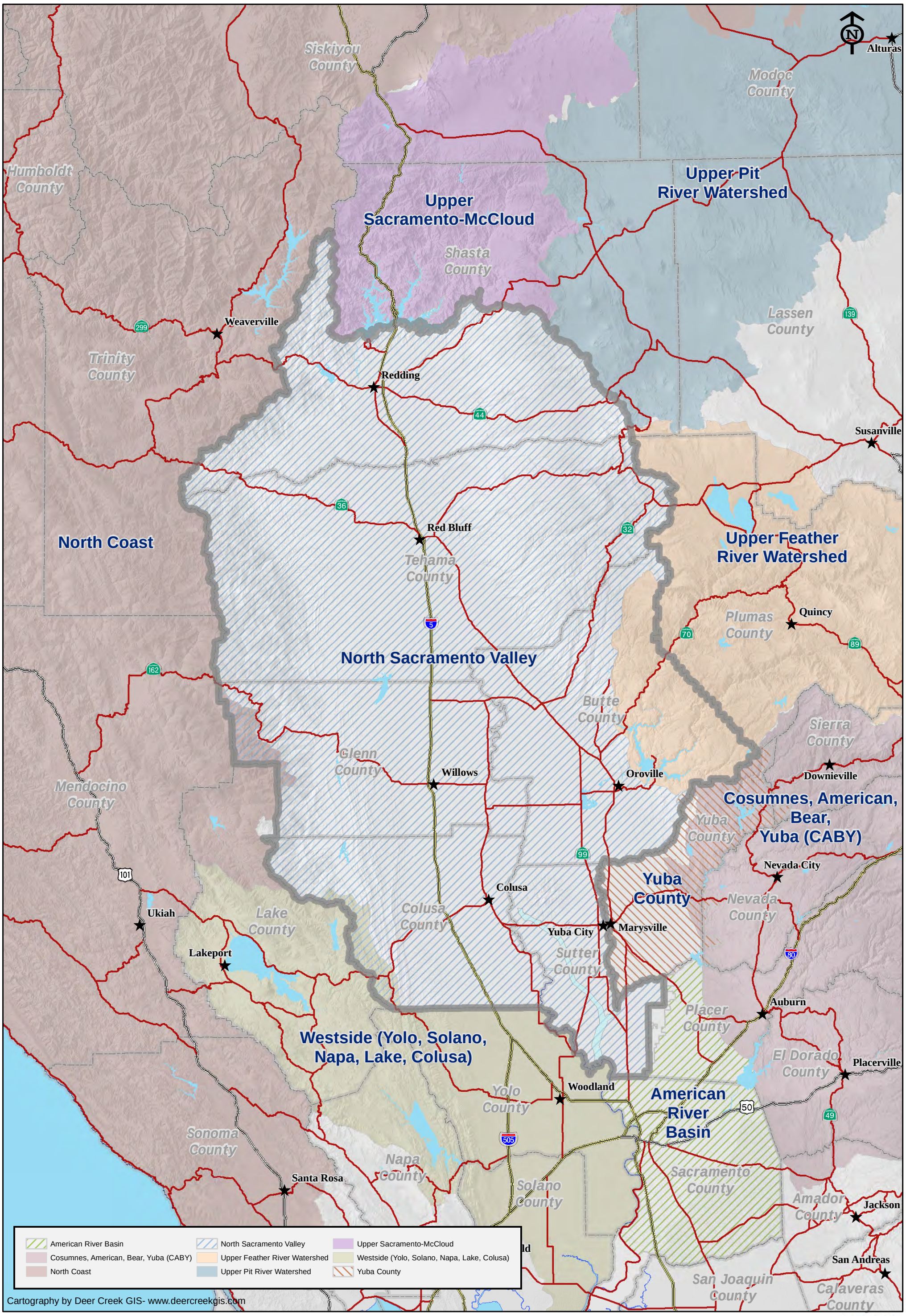
Northern Sacramento Valley Integrated Regional Water Management Plan - Neighboring IRWM Regions *Figure 1-17*



Data Source: Ca. Department of Water Resources.
IRWM Grant Program:
http://www.water.ca.gov/irwm/grants/resourceslinks.cfm

0 10 20 40 60 80
Miles