Southern Sierra

Integrated Regional Water Management Plan

Southern Sierra Integrated Regional Water Management Plan

REGISTERED PROFESSIONAL ENGINEER
OWEN KUBIT
No. C66552
Civil
STATE OF CALIFORNIA

Date Signed: 10-31-2018

November 2014
Revised November 2018

Prepared by:

Provost & Pritchard Consulting Group

In cooperation with

Funded Partially by:

A Grant from the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84)
and a subsequent 2016 Propo 1 Planning Grant

Acknowledgements

The content of this Integrated Regional Water Management Plan (IRWMP) represents a culmination of six years of planning activities from 2008-2014 and revisions in 2017/18. This work could not have been possible without start up funding from the Sierra Nevada Conservancy and leadership and initiative from Sequoia Riverlands Trust and the Sierra Nevada Alliance.

The Southern Sierra Regional Water Management Group (RWMG) would like to thank all members and interested stakeholders that provided valuable input and comments on the Draft IRWMP.

The Regional Water Management Group would also like to thank all members of the Coordinating Committee, who volunteered additional time to review and develop draft chapters for the IRWMP. The Coordinating Committee members included:

Carole Combs – Tulare Basin Wildlife Partners
John Shelton – California Department of Fish and Wildlife
Kathy Wood McLaughlin – Tulare Basin Wildlife Partners
Koren Nydick – Sequoia & Kings Canyon National Parks
Nancy Bruce – Springville Public Utilities District, Circle J-Norris Ranch
Nina Hemphill – US Forest Service
Julie Allen – Sequoia Riverlands Trust
Steve Haze – Sierra Resource Conservation District

Compilation of early versions of this plan would not have been possible without in-kind contributions from individuals such as Bobby Kamansky, Principal Biologist, Kamansky's Ecological Consulting, Allan Pearce, and Courtney Lewis, M.S. candidates, Antioch University, Tasha Newman and John McCaull, Conservation Strategy Group, and Elissa Brown, grant writer.

IRWMP regions surrounding the Southern Sierra IRWMP include the Inyo-Mono, Madera, Upper Kings, Kaweah, Tule, Poso and Kern Regional Water Management Groups. These regions shared information, collaborated on boundaries, and continue to integrate across jurisdictional boundaries in the Tulare Lake and San Joaquin Funding Regions.

The Fresno office of the California Department of Water Resources also assisted the Region tremendously, providing guidance about policies, laws, grants and processes.

Thanks is also extended to the Sacramento State University Center for Collaborative Policy who, since 2011, facilitated the public meeting process and to the University of Califorinia, Merced, who contributed results of its study on *Assessment of Climate*

Change Effects and Impacts on the Hydrology of Southern Sierra Nevada Basins, and significant updates to the climate change chapter.

Special thanks are also provided to those that contributed pictures for the IRWMP including Bobby Kamansky, Niki Woodard, and Nancy Bruce.

Southern Sierra Regional Water Management Group Memorandum of Understanding Signatories

Big Sandy Rancheria
California Department of Fish and Wildlife
Desert and Mountain Resource Conservation & Development Council
Fresno Metropolitan Flood Control District
Inyo National Forest
Pacific Southwest Research Station
Revive the San Joaquin
San Joaquin Valley Leadership Forum
Sequoia National Park and Kings Canyon National Park
Sequoia National Forest
Sequoia Riverlands Trust
Sierra and Foothill Citizen's Alliance
Sierra Club – Tehipite Chapter
Sierra National Forest
Sierra Resource Conservation District
Springville Public Utilities District
Tulare Basin Wildlife Partners
Tule River Reservation
Yosemite/Sequoia Resource Conservation & Development Council

Fresno Metropolitan Flood Control District

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ABBREVIATIONS

µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
µS/cm	microsiemens per centimeter
AB	Assembly Bill
AF	acre-feet
AWMP	Agricultural Water Management Plan
BAER	Burned area emergency response
BMP	best management practice
CaLEEMod	California Emissions Estimator Model
CALFED	CALFED Bay Delta Program
CAS	California Aquifer Susceptibility
CASGEM	California State Groundwater Elevation Monitoring
CBI	Conservation Biology Institute
CCC	California Climate Commons
CDEC	California Data Exchange Center
CDPH	California Department of Public Health
CEDEN	California Environmental Data Exchange Network
CEIC	California Environmental Information Clearinghouse
CEQA	California Environmental Quality Act
CERES	California Environmental Resources Evaluation System
CHSC	California Health and Safety Code
CII	commercial, industrial and institutional
CIMIS	California Irrigation Management Information System
CIWQS	California Integrated Water Quality System
CNRA	California National Resources Agency
COC	constituent of concern
CSA	County Service Area
CSD	Community Services District
CSET	Community Services and Employment Training
CTS	California Tiger Salamander
CVP	Central Valley Project
CV-SALTS	Central Valley Salts Coalition
CWAP	California Water Action Plan
CWC	California Water Code
CWI	California Water Institute
CWP	California Water Plan
DAC	disadvantaged community
DDW	State Water Resources Control Board, Division of Drinking Water
DFW	Department of Fish and Wildlife
DMM	Demand Management Measures
DWR	Department of Water Resources
EA	Environmental Assessment

EC	electrical conductance
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EWMP	Efficient Water Management Practice
FAR	functioning at risk
FERC	Federal Energy Regulatory Commission
FMFCD	Fresno Metropolitan Flood Control District
GAMA	Groundwater Ambient Monitoring and Assessment
GHG	greenhouse gas
GIS	geographic information system
GMP	Groundwater Management Plan
I&M	Inventory and Monitoring
ILP	Irrigated Lands Program
IMPROVE	Interagency Monitoring of Protected Visual Environments
IRWM	Integrated Regional Water Management
IRWMP	Integrated Regional Water Management Plan
IWRIS	Integrated Water Resource Information System
JPA	Joint Powers Authority
KBWA	Kings Basin Water Authority
KCWA	Kern County Water Agency
KREW	Kings River Experimental Watershed
KRFMP	Kings River Fisheries Management Program
KRWA	Kings River Water Association
LAFCO	Local Agency Formation Commissions
LUST	leaking underground storage tank
mAF	million acre feet
MCL	maximum contaminant level
MHI	median household income
MOU	Memorandum of Understanding
MSL	mean sea level
MSR	Municipal Service Review
mya	million years ago
NADP	National Atmospheric Deposition Program
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRA	Natural Resources Agency
NRCS	Natural Resources Conservation Service
NSF	National Science Foundation
O&M	operation and maintenance
PG&E	Pacific Gas & Electric
PUD	Public Utilities District
RC&DC	Resource Conservation & Development Council

RCD	Resource Conservation District
RHNA	Regional Housing Needs Allocation
RMS	resource management strategy
RP	responsible party
RWMG	Regional Water Management Group
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SDAC	severely disadvantaged community
SEKI	Sequoia & Kings Canyon National Parks
SIEN	Sierra Nevada Network
SJER	San Joaquin Experimental Range
SJR	San Joaquin River
SNAMP	Sierra Nevada Adaptive Management Project
SNRI	Sierra Nevada Research Institute
SOI	sphere of influence
SPUD	Springville Public Utilities District
SSCZO	Southern Sierra Critical Zone Observatory
SWAMP	Surface Water Ambient Monitoring Program
SWFM	stormwater flood management
SWRCB	State Water Recourse Control Board
SWWG	Sierra Water Workgroup
TDS	total dissolved solids
TLB	Tulare Lake Basin
TMDL	total maximum daily load
TMF	technical, managerial and financial
USACE	United Stated Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USDI	United Stated Department of the Interior
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VA	Vulnerability Assessment
VOC	volatile organic compound
WDL	Water Data Library
WWTF	Waste Water Treatment Facility

Executive Summary

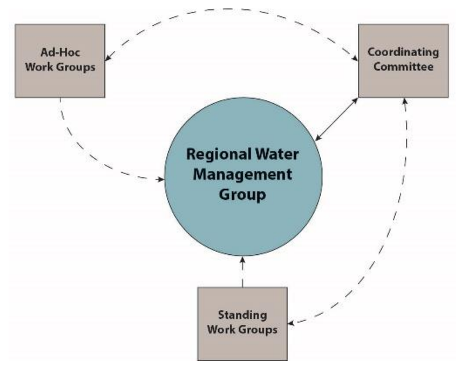
Introduction (Chapter 1)

The Southern Sierra Integrated Regional Water Management Plan (IRWMP) is the first truly regional effort to address water management in the Southern Sierra Region (Region). The contents of this IRWMP represent a culmination of the planning activities from 2008 to 2014. IRWMPs are prepared by Regional Water Management Groups (RWMG) comprised of a collection of agencies, stakeholders and individuals who share a common interest in managing water resources in a specific hydrologic region. This IRWMP documents regional and local data, water-related issues, water-related objectives, resource management strategies and collaborative efforts. The IRWMP was developed with significant input from RWMG members and other interested stakeholders.

Historically, water management in the Southern Sierra has been limited to independent operations by local agencies, tribes, private well owners and non-profit organizations. There has been limited coordination between these groups due to a lack of regional coordination forums and regional entities. With the creation and establishment of the RWMG, stakeholders have come together and the Region now has a vehicle to improve communication, collaboration and cooperation on water management. Continuing development in the foothills, limited groundwater supplies, droughts and the threat of climate change call for immediate action to pool resources and begin regional water management in the Southern Sierra.

The Southern Sierra IRWMP was developed through a collaborative process including the RWMG members, interested stakeholders and the Department of Water Resources. The State has established sixteen IRWMP standards (topics) that must be addressed. Each of the sixteen IRWMP standards was individually discussed and they are addressed in the fourteen chapters described below.

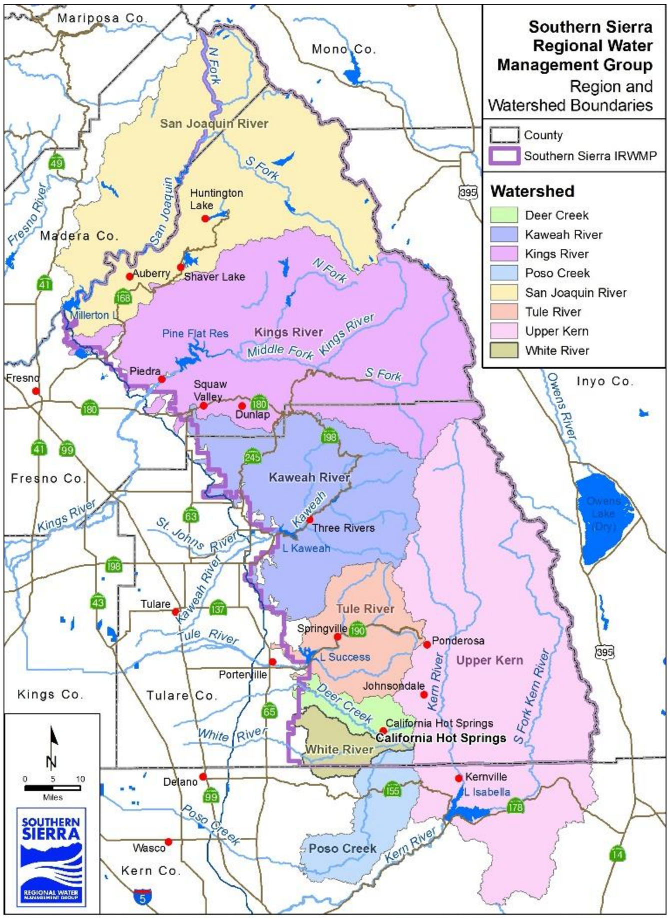
Governance (Chapter 2)



The Regional Water Management Group is governed according to a Memorandum of Understanding (MOU) prepared in 2009. The Group includes 18 members who have signed the MOU and 43 interested stakeholders who participate but have no voting rights. Dues are not required for membership. The RWMG is supported by a Coordinating Committee and various Work Groups who provide advice and input to the RWMG. Decisions are made generally by the consensus of the MOU signatories who have voting rights. The organizational structure provides balanced opportunities for stakeholder participation.

Region Description (Chapter 3)

The Southern Sierra Region covers approximately 6,195 square miles (3,964,800 acres) and includes the foothills and mountain headwater regions of the Kern, Poso, White, Tule, Kaweah, Kings and San Joaquin River watersheds. These watersheds cover the Sierra Nevada portion of Fresno and Tulare counties and a portion of Madera County. The Region is considered appropriate as a RWMG since it has a strong hydrologic basis with borders based on watershed boundaries and the Sierra Nevada crest. The area covered by the Southern Sierra RWMG is coterminous with the area covered by this IRWMP.



The Region generally has abundant surface water supplies including several large rivers and scores of creeks and streams. However, most of the surface water rights are held in downstream areas of the Central Valley. Most of the local water users rely on hard rock (typically granitic) wells that have limited ability to hold and transmit groundwater, and typically have low yields. The water budget is not well understood in most of the Region.

Over 75% of the land is administered by State and Federal agencies, primarily the US Forest Service and US Park Service. Most of the foothill areas are privately owned and used for agriculture and ranching. The region only has a permanent population of 34,000, but over two million tourists visit the area each year which put demand on water supplies.

The area includes many important ecological resources including vast wilderness areas, forests, meadows, wetlands, aquatic species, Giant Sequoias and numerous special status species. Important issues in the area include wildfires, limited groundwater supplies, limited surface water rights, fish passage, forest management to increase water yield, growth in foothill areas and the potential for climate change to exacerbate all of these issues.

The Southern Sierra RWMG abuts seven adjacent RWMGs and has coordinated with these RWMGs on borders and identifying regional projects. The Southern Sierra Region is unique in that it covers the headwaters supplying surface and groundwater to vast areas of valley agricultural lands.

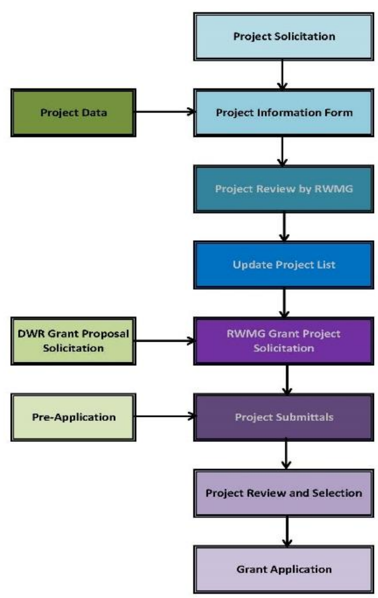
In 2018 the SS RWMG significantly revised portions of this Chapter. The revisions included updates to address new requirements that nitrates, arsenic, perchlorate and hexavalent chromium be specifically discussed.

Goals and Objectives (Chapter 4)

The Regional Water Management Group developed goals and measurable objectives through a collaborative process including input from the MOU signatories, Coordinating Committee, interested stakeholders and the general public. Seven broad goals were identified including: Improve Water Supply Management, Protect and Improve Water Quality, Perform Integrated Flood Management, Improve Watershed and Environmental Resource Management, Expand Stakeholder Education, Protect Unique/Important Environmental Resources and Reduce Energy consumption abd GHG Emissions. Each goal has several measurable objectives and metrics are provided for measuring the success of each objective. The seven goals are considered coequal, but the objectives were ranked by importance through a stakeholder survey to provide focus and capture a cross-section of the group's input.

In 2018 the SS RWMG revised portions of this Chapter. This chapter was modified to include new goals and objectives required by the State related to runoff, climate change and energy conservation.

Resource Management Strategies (Chapter 5)



A resource management strategy is a project, program or policy that helps agencies manage their water and land resources. This IRWMP evaluates 36 strategies identified in the 2013 California Water Plan Update, in addition to 'Drought Planning and Climate Change Mitigation strategies added by the RWMG. The strategies fall into eight broad categories: Reduce Water Demand, Improve Operational Efficiency and Transfers, Increase Water Supply, Improve Flood Management, Improve Water Quality, Practice Resources Stewardship, People and Water, and Other Strategies. The evaluations include a description of each strategy, current use and applicability in the Region and constraints to development. The Region uses 33 of the 38 different strategies evaluated and has a diverse portfolio of relevant water management options.

In 2018 the SS RWMG revised portions of this Chapter. This chapter was modified primarily to include a new Resources Management Strategy on Carbon Sequestration.

Project Review Process (Chapter 6)

The RWMG has a project review process to solicit and approve projects for a formal project list (Appendix G), and to rank potential projects for inclusion in grant applications. The project list is updated annually but projects can be submitted at any time. A project must be compatible with the regional goals and objectives to be added to the project list. Projects must be on the list to be considered for grant applications. A formal process is established for reviewing projects proposed for IRWMP grant applications that are funded as a whole, and not individually by project. The process includes development of a pre-application and scoring each application according to established criteria set forth in Appendix I. Collective grant applications should begin this process at least 90-days prior to final grant deadlines.

Impacts and Benefits of Plan Implementation (Chapter 7)

Historically, water management has been fragmented and generally performed only on a local scale, with little regional cooperation. Regional water management can enhance these local efforts, reduce conflicts and improve overall resource management. Some problems, such as watershed restoration, can only be solved with regional cooperation. A comprehensive list of benefits and impacts from implementing the 33 resource management strategies were identified for the Southern Sierra Region and surrounding IRWMP regions. The impact/benefit analysis can be used to evaluate projects, establish goals and priorities and identify potentially adverse impacts from projects that are often overlooked.

Plan Performance and Monitoring (Chapter 8)

The RWMG will prepare annual reports to document progress in meeting IRWMP objectives, success in implementing projects, an updated project list, proposed amendments to the IRWMP and changes in governance, policies and membership. Guidelines are provided for project-specific monitoring plans on RWMG sponsored projects. Numerous regional monitoring programs are active in the Southern Sierra and are also described.

In 2018 the SS RWMG revised portions of this Chapter. The revisions included moving Section 8.1 to the end of the Chapter, renumbering it as Section 8.5, and adding additional monitoring plans.

Data Management (Chapter 9)

The RWMG has identified several data needs in the Region including more detailed information on groundwater, watershed management plans and better information on water budgets. The RWMG does not have the resources to build or maintain databases and relies heavily on several State and Federal databases for data storage. The RWMG website will be the main portal for storing data collected and generated by the RWMG (http://www.southernsierrarwmg.org/). A list of important water related data sources is provided.

Financing (Chapter 10)

The RWMG needs funding for on-going operations, updating the IRWMP, preparing grant applications, project development, project operation and maintenance, and local cost share for grant applications. The RWMG does not require member dues and has operated on grant funding and in-kind professional services from members and interested stakeholders. A detailed list of potential funding programs and agencies is provided.

Technical Analysis (Chapter 11)

Due to the nature of the IRWM process the RWMG was not able to fund significant new studies to support the process, and relied largely on existing studies, reports and data sets. A summary table of this information is presented in Chapter 11. The RWMG felt that potential effects from climate change were wide spread and significant enough that the Geos Institute was retained to evaluate and down scale current models to the Region. The DWR, through its technical assistance program, conducted a water supply study for the community of Three Rivers at the request of the RWMG. The RWMG is hopeful that this study will serve as a model for other studies in other portions of the Region as funding becomes available.

Relation to Local Land-use and Water Planning (Chapter 12)

Local agencies have their own water planning documents and land-use planning documents that reflect their policies and goals. Both water and land-use planning documents from the member and interested stakeholder agencies were reviewed and inventoried. The RWMG was able to identify the relationship between local planning documents and regional issues, regional water management goals and resource management strategies. Existing gaps in the local plans were documented in a tabular format. The dynamics between the water and land-use plans were also identified. Opportunities to enhance proactive collaboration between local land-use planners and water managers are discussed and summary of successful information sharing and collaboration between land use planners and water managers also provide.

In 2018 the SS RWMG revised portions of this Chapter. The revisions included addition of a new Resources Management Strategy on Climate Change and Adaptation.

Stakeholder Involvement (Chapter 13)

Stakeholder involvement is considered fundamental to the success of the RWMG. A wide variety of public outreach methods have been used to engage the general public, agencies and organizations. The RWMG provides equal opportunity for participation and most of the major stakeholders in the region are now participating in the RWMG. Future outreach efforts will mimic past efforts with goals directed towards continuous recruitment, education on regional issues and outreach to disadvantaged communities.

In 2018 the SS RWMG revised portions of this Chapter. The revisions included edits made to expressly acknowledge Native American Tribes as Sovereign Nations.

Coordination and Integration (Chapter 14)

Coordination involves public outreach and facilitation efforts to bring stakeholders together and working as a unified group. Integration is defined as combining separate pieces into an efficient unified effort. These two IRWMP standards are closely related and were combined into a single chapter. The RWMG's governance structure fosters integration and coordination through the organizational structure, opportunities for participation and a public outreach program. The RWMG also communicates/coordinates regularly with neighboring IRWMP groups and State DWR staff.

Climate Change (Chapter 15)

Climate change is affecting California in many measurable ways - sea levels are rising, snowpack is decreasing and water temperatures are increasing. All of these changes are impacting our water resources now. Continuation of these trends has the potential to significantly impact the sustainability of the State's water supplies with serious consequences in the State's ability to meet ever-growing demand. Climate changes are predicted to generate significant water resources and ecosystem vulnerabilities including modified habitats, up-slope migration of flora and fauna, major shifts in fire return intervals, severity and size of wildfires, increased variability in precipitation patterns and river flows, rising temperatures and earlier or faster snowmelt.

The University of California, Merced was engaged by the RWMG to evaluate current models and prepare a report addressing future trends, vulnerabilities and possible climatic conditions. The RWMG also performed a climate change vulnerability assessment on water demands, water supplies, water quality, flooding, ecosystems and habitat, and hydropower. The Region supports 'no-regret' strategies to address climate change, which are strategies that help to adapt to climate change, but also offer benefits if climate change does not occur or is less severe than predicted.

The University of California, Merced, Sierra Nevada Research Institute (SNRI) was engaged in 2017/18 to provide more current information on what is now known and understood about impacts from climate change. Much of the information was generated by a study performed for the RWMG by SNRI entitled Evaluating Climate Change Effects on the Hydrology of Southern Sierra Nevada Basins (Appendix M). The study discusses climate change effects on temperature increases, precipitation increases (more rain, less snow pack), impacts to drought from lower precipitation combined with higher temperatures, climate change impacts to water quality and secondary effects to species, including vegetation transformation and effects of tree mortality, vegetation distribution and density, and relationship to wildfire incidents and intensities.

In 2018 the SS RWMG revised portions of this Chapter. The revisions included addition of a new Section 15.2 which includes updates provided by UC Merced pursuant to current studies.

Disadvantaged Communities (Chapter 16)

Disadvantaged communities exist in the Southern Sierra Region and due to their economic disadvantages have many critical and unique water supply, water quality and wastewater issues and needs.

There is financial opportunity for the RWMGs to seek out DACs or EDAs in the Region, as many State grants either give special consideration or preferences for projects that serve DACs or EDAs or have funding percentages set aside for projects that help meet the needs of DACs or EDAs. Even communities that don't meet the statutory definition of a DAC or EDA can benefit if they are below the Median Household Income (MHI) level for the region.

Therefore, the purpose of this chapter is to identify the Disadvantaged Communities (DAC) and Economically Distressed Areas (EDA) within the Southern Sierra Region and highlight their needs with the desired result being that these communities can be successful in applying for Proposition 1 grant and loan programs for projects that will benefit them.

Southern Sierra Regional Water Management Group

The Southern Sierra Regional Water Management Group is an open organization and encourages participation from local water agencies, land-use agencies, industry organizations, non-governmental organizations and individuals in the Southern Sierra Region. The Regional Water Management Group meets every three months with meetings alternating between Fresno and Visalia.

Please contact the RWMG if you have any questions about the IRWMP, or would like to become a member or interested stakeholder. Contact information can be found on the RWMG website at http://www.southernsierrarwmg.org/.

Funding for preparing this plan was provided in part by the California Department of Water Resources through a Proposition 84 IRWM Planning Grant, and a subsequent 2016 Prop 1 Planning Grant.

Prepared by: In cooperation with:

Chapter 1 - INTRODUCTION

The Southern Sierra Integrated Regional Water Management Plan (IRWMP) is the first truly regional effort to address water management in the Southern Sierra Region (Region). The contents of this IRWMP represent a culmination of the Regional Water Management Group's (RWMG) planning activities. The RWMG formally began in April 2008 with initial funding from the Sierra Nevada Conservancy and support and vision from Sequoia Riverlands Trust and the Sierra Nevada Alliance.

Integrated Regional Water Management Plans are prepared by RWMGs comprised of a collection of agencies, stakeholders and individuals who share a common interest in managing water resources in a specific hydrologic region. The Southern Sierra RWMG was developed to improve coordination and collaboration on regional water management in the Southern Sierra Region, and the completion of this IRWMP is a significant milestone for the RWMG. This IRWMP documents regional and local data, issues, water-related objectives, resource management strategies and collaborative efforts. The IRWMP was developed with significant input from RWMG members and other interested stakeholders.

The idea of integrated regional water management first surfaced in the State of California in Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, which was passed by California voters in the November 2002 general election. This was followed by Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act, passed in 2006, which provided $1,000,000,000 for Integrated Regional Water Management (IRWM) planning and implementation. In 2013, the RWMG secured a Proposition 84 IRWM Planning Grant from the Department of Water Resources (DWR) to prepare this IRWMP in compliance with State standards.

1.1 - Background

The Southern Sierra Region covers approximately 6,195 square miles (3,964,800 acres) and includes the foothills and mountain headwater regions of the Kern, Poso, White, Tule, Kaweah, Kings and San Joaquin River watersheds (see **Figure 1-1**). These watersheds cover the Sierra Nevada portion of Fresno and Tulare counties, and a portion of the Sierra Nevada in Madera County. The Region is considered appropriate as a RWMG since it has a strong hydrologic basis with borders based on watershed boundaries and the Sierra Nevada crest. The area covered by the Southern Sierra RWMG, which is analogous to the area covered by this IRWMP, will hereafter be called the Southern Sierra Region or simply the Region.

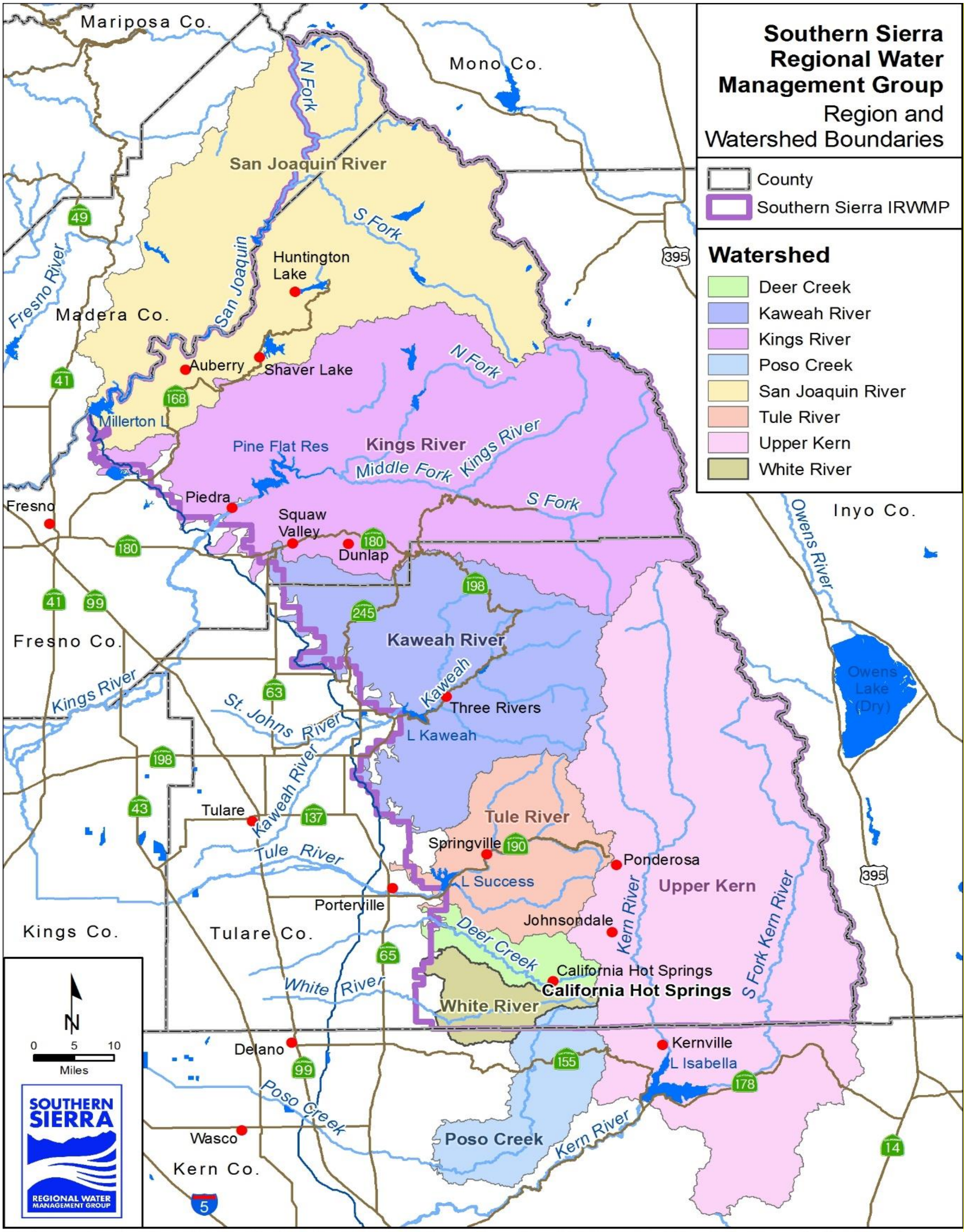


Figure 1-1 Southern Sierra Region and Watershed Boundaries

The Region has abundant surface water supplies including several large rivers and scores of creeks and streams. However, most of the surface water rights are held in downstream areas of the Central Valley. Most of the local water users rely on hard rock (typically granitic) wells. These hard rock aquifers have limited ability to hold and transmit groundwater, and the wells typically have low yields.

The Southern Sierra RWMG is comprised of 18 formal members (MOU Signatories) and 43 interested stakeholders (who participate but are not formal members and have no voting rights).

The rural lands of the Region are managed by numerous entities including the United States Forest Service (Sierra, Inyo, and Sequoia National Forests and Sequoia National Monument), the National Park Service (Sequoia and Kings Canyon National Parks), Native American Tribes (Tule River Indian Reservation, Big Sandy Rancheria, and Cold Spring Rancherias), non-profit entities, special and public utility districts, and private landowners. **Section 3.2** includes a full list of members and interested stakeholders. This diverse range of perspectives has been valuable in identifying a broad range of water management strategies and project ideas.

The Southern Sierra RWMG abuts seven adjacent RWMGs as shown in **Figure 1-2**. The various RWMGs have made efforts to coordinate their boundaries as much as possible, and the Southern Sierra IRWMP only overlaps with the Madera and Upper Kings IRWMPs in very small areas. The various IRWMP boundaries inevitably split watersheds for the major rivers and streams. This was unavoidable due to the overall size of the watersheds and the different boundary focus (watershed versus jurisdictional) of different RWMGs. In general, RWMGs cover either mountain or valley areas.

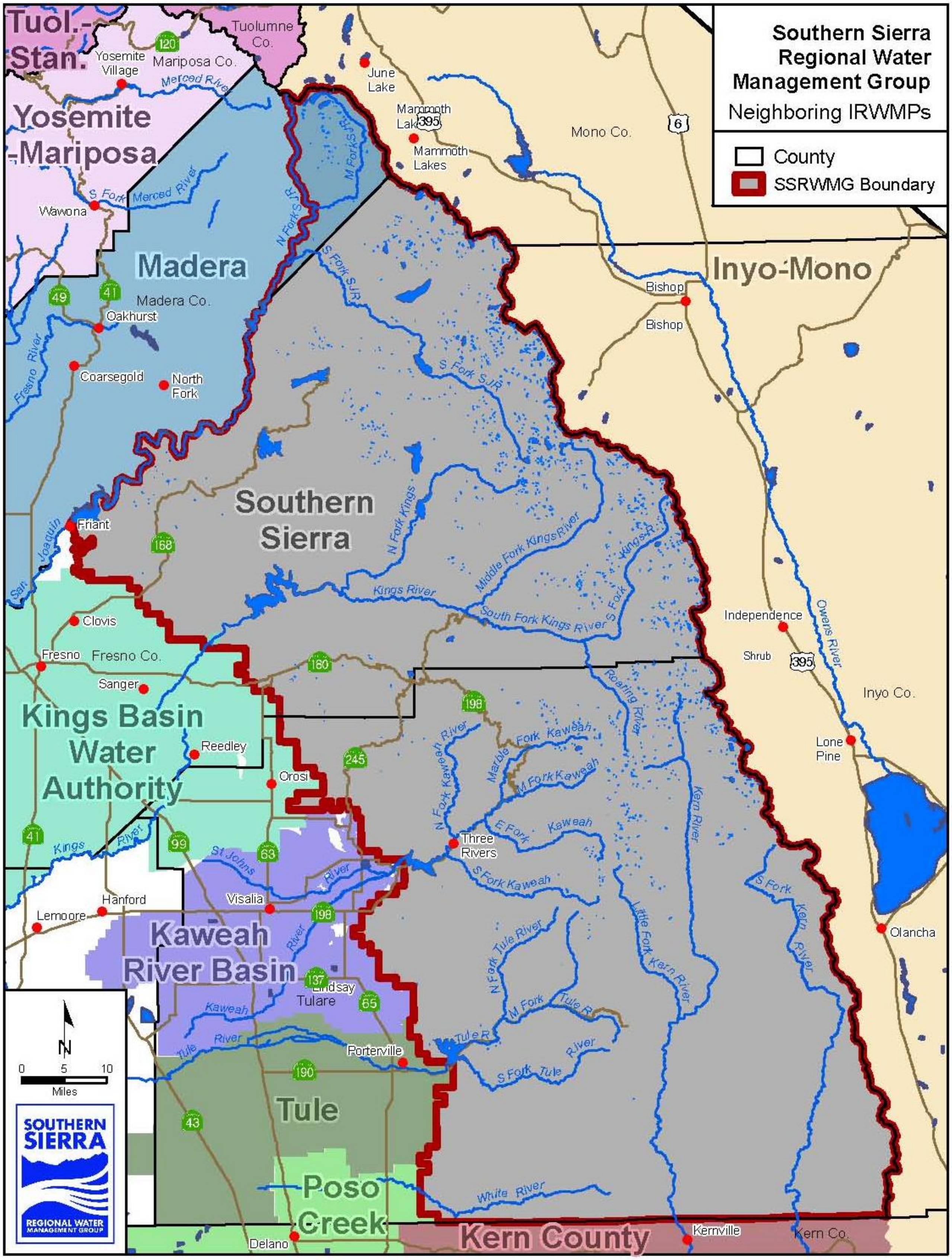


Figure 1-2 Neighboring RWMGs

For more general information on the Southern Sierra Region and the RWMG please refer to **Chapter 3 – Region Description** and the RWMG website at http://www.southernsierrarwmg.org/.

1.2 - Mission, Vision and Values of the Regional Water Management Group

The Southern Sierra RWMG has developed a mission statement, vision statement and list of cardinal values. These were developed with stakeholder input and are intended to guide the RWMG through its efforts to improve water resources throughout the Southern Sierra.

RWMG Mission

The mission of the RWMG is to provide a forum to discuss, plan and implement creative, collaborative, regional, integrated water/natural resource/watershed management actions that enhance the natural resources and human communities of the Southern Sierra Region.

Regional Vision

The vision of the RWMG is that the Southern Sierra will have healthy, sustainable watersheds, with vibrant economies, adequate water supplies, and sufficient capacity to:

- Engage in collaborative processes;
- Obtain resources to address water and natural resource issues;
- Construct and implement plans and projects; and
- Resolve regional and local conflicts and issues in a consensus-based, voluntary and non-regulatory manner.

RWMG Values

In order to realize its mission and regional vision in a transparent and inclusive manner, the RWMG values the following as means to those ends:

- Stakeholder input, science and consensus as a basis for natural resource decision-making;
- Inclusivity and transparency;
- Respect for private property rights;
- Respect for the public trust;
- Equity and fairness in resolution of water conflicts and in developing mutually beneficial approaches and results;
- Integration of management entities, strategies and benefits;
- Coordination with adjacent regions; and
- Sharing of data, information and knowledge in a variety of ways to meet the needs of the stakeholders and the public at large.

1.3 - Purpose, Need and Common Understanding for the IRWMP

Historically, water management in the Southern Sierra has been limited to independent operations by local agencies, tribes, private well owners and non-profit organizations involved with water resources. There has been limited coordination between these groups due to a lack of regional coordination forums and regional entities. With the creation and establishment of the RWMG, stakeholders have come together, and the Region now has a vehicle to improve communication, collaboration, and cooperation; to develop a consensus on the regional problems and solutions; and to resolve or proactively avoid conflicts. The primary organizational goals of the RWMG include:

- Develop the first truly regional water management plan for the Southern Sierra;
- Identify water related vulnerabilities and deficiencies;
- Formally document policies, procedures and strategies for securing funding and implementing projects in the Region;
- Engage stakeholders to obtain a broad cross section of input in a single document;
- Qualify for certain state funding that requires an IRWMP developed according to State standards;
- Create a comprehensive list of goals, objectives and proposed projects to guide the Region's future efforts; and
- Provide a roadmap to work together within the Region and surrounding regions to further develop and manage the available water supplies.

The need for and value of the IRWMP is clear. Continuing development in the foothills, communities struggling to maintain water supplies, limited groundwater supplies, droughts, and the threat of climate change call for immediate action to pool resources and begin regional water management in the Southern Sierra.

1.4 - IRWMP Development

The Southern Sierra IRWMP was developed through a collaborative process over the past 6 years. A draft IRWMP was completed in 2013. Also, later in 2013, the RWMG was awarded a Proposition 84 Planning Grant which was used to expand and update the draft IRWMP to meet State IRWMP Standards (DWR, June 2014). The IRWMP was also updated with in-kind professional services, which are contributions in the form of time or expertise from RWMG members and interested stakeholders. The State has established sixteen IRWMP standards for IRWMPs. Each of the sixteen IRWMP standards was individually discussed and chapters were written, reviewed, and discussed individually to form a comprehensive IRWMP. The IRWMP was developed through discussions at numerous RWMG, Coordinating Committee and outreach meetings and special workshops.

The RWMG updated the IRWMP with assistance from Provost & Pritchard Consulting Group, Sequoia Riverlands Trust, Kamansky's Ecological Consulting, and the Geos Institute. In addition, the California (Fresno) DWR sponsored professional facilitation services that assisted with the formation of the RWMG, and development of final IRWMP chapters. With the help of the professional facilitator, each chapter was individually reviewed and discussed through an open and transparent process. DWR also conducted a Three Rivers Area Water Supply Study, which was funded under its Technical Assistance program.

1.5 - Planning Horizon

The Department of Water Resources requires a planning horizon of at least 20 years for IRWMPs. The planning and implementation horizon for the RWMG extends thirty years, to approximately 2043-2045. However, many Southern Sierra discussions and actions will be guided by a longer horizon of up to fifty years into the future.

1.6 - Organization of the Report

This IRWMP is organized according to the sixteen IRWM Plan Standards listed by the Department of Water Resources in its 2014 Guidelines. Due to similarity of topics, several pairs of IRWMP standards were combined into single chapters, including the Coordination and Integration standards (Chapter 14), and the Relation to Local Land Use Planning and Relation to Local Water Planning standards (Chapter 12). All other standards are addressed in their own chapter. **Table 1.1** includes a brief summary of this report's organization and descriptions of each chapter.

Table 1-1 - Report Organization and Summary of Chapters

Chapter	Subject	Description
ES	Executive Summary	A brief summary of the entire IRWMP Report.
1	Introduction	Provides background information on the Southern Sierra Region, the purpose and need for the IRWMP, and the organizational structure of the RWMG.
2	Governance	Describes the history of the IRWM process in the Region, the formation of the RWMG, the existing governance structure and decision making protocols, and the role of governance in implementing the IRWMP.
3	Region Description	Describes members and interested stakeholders, local hydrology, geology, and physiography of the Region, the basis for the IRWMP boundary, and the local water infrastructure.
4	Goals and Objectives	Documents regional goals and objectives that were established to resolve identified issues. Includes results of a public survey to rank each objective in terms of greater and lesser importance as perceived by the member and interested stakeholders.

Chapter	Subject	Description
5	Resource Management Strategies	Presents over 30 Resource Management Strategies (RMS) that the RWMG considers relevant in the Region, and describes their applicability and potential use.
6	Project Review Process	Describes the processes the RWMG will use to solicit and review projects for inclusion on the project list, possible funding, and inclusion in specific grant applications.
7	Impacts and Benefits of Plan Implementation	Discusses the general benefits of regional water management, impacts and benefits of the adopted Resource Management Strategies, the potential impacts and benefits of these strategies.
8	Plan Performance and Monitoring	Identifies and describes several regional monitoring programs, describes the RWMG's plan to monitor progress in meeting IRWMP goals and implementing projects, presents reporting procedures, responsibilities and guidelines for project-specific monitoring, and discusses the content of annual RWMG reports.
9	Data Management	Describes the RWMG's existing data management operations and future plans for data collection, storage, and dissemination.
10	Financing	Provides a general overview of existing and potential funding sources for RWMG operations, IRWMP updates, regional studies, grant application preparation, project implementation, and project operation and maintenance.
11	Technical Analysis	Provides a compilation of the previously-published technical analyses relied upon in the IRWMP.
12	Relation to Local Land-use and Water Planning	Describes local water plans prepared by urban agencies, counties, water agencies, and other special districts, and their relationship to the IRWMP. Describes local land-use plans prepared by the communities and the counties, their policies related to water management, the compatibility of the water management policies with the IRWMP, and possible future collaborations between land-use planners and water managers.
13	Stakeholder Involvement	Discusses past public outreach efforts, public outreach efforts during the IRWMP update, and a plan for future public outreach.
14	Coordination and Integration	Discusses the RWMG's efforts to coordinate projects and activities with local agencies, stakeholders, neighboring IRWM groups, state agencies, and federal agencies.
15	Climate Change	Includes anticipated impacts within the Region from climate change, a vulnerability assessment for the Region, proposed adaptation measures, plan for monitoring climate change, and a process for evaluating greenhouse gas emissions in project selection.
16	Disadvantaged Communities	Identifies the Disadvantaged Communities (DAC) and Economically Distressed Areas (EDA) within the Southern Sierra Region and highlights their needs.

Chapter	Subject	Description
17	References	Lists the documents cited in the IRWMP.

Chapter 2 - GOVERNANCE

2.1 - Introduction

This chapter discusses the governance structure for the Southern Sierra Regional Water Management Group (RWMG). The RWMG is the governing body responsible for implementing the Southern Sierra Integrated Regional Water Management Plan (IRWMP). The RWMG functions under a strong governance structure that provides equal opportunity for participation, enhances communications, and provides decision-making protocols for the RWMG.

2.2 - Description of Regional Water Management Group

The RWMG was initiated through the actions of the Sequoia Riverlands Trust, Sierra Nevada Alliance, and the Sierra Nevada Conservancy. The Sierra Nevada Conservancy provided a grant to fund a launch phase of the planning process to identify stakeholders, hold public meetings, construct a governance structure, and write a grant application to the California Department of Water Resources (DWR) for funding to prepare this IRWMP. The Sequoia Riverlands Trust accepted the role of grantee and worked with the Sierra Nevada Alliance to identify stakeholders and organize meetings.

The early objective of the launch phase was to establish a group that could make consensus-based decisions such as identifying and recommending RWMG boundaries to DWR, developing and approving a governance structure, identifying and acquiring funding mechanisms, and developing a public participation process. The initial planning group adopted governance principles in 2009, which are documented in **Appendix A – Memorandum of Understanding**.

The RWMG efforts were carried out with very limited fiscal resources from local and regional sources, supplemented by a strong core of in-kind professional services support from consultants and non-governmental organizations, and technical support from state and federal agencies.

<u>Definition of Regional Water Management Group</u>
According to DWR, a regional water management group must include at least three members with two that have statutory authority for water management. The Southern Sierra RWMG has eighteen members and three with statutory authority over water management, and therefore meets the definition of a regional water management group. The three members with water management authority include: Sierra Resource Conservation District, Springville Public Utilities District, and Fresno Metropolitan Flood Control District.

IRWMP Boundaries

The RWMG covers a large geographic area (refer to **Figure 3.1 – Southern Sierra Region and Watershed Boundaries**) including the upper watersheds of the San Joaquin, Kings, Kaweah, Tule, Deer, White, and Kern Rivers, in addition to several smaller stream watersheds. The IRWMP boundary contains lands representing several Native American Tribes, and jurisdictional areas for several federal land agencies (National Forests, National Parks and National Monuments) and local agencies (Springville, Three Rivers, and many smaller communities). The next section provides a list of RWMG members and interested stakeholders.

2.3 - Members

Stakeholders can become formal members of the RWMG by signing the MOU. The following organizations have signed the MOU as of September 2014:

Table 2-1 - Memorandum of Understanding Signatories

Big Sandy Rancheria
California Department of Fish and Wildlife
Desert and Mountain Resource Conservation & Development Council
Fresno Metropolitan Flood Control District
Inyo National Forest
Pacific Southwest Research Station, US Forest Service
Revive the San Joaquin
San Joaquin Valley Leadership Forum
Sequoia and Kings Canyon National Parks
Sequoia National Forest
Sequoia Riverlands Trust
Sierra and Foothill Citizen's Alliance
Sierra Club – Tehipite Chapter
Sierra National Forest
Sierra Resource Conservation District
Springville Public Utilities District
Tulare Basin Wildlife Partners
Yosemite/Sequoia Resource Conservation & Development Council

Breadth of Membership
The current RWMG consists of eighteen organizations that represent a broad range of interests including: water supply, water quality, environment/habitat, recreation, agriculture, ranching, resource management, sanitation, disadvantaged communities, non-profit organizations, Native American tribes, and local, state and federal agencies. The interested stakeholders, who participate but are not formal members, represent a similar range of interests. Members and stakeholders do not need to be located within the Region's boundaries, but do need to have an interest or role in water management in the Southern Sierra Region.

2.4 - Governance Structure

A Memorandum of Understanding (MOU) documents the governance structure for the RWMG (see **Appendix A)**. The RWMG is the decision-making authority, with a Coordinating Committee that serves an advisory role, and various Work Groups that perform specific functions and report to the Coordinating Committee and RWMG.
Figure 2-1 illustrates the organization chart for the RWMG.

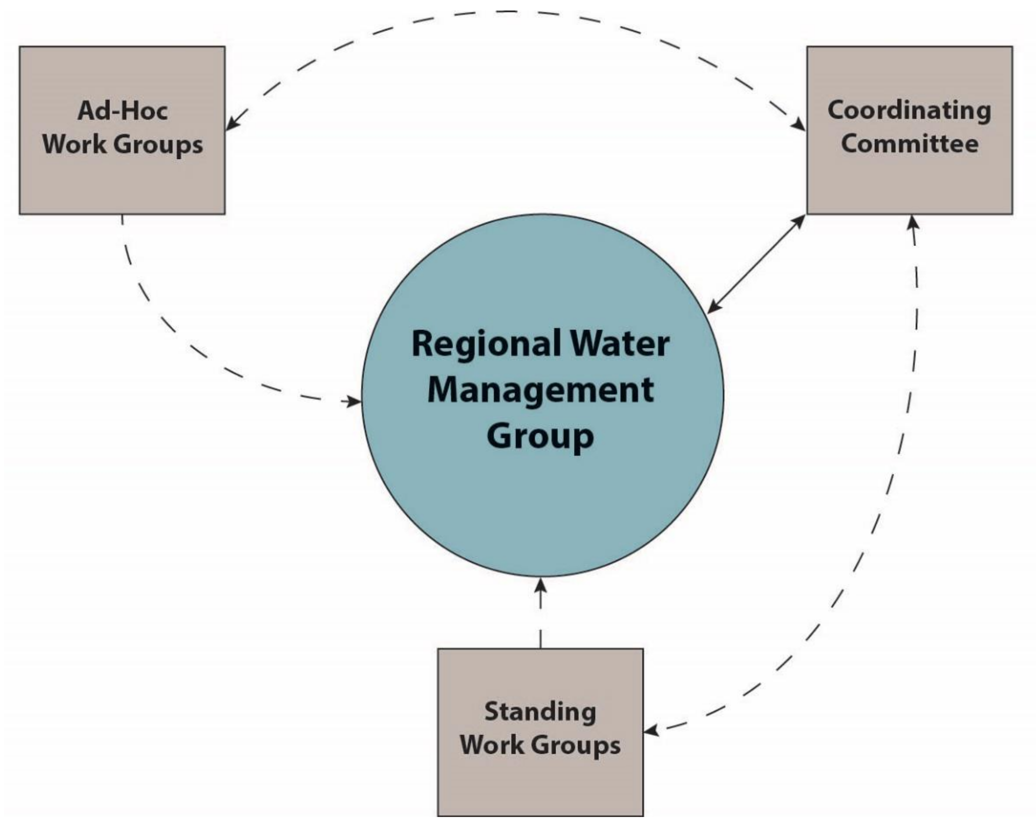


Figure 2-1 Organization Chart for Southern Sierra Regional Water Management Group

Memorandum of Understanding

The MOU is a statement of mutual understanding among the signatories regarding RWMG governance. Major topics addressed in the MOU include RWMG membership, geographic boundaries, committees, responsibilities, public outreach, and decision making. These topics are discussed throughout this chapter. Between 2009 and September 2014, eighteen organizations signed the MOU. The MOU states that it will remain effective for three years from the most recent date of signing, or until replaced by another agreement.

Refinements to Memorandum of Understanding

After implementation of the MOU, members determined that it required some clarification. The RWMG made several refinements to the MOU and adopted them on May 10, 2012 (**Appendix A**). These materials do not replace the MOU, but rather provide supplemental details to eliminate ambiguity and add protocols on important topics that had not yet been addressed. Major topics addressed in the refinements include definitions, membership, work groups, responsibilities, public outreach, decision making and fact finding. More detail about these refinements can be found throughout this chapter.

The Governance Principles diagram (**Appendix A)** illustrates the relationship between the RWMG, Coordinating Committee, and Grantee, as well as their respective responsibilities. Additional information on these groups is provided below.

Regional Water Management Group

The Regional Water Management Group (RWMG) is the primary governing and decision-making body of the group.[1] Any qualifying entity that signs the MOU will become an official member of the RWMG.

Responsibilities of the RWMG include:

1. Oversee and approve major decisions;
2. Set the overall strategic direction for the group;
3. Provide feedback on draft work products;
4. Adopt final work products;
5. Contribute expertise, data, and information to assist in decision making, setting goals, and advancing innovation;
6. Communicate information to and from their agencies, organizations, and/or constituencies;
7. Act in a manner that will enhance trust among all participants; and
8. Provide leadership to the program.

The RWMG has generally met every other month, depending on workload. The frequency of future meetings will depend on workload, but is anticipated to be at least quarterly.

[1] In the past the RWMG was called the Planning Committee. The MOU refers to a Planning Committee but not a RWMG. In July 2012, the MOU Refinement formally renamed the Planning Committee to the RWMG.

Each member organization must identify its lead representative for the RWMG who will make their best effort to attend RWMG meetings. Members may also identify an alternative representative, but are encouraged to have one representative attend the RWMG meetings for consistency.

Any stakeholder organization with an interest or role in water management in the IRWMP area may join the RWMG. Stakeholders could include, but are not limited to such organizations as: water agencies, conservation groups, agriculture representatives, businesses, tribal groups, land use entities, private entities; and local, state, federal agencies. A group wanting to join the Southern Sierra RWMG should notify the Stakeholder Coordinator or Project Manager (contact information on the RWMG website: http://www.southernsierrarwmg.org/) and sign the MOU to signify their good faith effort to join. Any entity who would like to discontinue their participation may do so at any time by submitting the request in writing. The MOU is non-binding and non-regulatory. Interested stakeholders are not required to sign the MOU or adopt the IRWMP.

The benefits of signing the MOU and becoming an official member of the RWMG include:

1. Right to participate in decision making, including setting regional goals and determining which projects are included in grant applications;
2. Greater influence on consensus-based decisions;
3. Proof of a good faith effort to improve local water management;
4. Ability to submit and sponsor projects for implementation;
5. Larger public benefit to the Region by having more entities involved.

Coordinating Committee

The Coordinating Committee is a smaller group of RWMG members and interested stakeholders. The Coordinating Committee assumes tasks similar to an executive committee, but is entirely advisory to the RWMG and has no formal decision-making authority. Specific roles of the Coordinating Committee include:

- Assist in developing meeting agendas;
- Assist with developing draft rules and policies for the RWMG;
- Assist with detailed fiscal oversight;
- Assist with developing funding proposals;
- Assign tasks to existing Work Groups and review their work;
- Recommend the need for new Work Groups;
- Assist in developing draft IRWMP chapters; and
- Perform other tasks assigned by the RWMG.

Stakeholders volunteer to participate on the Coordinating Committee and their membership on the committee must be approved by the RWMG. The Coordinating Committee generally meets every one to two months, depending on workload.

Work Groups

The RWMG may choose to create Work Groups to advance specific tasks outside of RWMG and Coordinating Committee meetings. The RWMG will define a clear purpose for a Work Group and expected work products and completion dates. All Work Groups will provide a status update on their activities at the RWMG meetings. All work products will be submitted in draft form to the RWMG for review and approval. The Work Groups may also receive some guidance from the Coordinating Committee. While the Work Groups may make day-to-day decisions to advance their efforts, the Work Groups are entirely advisory to the RWMG and thus have no final decision-making authority. Work Groups consist of volunteers from the RWMG members and interested stakeholders.

The RWMG includes the following Work Groups:[1]

Finance — The RWMG identified responsibilities for the Finance Work Group in May 2012, but the group has not yet been formed, nor has it held meetings. The responsibilities of the Work Group will be to: identify funding opportunities, identify sources for required cost shares, identify funding models for on-going administration, and advocate for funding for the Region. This Work Group is expected to convene in late 2014.

Project Review — The Project Review Work Group is responsible for soliciting and reviewing projects to include on the RWMG project list and/or in grant applications. The review process they follow is documented in **Chapter 6 - Project Review Process**.

Hydrologic Capacity — The RWMG developed the Hydrologic Capacity Work Group to identify needed information and studies to better understand hydrologic conditions in the Region. The group developed a scope of work for a regional hydrologic study, and Kamansky's Ecological Consulting developed a study prospectus, but the full study has not yet been funded. A pilot study was funded by the DWR for the Three Rivers Area.

Grantee Selection — The Grantee Selection Work Group is responsible for recommending which organization, among a group of volunteer candidates, would best serve as the Grantee for grant funded projects. The Grantee as defined here is not the RWMG, but rather an organization that administers a grant on behalf of the RWMG.

<u>Stakeholder Interface</u>

Stakeholders can interface with the RWMG, Coordinating Committee, and Work Groups at regular RWMG meetings. Work products from the groups will also be posted on the RWMG website for public review.

[1] Some of these Work Groups have formerly been called committees or sub-committees.

2.5 - Public Outreach Process

Public outreach is one of the great strengths of this RWMG. Since its initial session in May 2008, the RWMG has met regularly, except for a three-month break during the state financial crisis. Participants encourage public involvement, and all the meetings have been open to the public. All attendees are allowed to participate in discussions.

The RWMG makes concerted and consistent efforts to include an increasing number of interest groups and members of the public in this process. Additionally, meeting agendas and minutes are circulated to a broad and inclusive group of interests including members and interested stakeholders. Meeting notices, agendas, and minutes are posted to the RWMG's website, www.southernsierrarwmg.org. Meeting notices and agendas are also posted in the Sequoia Riverlands Trust (SRT) office approximately five to six days in advance of meetings.

The RWMG has made extensive efforts to invite and include relevant stakeholders in the Region. Through ever-pursuing ways to expand participation, the RWMG is confident in their efforts, to date, to be inclusive. SRT, as the managing agency, used lists of interested stakeholders from past water resource projects, as well as recommendations from other agencies, the public, and NGOs, to solicit involvement. The RWMG has made every attempt to facilitate stakeholder participation and inform stakeholders about the process. The RWMG has not barred any entity from participation, nor is it aware of any entities that are purposefully boycotting the process or harbor serious concerns about its actions and decisions to date.

Of the 43 interested stakeholders, the following 15 organizations have participated in RWMG meetings but have not yet signed the MOU.

- Buckeye Ranch
- California Water Institute
- County of Tulare
- Deer Creek-Tule River Authority
- Dennison Ditch Company
- Foothill Engineering
- Fresno County
- Friends of the South Fork of the Kings River
- National Resource Conservation Service, Area 3
- Sierra Nevada Conservancy
- Three Rivers Community Services District
- Tulare County Audubon Society
- Tulare County Citizens for Responsible Growth
- Tulare County Farm Bureau
- Wildplaces

The public outreach process is described in more detail in **Chapter 13 – Stakeholder Involvement**.

2.6 - Decision Making

Members of the RWMG serve as the decision-making body. The Coordinating Committee and various Workgroups give input and recommendations to the RWMG, but have no decision-making authority. The RWMG strives for consensus (agreement among participants) in its entire decision making process. In reaching consensus, some RWMG members may strongly endorse a proposal, others may accept it as 'workable,' and others may not support it yet allow it to proceed if it does not compromise their interests. Any of these actions still constitutes consensus.

The MOU also includes a traditional voting process to address issues that do not have full consensus. The decision to use this process will not be taken lightly. When voting occurs, decisions or agreements must be endorsed by 75% of the number of active members of the RMWG who are present (including via telephone) when the decision is made. Votes could potentially be provided by email if a member cannot attend a meeting. This could only occur if it is known in advance that voting will occur at a meeting.

When meetings require decisions, members will be notified two weeks in advance and are requested to acknowledge receipt of the notice. Only active members who have attended half of the RWMG meetings in the last year (or half since they have joined, if they are new members) can participate in the voting process. Refer to the MOU **(Appendix A)** for more details on the definition of an Active Member.

Some stakeholders are affiliated with several organizations and could serve as the designated representative for more than one member entity. In these cases, an individual can only represent one organization when there is a formal vote.

Information for decision making is often gathered by the Coordinating Committee and Work Groups and then presented to the RWMG. The RWMG may also choose to conduct joint fact-finding when it needs to make a complex decision. Joint fact-finding involves a subset of RWMG members working with a consultant or subject-matter experts to identify and frame the appropriate questions, interpret existing information, and generate recommendations. A Joint Fact-Finding Protocol is described in the MOU Refinements (see **Appendix A**).

Issues related to decision-making can be brought to the RWMG by any member or by the RWMG staff. They must be included on a meeting agenda (through contact with the Project Manager) in order to be considered as an 'action item.' The consensus-building process is led by a Facilitator, and the conclusions reached are clearly specified in meeting minutes. Non-members are not entitled to vote on decisions, but are free to voice opinions, recommendations, and concerns.

2.7 - Opportunity for Participation

The governance structure provides equal opportunities for participation and helps ensure a balanced group of members through the following policies and procedures.

Regional Water Management Group — Membership in the RWMG is open to any agency, organization, or company that signs the MOU and is approved by existing RWMG members. Membership does not require any financial commitments. The right to become a member is based primarily on having a local presence in or around the IRWMP area and an interest in water resources management. The type, size, or financial status of an organization are not factors. Each member of the RWMG is given one vote; voting power is not weighted based on size, area, or financial status.

Coordinating Committee — Any member or interested party can ask to join the Coordinating Committee. The RWMG must approve a member's participation on the Coordinating Committee. Approval to participate is based primarily on having a local presence in the IRWMP area, an interest in water resources management, and willingness to do the work of the Coordinating Committee as described in **Section 2.4**. The type, size, or financial status of an organization are not factors.

General Public — The general public can attend RWMG meeting or contact the Project Manager or Stakeholder Coordinator via contact information provided on the RWMG website (http://www.southernsierrarwmg.org). Private individuals are not allowed to become formal members of the RWMG, but can be added to the list of interested stakeholders and participate in RWMG meetings. Input from any member of the general public is considered regardless of their associations or history.

Official Positions

Official positions within the RWMG include a Project Manager, Grantee, Stakeholder Coordinator, and Meeting Facilitator. The positions have no governance authority and therefore are not shown in the organization chart (**Figure 2.**1). Their roles are related to managing RWMG meetings, stakeholder outreach, and grant contracts.

Project Manager — The Project Manager is responsible for managing the IRWMP process, maintaining the schedule, and working with DWR on grant administration. The Project Manager also provides overall leadership, but does not have any specific authority or special powers.

Grantee — The Grantee is an organization or agency that is assigned, as needed, to administer grant funds. They are selected by the RWMG based on recommendations provided by the Grantee Selection Work Group. Each time a new grant is awarded to the RWMG they have the option to select a new Grantee, or continue using the existing Grantee. Responsibilities of the Grantee include:

- Administering grant funds;
- Coordinating meetings for the RWMG and Coordinating Committee;
- Compiling progress reports and pay requests;
- Making meeting notes and notices publicly available; and
- Maintaining a webpage where IRWMP documents can be accessed.

Fiscal oversight of the Grantee is performed by the RWMG and Coordinating Committee.

Stakeholder Coordinator — The Stakeholder Coordinator is responsible for organizing RWMG and Coordinating Committee meetings and public workshops. He/she also takes the lead role in other public outreach efforts including email notices, print publications, and the RWMG website. His/her responsibility includes general outreach for the RWMG, and outreach related to specific projects. The position is assigned by consensus or a vote by the RWMG.

Meeting Facilitator — A Meeting Facilitator provides impartial guidance regarding the IRWM planning and implementation process, and manages meetings on behalf of the RWMG. Facilitators are content-neutral, which means they will not advocate for particular policy or technical outcomes; the facilitators will, however, advocate for a fair, transparent, effective, and credible dialogue and decision-making process. Specific duties include:

1. Design meeting agendas in partnership with the Project Manager, Coordinating Committee, and other RWMG members;
2. Provide guidance on process options and decisions;
3. Review and provide feedback on draft meeting materials;
4. Oversee the preparation of meeting minutes, including action items, key points of discussion, agreements and decisions; and
5. Serve as a confidant for members who wish to express concerns privately.

The facilitator is in service of the RWMG and will provide equal support to all of its members. Consultants or stakeholders may fulfill the role of Meeting Facilitator. When funding is available, the RWMG utilizes the professional facilitation skills of a hired consultant. When facilitation funding is unavailable, members or interested stakeholders can volunteer to serve as facilitators. Stakeholder facilitators will be rotated every six months and facilitators selected through the RWMG decision-making process. The RWMG will seek formal training for any stakeholder that serves as a facilitator.

2.8 - Effective Communication

<u>Internal Communication</u>
Communication between members, stakeholders, and RWMG staff is encouraged during meetings as well as through any direct follow-up via email, phone, or in-person meetings. The RWMG has an open door policy. Any agency, organization, company, or individual is free to attend RWMG meetings or directly contact the Project Manager or Stakeholder Coordinator. The governance structure helps to foster communication primarily through the Coordinating Committee, Work Groups, and an open door policy to the general public. The Coordinating Committee and various Workgroups allow stakeholders to provide detailed input on RWMG projects and policies, which is then directly communicated to the decision-making Board, the RWMG.

<u>External Communication</u>
The RWMG communicates with external groups such as other RWMGs, the media, and the general public. According to the MOU, the Project Manager or other designated

representatives may make public statements on behalf of the Southern Sierra RWMG as an entity. Generally, other members or interested stakeholders are not permitted to speak on behalf of the RWMG. The MOU provides a detailed guideline on how member representatives should communicate with external sources, e.g., communicating sentiments consistent with their expressions at RWMG meetings, and stating that they are not speaking on behalf of the entire RWMG.

2.9 - Long-Term Implementation of IRWMP

The Southern Sierra RWMG is relatively new, having been formally organized in 2009. One of the group's significant motivations for forming was the ability to secure grants for the Region. The group also formed out of interest to share information, share ideas, seek other grant funds, collaborate on projects, educate the public, and promote better water management.

The group recognizes that funds from any one source may become temporarily or permanently unavailable at the State's discretion. The group also acknowledges that grant applications submitted for these funds may not be successful as the application process is competitive with other RWMGs. Regardless, the group is committed to staying active even in the absence of state funding. The group survived several years without funding, and above all, has demonstrated the value of patience, perseverance, and the power of maintaining strong relationships among water interests in the Region. The group is also actively pursuing other funding sources beyond DWR grants (see **Chapter 10 – Financing**).

The planning and implementation horizon for the RWMG extends thirty years, to approximately 2043-2045. However, many Southern Sierra discussions and actions will be guided by a longer horizon of up to fifty years into the future.

2.10 - Coordination with Neighboring IRWMPs

The RWMG has a unique role since its regional boundaries include the headwaters for several RWMG's in the San Joaquin Valley. The RWMG takes several active steps to coordinate with neighboring IRWMPs, including:

- Participation in IRWMP 'Round Table of Regions' meetings — The Roundtable of Regions is an ad hoc group of representatives from IRWMP regions around the State. The group provides a forum for IRWMP practitioners (people working on IRWM planning and implementation) to discuss their interests, share information, and provide recommendations to DWR on the IRWM grant program. This group holds regular conference calls and occasional face-to-face summits.
- Regularly attend monthly meetings for the Tulare Basin Integrated Regional Planning Effort — This is a regional collaboration among several IRWMPs in the Tulare Lake Basin Hydrologic Region, in which participants discuss inter-regional topics.

- Attend yearly conferences for the Sierra Water Workgroup – The Sierra Water Workgroup was formally organized in 2011 to help coordinate and facilitate the efforts of 11 IRWMP areas in the Sierra Nevada Mountains. Participating groups that neighbor the Southern Sierra RWMG include the Madera RWMG and Inyo-Mono RWMG.
- The Region also coordinates activities on a project-by-project basis if projects, plans or studies are determined to be of specific interest to surrounding IRWM regions.

The Stakeholder Coordinator plays the lead role in coordinating with neighboring IRWMPs. Information and ideas gathered at these meetings are shared with the Coordinating Committee and RWMG. The RWMG has also worked successfully with the neighboring IRWMPs (Madera, Kings Basin, Kaweah River, Tule, Poso Creek and Inyo-Mono) to mutually develop reasonable and logical IRWMP boundaries.

More information on coordination with neighboring RWMGs is found in **Section 14.7**.

2.11 - Coordination with State and Federal Agencies

<u>State Agencies</u>
The California Department of Fish and Wildlife is an MOU signatory, regularly attends RWMG meetings, and participates in workgroups and the Coordinating Committee. The RWMG has also worked closely with DWR since the group began meetings in 2008. The DWR played an important role in helping the group form, identify funding opportunities, collect data, and implementing a high-priority project - a hydrologic study for the Three Rivers area through their Technical Assistance Program. DWR has also provided critical facilitation grants to support RWMG processes and programs. The RWMG considers DWR a strong ally and hopes to continue its partnership with DWR as the RWMG implements this plan.

<u>Federal Agencies</u>
Five federal agencies have signed the MOU: Sequoia National Forest, Sierra National Forest, Inyo National Forest, Pacific Southwest Research Station, and Sequoia & Kings Canyon National Parks. Because the IRWMP area is comprised of 76% federally managed lands (**Figure 3-7**), member participation from these federal agencies is very important. They have also been active participants at RWMG meetings and in workgroups. Other federal agencies are interested stakeholders or have been contacted by the RWMG to participate, including the US Fish and Wildlife Service, the U.S. Army Corp of Engineers, Devils Postpile National Monument, Bureau of Land Management and Natural Resources Conservation Service.

2.12 - Collaborative Process to Establish Objectives

The IRWMP goals and objectives were established through a collaborative process including numerous public meetings and workshops, and recommendations from the

Coordinating Committee, Regional Water Management Group, interested stakeholders, consultants, general public and DWR. The process followed is documented below.

1. Input was solicited on goals, objectives and priorities at numerous public meetings and workshops from 2009 to 2014.
2. The goals that were summarized in a Draft IRWMP prepared by consultants.
3. A special meeting was held with the Coordinating Committee to discuss the draft goals and objectives. Suggestions were made to add new goals and refine existing goals.
4. The revised Goals and Objectives chapter was reviewed and approved by the Coordinating Committee and RWMG.
5. The objectives were ranked according to a public survey.
6. The Draft-Final IRWMP was released for public input. The IRWMP was placed on the RWMG website and hard copies were sent to MOU signatories. The IRWMP release was also publicized through email, newspaper notices, press releases, at a RWMG meeting, and at numerous stakeholder meetings.
7. The final goals and objectives were adopted when the RWMG adopted this IRWMP.

2.13 - IRWMP Updates

The RWMG will update the IRWMP as needed to satisfy new IRWMP standards established by DWR, or when substantial changes in the Region merit an update. It is expected that update will occur every five to ten years. To document ongoing progress, the RWMG plans to prepare an annual report that will include an updated project list, progress on current projects, changes to policies and procedures, and other relevant information that should be included in an IRWMP. These annual reports will be considered attachments to the current IRWMP and the information will be formally incorporated when the IRWMP is updated. This will help to formally archive important information each year and reduce the need for large costly updates every five to ten years.

Formal updates will follow the same process used to develop this plan, including use of a Coordinating Committee to review and recommend changes, and a RWMG to formally adopt the updated IRWMP. Public noticing requirements will also be followed, and an appropriate amount of public outreach will be provided.

Interim and informal updates will be made as needed, when important information needs to be documentes. Interim and informal updates will generally be made when DWR is not requiring an update or has not released new IRWMP standards. These updates will be made in a collaborative fashion, similar to the methods used to prepare this plan. Updated information will be reviewed by the Coordinating Committee, who will recommend the updates to the RWMG. The RWMG will then adopt the updates, preferably by consensus. Interim and informal updates will likely be separate attachments that will be incorporated into the IRWMP when a formal or comprehensive update is performed.

2.14 - Public Noticing and Plan Adoption

The IRWMP was updated and adopted through a formal public noticing process according to California Government Code §6066. This included a Notification of Intention to Prepare an IRWMP in July 2013, and an Intent to Adopt the IRWMP in September 2014. This procedure is documented in more detail in **Chapter 13 – Stakeholder Involvement**.

The IRWMP was formally adopted by the RWMG on November 13, 2014 at a public RWMG meeting. **Appendix B** includes a copy of the RWMG resolution adopting the IRWMP. Member agencies are required to adopt this IRWMP through separate action by their local governing bodies and provide the RWMG with proof of adoption.

Chapter 3 - Region Description

3.1 - Introduction

This chapter describes the physical conditions, water infrastructure, and stakeholders in the area covered by this Integrated Regional Water Management Plan (IRWMP) area. The Region is very large (3 million acres), and it is dominated by lands managed by federal agencies (76%) with 50% of the area being in National Forests. The lower elevations of the Region are privately owned and contain some of the users and distributors of the waters that flow from the higher elevations. A challenge for integrated water management planning in this part of California is to productively bring together, for the development of mutually beneficial projects, the public land managers who mostly represent the source waters in this Region with the users and water distributors who are in several different downstream IRWMPs (**Figure 3-2**).

The purpose of this chapter is to summarize regional water resources data so all stakeholders have the necessary background data to participate in regional planning and decision making. Specific topics that are discussed include:

- Regional Water Management Group
- Physical and Hydrological Conditions
- Watersheds
- Infrastructure
- Geology and Hydrogeology
- Surface Water Resources
- Other Water Resources
- Water Supply and Demand
- Reducing Dependence on Delta Water Supply
- Water Quality
- Environmental Issues
- Potential Effects of Climate Change
- Social/Cultural Makeup and Disadvantaged Communities
- Major Water Related Objectives and Conflicts
- Maximum Opportunities for Water Management Activity Integration

The reader is also referred to the RWMG website (http://www.southernsierrarwmg.org/), which also includes information on the Region. The area covered by the Southern Sierra Regional Water Management Group (RWMG), which is analogous to the area covered by this IRWMP, will hereafter be called the Southern Sierra Region or simply the Region. Information provided herein is intentionally regional in nature and not specific to individual agencies, districts or other entities.

3.2 - Regional Water Management Group

3.2.1 Members and Interested Stakeholders

The Southern Sierra RWMG is comprised of 18 formal members (MOU Signatories) and 43 interested stakeholders (who participate but are not formal members and have no voting rights). Following are lists of the MOU Signatories and interested stakeholders

Members (MOU Signatories)

- Big Sandy Rancheria
- California Department of Fish and Wildlife
- Desert/Mountain Resource Conservation & Development Council
- Fresno Metropolitan Flood Control District
- Inyo National Forest
- Pacific Southwest Research Station, United States Forest Service
- Revive the San Joaquin
- San Joaquin Valley Leadership Forum
- Sequoia and Kings Canyon National Parks
- Sequoia National Forest
- Sequoia Riverlands Trust
- Sierra and Foothill Citizen's Alliance
- Sierra Club – Tehipite Chapter
- Sierra Foothill Conservancy
- Sierra National Forest
- Sierra Resource Conservation District
- Springville Public Utilities District
- Tulare Basin Wildlife Partners
- Yosemite/Sequoia Resource Conservation & Development Council

Interested Stakeholders

- Alta Irrigation District
- Buckeye Ranch
- California Water Institute
- Calnatives Plant Nursery
- Central Sierra Watershed Committee
- Central Unified School District
- Chuckchansi Tribe
- Chumash Council of Bakersfield
- Coarsegold RCD
- Community Water Center
- County of Tulare
- Deer Creek-Tule River Authority
- Dennison Ditch Company
- Devils Postpile National Monument
- Foothill Engineering
- Fresno County
- Friant Water Users Authority
- Friends of the South Fork of the Kings River
- Kaweah Delta Water Conservation District
- Madera County
- National Resource Conservation Service, Area 3
- North Fork Rancheria of Mono Indians
- Picayune Rancheria of the Chuckchansi Indians
- River Ridge
- San Joaquin River Parkway and Trust
- Self Help Enterprises
- Semitropic Water Storage District
- Sequoia Foothills Chamber of Commerce
- Sierra Business Council
- Sierra Nevada Conservancy
- Southern California Edison Company
- Southern Sierra Miwok Nation
- Sustainable Conservation
- The Nature Conservancy
- Traditional Choinuymni Tribe
- Tulare County Audubon Society
- Tulare County Citizens for Responsible Growth
- Tulare County Farm Bureau
- Tulare County Water Commission
- Tule River Indian Reservation
- Kings Basin Water Authority
- US Representative Jim Costa
- WildPlaces

3.2.2 Regional Boundary

The RWMG sanctioned a Planning Committee that developed and approved Region boundaries after numerous discussions, evaluations and public meetings. The boundary of the Southern Sierra RWMG has a common northern border with the Madera RWMG, with a small overlap, a common southern border with the Kern County RWMG, boundaries at the crest of the Sierra with the Inyo-Mono RWMG, and western borders based largely on the boundaries of special districts and conforms to land use differences.

The Southern Sierra RWMG boundaries, and boundaries of the eight watersheds in the Region, are shown on Error! Reference source not found.**.** Below is a discussion on the boundaries and the rationale for selecting them.

<u>Eastern Boundary</u>
To the east, the Southern Sierra RWMG boundary is defined by the Sierra Nevada crest.

Rationale: The Sierra Nevada crest (divide) is a hydrologic barrier. Waters flowing to the west flow through the Region to the foothills and out into the San Joaquin Valley. Waters to the east of the Sierra crest flow to the eastern Sierras (into the Inyo-Mono RWMG) and are not hydrologically connected to the Region.

<u>Northern Boundary</u>
To the north, the Southern Sierra RWMG boundary is defined by the upper San Joaquin watershed.

The upper San Joaquin River Basin is split between Fresno and Madera Counties, but the river is managed across counties. The issues on either side of the county line are similar, but contrast sharply with downstream users in intensive agricultural areas outside of the Sierra Nevada Region. The San Joaquin watershed shares many of the same issues with watersheds further south in the Region.

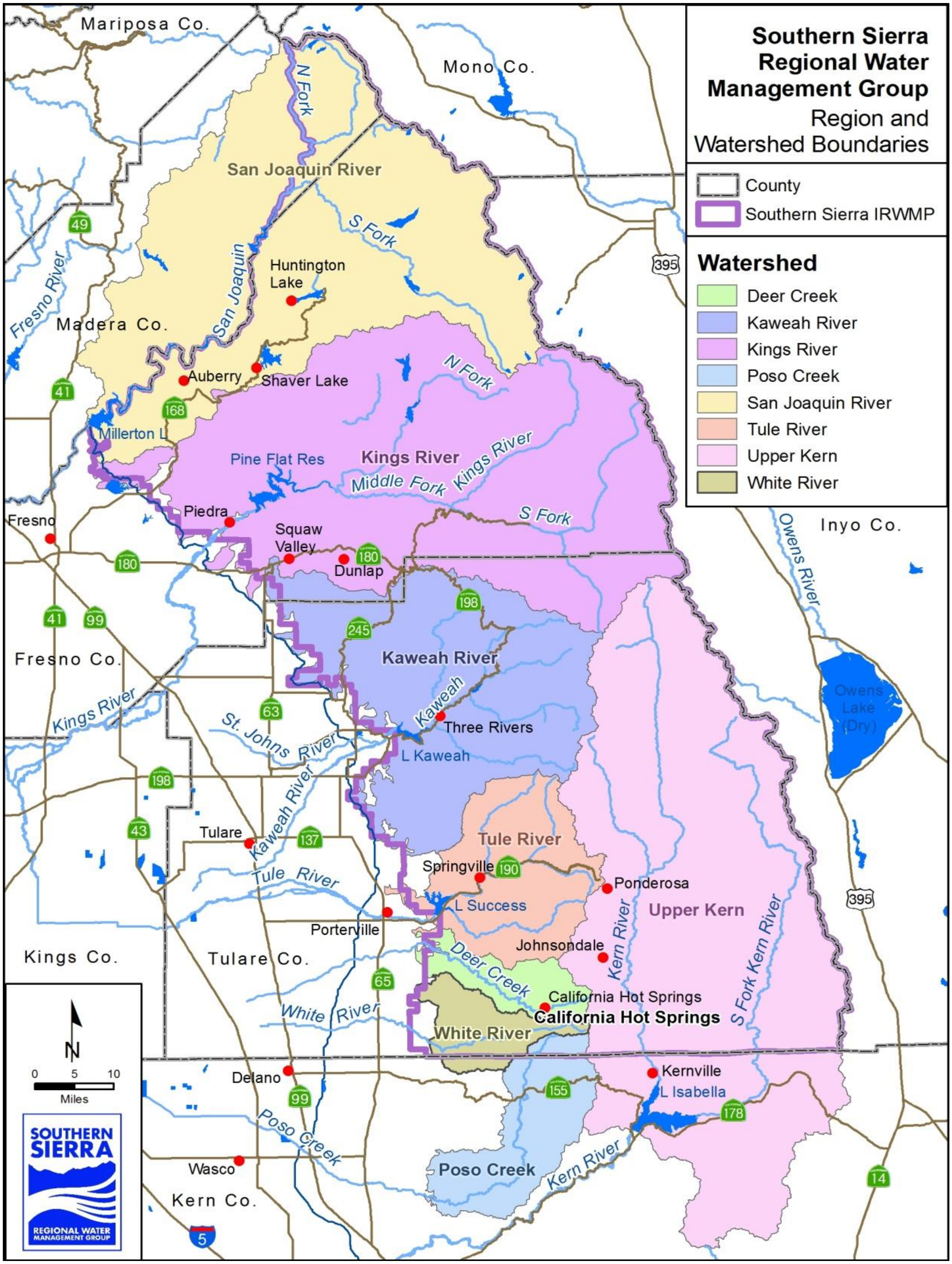


Figure 3-1 Region and Watershed Boundaries

North of the Southern Sierra IRWM Region is the Madera IRWMP which already has an IRWMP based on the Madera County boundary. The Madera IRWMP and Southern Sierra IRWMP overlapped in a small area of the San Joaquin River Watershed, specifically the area south of the river in Madera County. After some analysis, it was determined that issues emerging from the Southern Sierra RWMG were different from the Madera RWMG, and that 'joint management' of the overlap area would be a logical and feasible solution, even though overlapping IRWMP areas are discouraged by DWR (DWR did however approve the overlap). The boundary allows the Southern Sierra Region to include the entire San Joaquin River watershed south of the River. In addition, there is a small portion of the upper San Joaquin River Watershed which is outside of Madera County, and which is not included in the Madera IRWMP Region. In order to avoid a gap in coverage, the RWMG agreed to include this small area in their Region. See MOU in **Appendix A**.

Rationale: the boundary is based lands south of the San Joaquin River. A slight overlap with the Madera IRWMP, which are coterminous with Madera County boundaries, is logical and justified.

<u>Western Boundary</u>
To the west, the Southern Sierra IRWMP boundary is found in foothill to valley transitional areas, and is typically based on the boundaries of existing irrigation and water districts.

In the Kings River area, the Southern Sierra RWMG boundary extends to the District boundaries of the Tri-Valley Water District, Orange Cove Irrigation District, and Hills Valley Water District east of the towns of Orange Cove, Orosi and East Orosi. East of the City of Fresno, the boundary extends to the boundaries of the Fresno Metropolitan Flood Control District, International Water District, and Garfield Water District.

Rationale: This boundary was negotiated with the Kings Basin Water Authority (KBWA) to match the boundaries for their IRWMP group. KBWA's boundary extends along both banks of the Kings River to the northeast and ends at Pine Flat Dam. This area overlaps with the Southern Sierra RWMG and was justified by the fact that it incorporates the Kings River Conservancy's "Kings Ribbon of Gems" plan. No other overlaps or gaps between KBWA and Southern Sierra RWMG exist.

In the Kaweah Delta area, the Southern Sierra RWMG boundary extends to the Kaweah reservoir or the 600-foot contour in the Kaweah River Drainage. Some boundaries follow the RWQCB irrigated lands program and generally follow surface water-groundwater usage areas. Specific boundary criteria include the following:

- In the aquaculture/Lewis/Avocado area, the boundary will be the 600-foot elevation contour and squared to section lines; the agriculture north of Elderwood will be in the Kaweah Delta RWMG.
- In Davis Valley, the west side has small, irrigated lands while the east and the north are rangeland. The boundary will follow section lines in these areas.

- In Dry Creek, the boundary will follow land use: irrigated lands will be part of the Kaweah Delta RWMG and grazing land will be in the Southern Sierra RWMG.
- In Mehrten Valley, the 600-foot contour will be the guide' most of the valley will be in Kaweah Delta RWMG.
- In Yokohl Valley, most of the western valley will be in the Kaweah Delta RWMG while the eastern portion of the valley will be in the Southern Sierra RWMG.
- In Round Valley, east of Lindsay, the Kaweah Delta RWMG will include a few small areas east of the Integrated Lands Program (ILP), the boundary will again be based on land use and squared to the section lines.

Rationale: This boundary was negotiated with the Kaweah Delta Regional Water Management Group to match their boundaries.

In the Tule River Area, the Southern Sierra Region boundary includes the Tule River Indian Reservation and down to approximately the 600-foot contour in all forks of the Tule River and squared to section lines. The Deer Creek Tule River Authority planning area will follow irrigated lands while the SSIRWMP will follow rangeland.

Rationale: This boundary was negotiated with the Deer Creek-Tule River Authority Regional Water Management Group to match that Region's planning boundaries.

<u>Southern Boundary</u>
To the south, the Southern Sierra IRWMP boundary is defined by the Tulare-Kern County line.

The Kern County Water Agency proposed in January 2009 that the Southern Sierra RWMG boundary stop at the Kern County line. This would fragment the Kern River watershed with the upper portion in the Southern Sierra RWMG, and lower portion in the Kern RWMG. Kern County Water Agency stated that it had performed outreach in the Kern Valley and had numerous signatories to its MOU in the mountain areas. The SSIRWMP invited Lauren Bauer, the KCWA representative, to speak during a Coordinating Committee call after many Southern Sierra RWMG stakeholders objected to the boundary. The boundary change was approved during a RWMG meeting on April 22, 2009, on the condition that an MOU (See **Appendix R**) be developed between the Southern Sierra RWMG and the Kern County RWMG with the following items:

- Collaborate across jurisdictional boundaries to ensure benefits across watersheds including water quality, water quantity and source projects;
- The two IRWMPs will work collaboratively across jurisdictions, there will be project-specific consultation and specific cooperation;
- The Kern River Valley Revitalization group will need representation in the KCWA's mountain subregion committee as well as other groups such as Native American groups; and
- If the groups in Kern Valley continue to feel that they do not have representation, they can notify the Southern Sierra RWMG, which will pursue resolution with the KCWA or Tulare Basin JPA.

Rationale: The boundary is based on the KCWA service area and specific negotiations with the KCWA.

3.2.3 Internal Boundary Description

The rural lands of the Region are managed by numerous entities including the U.S. Forest Service (Sierra, Inyo, and Sequoia National forests and Sequoia National Monument), the National Park Service (Sequoia and Kings Canyon National Parks), US Army Corps of Engineers, Native American Tribes (Tule River Indian Reservation, Big Sandy, and Cold Spring Rancherias), non-profit entities, special and public utility districts, and private landowners. Many of these land managers only engage with each other on a limited basis or not at all. In order to protect critical water resources in the SSIRWM Region, increased coordination, collaboration and integration among the land managers and stakeholders of this Region is essential.

3.2.4 Appropriateness of the IRWMP Region for Water Management

The RWMG held several meetings to discuss the RWMG boundary and consideration was given to a number of factors including, but not limited to: land use and water management, political boundaries, water agency service area boundaries, physical characteristics of the landscape, streams and watersheds, water related man-made infrastructure, agency service areas, and major governmental ownership such as national forests and national parks. There was recognition that the area under consideration did not have a defined groundwater table or basin, and was predominantly one of fractured granite groundwater sources.

The Region is considered appropriate as an RWMG since it has a strong hydrologic basis based largely on watershed boundaries and the Sierra Nevada crest. The Region represents foothill and mountain communities with similar interests, issues and cultures. The Region also has similar groundwater conditions throughout most of its area. The area is significantly different than downstream Valley areas that have a higher population, greater groundwater supplies and abundant agriculture. The Region was accepted by DWR through the Region Acceptance Process and it has functioned well so far through RWMG sponsored efforts.

3.2.5 Nearby IRWM Regions

The Southern Sierra RWMG abuts seven different IRWMP Groups as shown in **Figure 3-2.** The various IRWMP groups have made efforts to coordinate their boundaries as much as possible, and the Southern Sierra IRWMP only overlaps with the Madera IRWMP and the Kings IRWMP, as discussed above. The various IRWMP boundaries inevitably split watersheds for the major rivers and streams. This was unavoidable due to the overall size of the watersheds and the different focus of different IRWMP groups, which generally cover mountain or valley areas and are not watershed-based. The Southern Sierra IRWMP is unique in the total percentage of federally owned land and low population density. Some neighbors are substantially different, such as IRWMPs in the San Joaquin Valley that use large quantities of water for agriculture and include medium and large-sized cities. However, during boundary discussions, issues that transcend the planning boundaries of the IRWMP groups were discussed and possible inter-regional projects were identified. The Southern Sierra IRWMP does not currently have any major conflicts with other IRWMP groups and hopes to collaborate on future projects with other groups. Chapter 15 – Coordination and Integration, provides more details on the similarities, differences and existing relationships with the other IRWMP Groups.

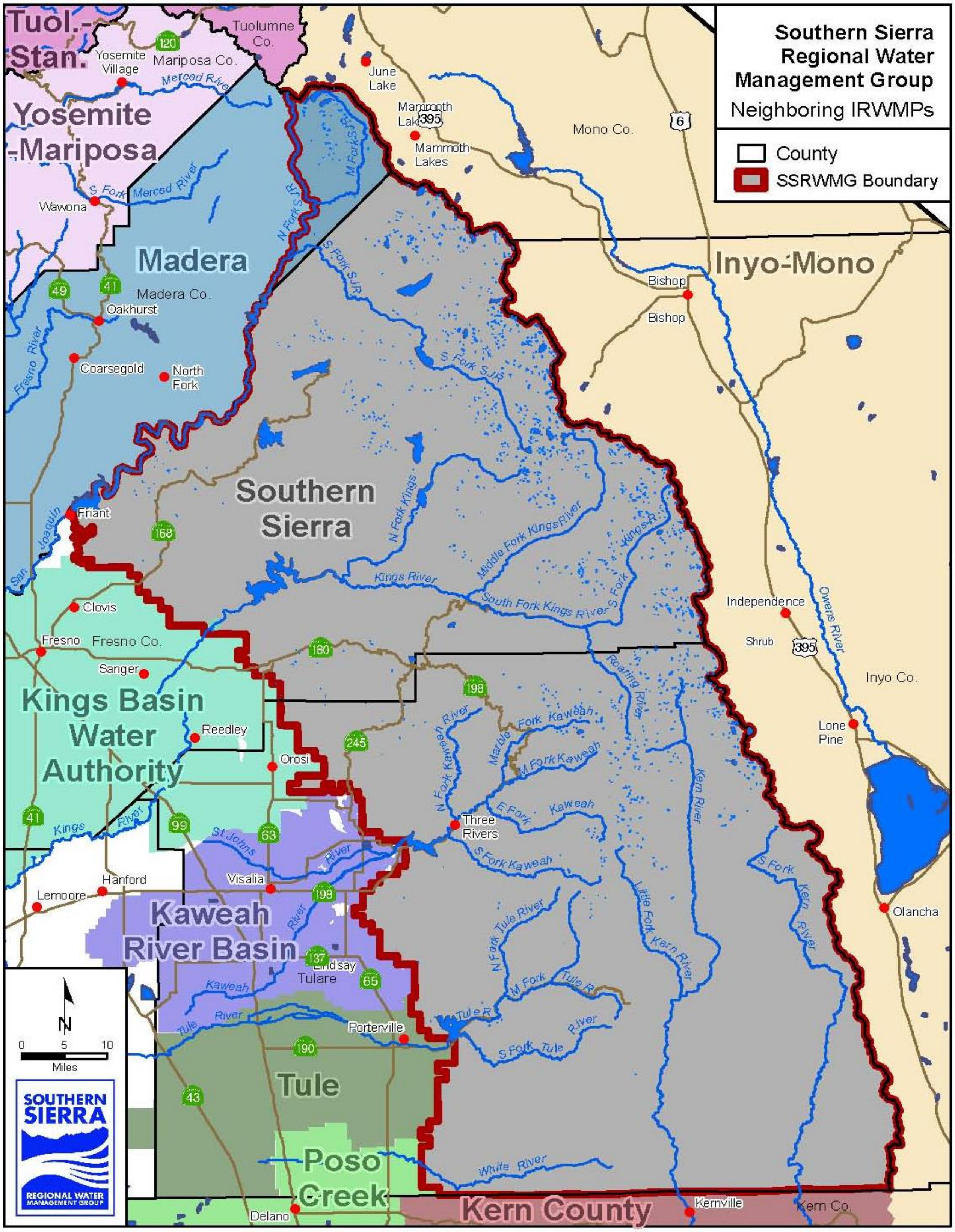


Figure 3-2 Neighboring IRWMPs

3.3 - Physical and Hydrological Conditions

The Southern Sierra Region of California is the fourth largest Integrated Regional Water Management (IRWM) Region in the state, covering approximately 6,195 square miles (3,964,800 acres) and includes the foothills and mountain headwater regions of the Kern, Poso, White River, Tule, Kaweah, Kings, and San Joaquin River (SJR) watersheds. These watersheds cover the Sierra Nevada portion of Fresno and Tulare counties, and a portion of the Sierra Nevada in Madera County. The Region's boundaries and the major hydrologic features in the Region are shown below in **Figure 3-3.** The 2013 California Water Plan Update contains important regional information on water supplies in the Southern Sierra.

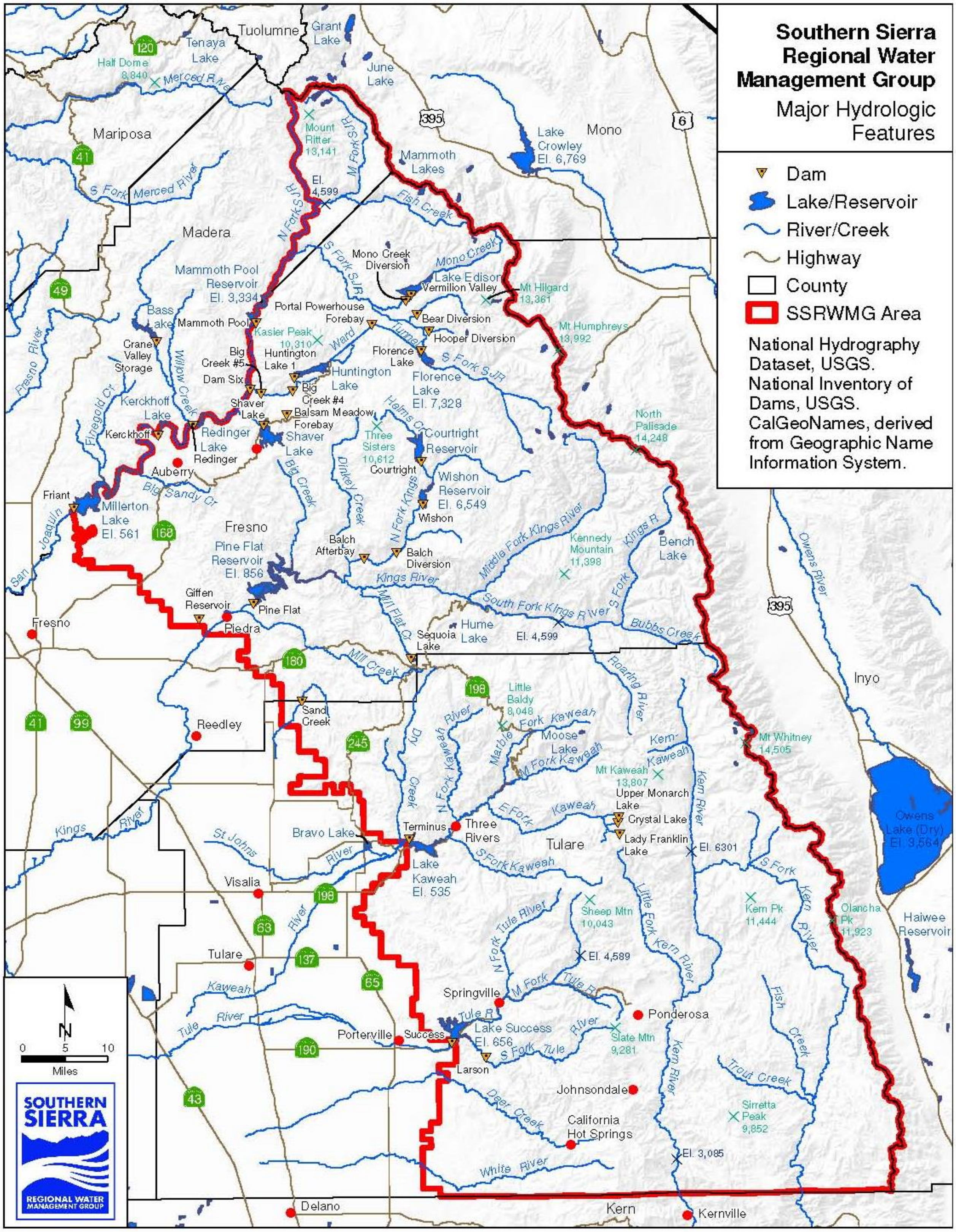


Figure 3-3 Major Hydrologic Features

This Region is of great importance to the overall well-being of the state, not only for its rich ecosystems, natural resources and abundant recreational opportunities, but also as a main source of water for California's thriving agriculture, energy production, wildlife species, habitats and corridors, and domestic water needs. The headwaters and mid-elevation watersheds of this Region are relatively intact as they are managed almost entirely for public benefits by federal agencies including the U.S. Forest Service, the National Park Service, the United States Army Corps of Engineers and others. Significant and increasing challenges include changing land uses, rapid climate change, habitat fragmentation, severe air pollution, altered fire regimes, and invasive species represent stresses on the landscape. In addition, changing population demographics, wildland/urban interface development, and other land use and natural resource demands already threaten the traditional working landscapes of the foothills to the upper reaches of the watersheds.

Meeting these challenges will require significant levels of planning, commitment and action by the local, tribal, state and federal stakeholders. However, the benefits of addressing such challenges extend not only to residents and visitors in the Region itself, but downstream to cities, towns, wildlife refuges and millions of acres of the most productive agricultural land in the world.

3.3.1 Precipitation

Precipitation in the area varies greatly based on elevation and latitude, and generally increases with elevation and distance north. Historically, much of the winter precipitation occurs as snowfall and provides important water storage for ecosystems and downstream water users. Climate projections indicate that future winter precipitation will consist of less snowfall and more rainfall (See **Chapter 15 -Climate Change)**. **Figure 3-4** shows how precipitation varies from 13 to 65 inches/year in the Region (60 year average 1900-1960). Although dated, this data provides the highest resolution contours that were readily available, and the data should be fairly similar to more recent data. The climate in the Region varies from subtropical in the lower elevations to temperate to subalpine and then to alpine at the highest elevations. Freezing temperatures are common throughout most of the Region in the winter.

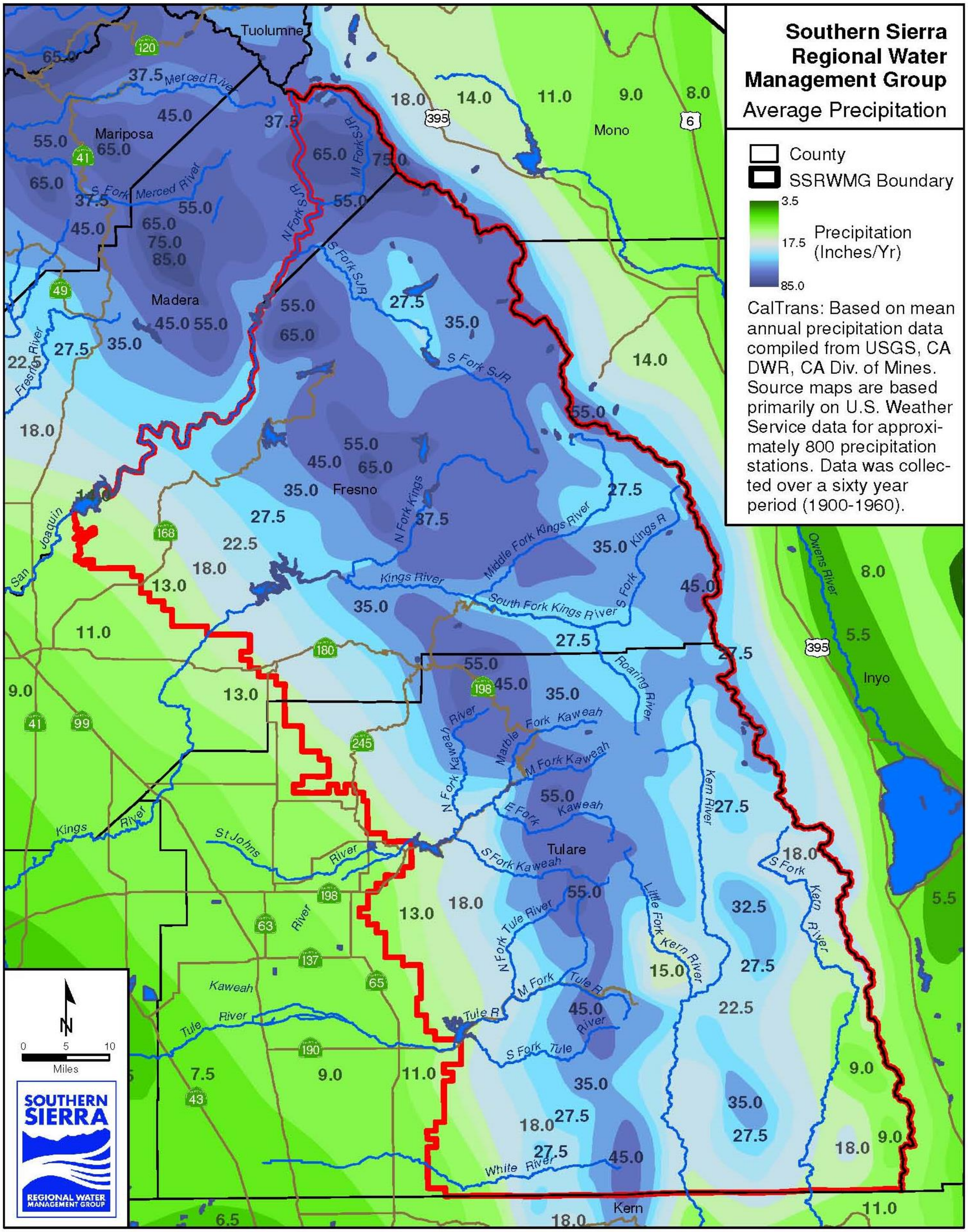


Figure 3-4 Average Annual Precipitation

3.3.2 Wild Fire Risk

Wild fire risk in the Southern Sierra Region ranges from moderate to very high. The Region is managed by several Federal agencies, local agencies and private owners with different approaches to reducing and reacting to wildfires. Although land managers utilize different strategies to reduce fire risk, it is understood that deviation from natural fire return-intervals has increased the risk of major wildfires, with great potential for ecosystem and economic impacts to the forests, watershed and local communities. Severe fires can reduce water quality and increase flooding, erosion, mass wasting and siltation of surface water bodies. High intensity wildfire also reduces a forest's ability to retain its snowpack; after a fire snowmelt can occur too early in the year to be useful to local water needs.

Fire risk is one of, if not the most, critical issue facing the Southern Sierra Region. The Sierra Nevada watersheds, including the Southern Sierra Region are a primary source of the State's water supplies. Therefore the health of these watersheds is crucial to a sustainable yield of water supply, not only with this Region, but within the State as well. Currently foothill and mountain watersheds are largely heavily forested with overgrown stands of trees and brush that have not burned in many years, thereby raising risk of catastrophic, stand-destroying wildfires such as the McNally Fire of 2002 in the Southern Sierra Region or the Rim Fire of 2013 in the Yosemite-Mariposa Region.

Fire is a natural part of the Sierra ecosystem; historically, fires burned frequently at low-intensity, removing excess fuel and thinning vegetation with little long-term impact to people or wildlife. Over 100 years of fire suppression, however, has resulted in overgrown and unhealthy forests susceptible to large, catastrophic wildfires resulting in the following problems: loss of vegetation exposes soil to erosion; runoff may increase and cause flooding; sediments may move downstream and damage houses or fill reservoirs, degrade surface water quality, put endangered species and community water supplies at risk; and increasing acreage of ground stripped by catastrophic fires of all water holding vegetation will result in increases in flood potential, as well. The Forest Service Burned Area Emergency Response (BAER) program addresses these situations with the goal of protecting life, property, water quality, and deteriorated ecosystems from further damage after the fire is out.

The numerous other fires occurring throughout foothill and mountainous areas of the Sierra Nevada during the summers of 2013 and 2014 seem to be an indicator of the increasing frequency and intensity of fires occurring in the Southern Sierra Region (e.g. Aspen Fire (2013) and French Fire (2014). Public expenditures for fire suppression rise with increasingly catastrophic fire events. Over 50% of the Forest Service's annual budget is used for fire suppression. Shifting more funds to forest restoration and fuel reduction projects would proactively reduce fire risk, improve forest health, and likely increase water yield and quality from forested land (see Practice Resource Stewardship, Section 5.7).

Southern Sierra Region federal land management agencies are beginning to shift their focus to prescribed fires to manage wildfires, which may have greater effects on both forest and watershed health and significant benefits to water management.

Figure 3-5 shows the level of fire risk in 2008 prior to several years of drought. It should be noted that most climate models indicate an increasing level of wildfire risk with increasing temperatures, reduced precipitation, and an increase in mortality of foothill and mid elevation forests (see Chapter 16 – Climate Change).

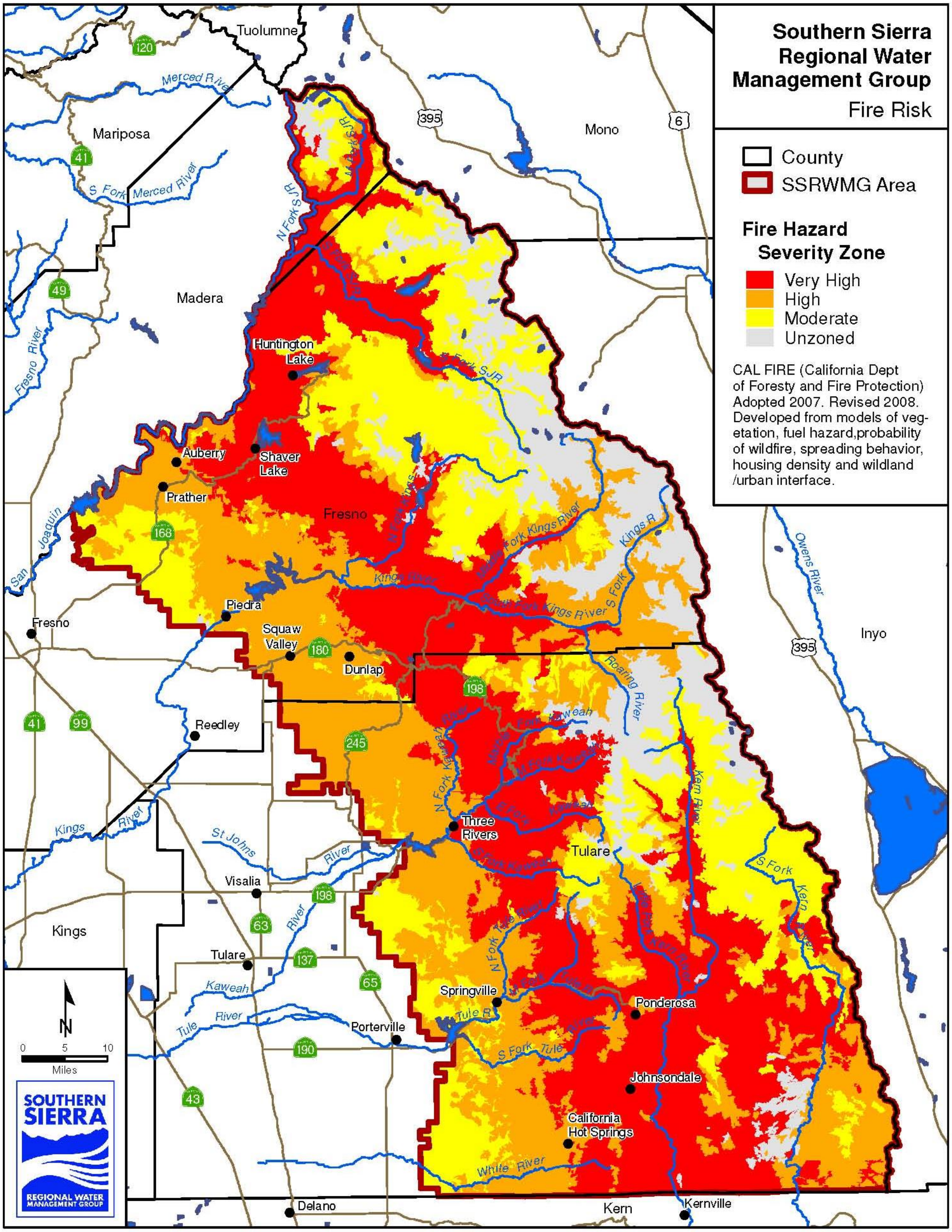


Figure 3-5 Fire Risk

3.3.3 Population, Demographics and Visitation

Approximately 34,000 residents live in this Region concentrated in several communities and tribal areas including Shaver Lake, Prather, Squaw Valley, Millerton/Friant, Big Sandy, Cold Springs, Table Mountain Rancherias and Tule River Indian Reservation, Springville and Three Rivers. **Figure 3-6** depicts the population density as reported in the 2010 federal census. The entire Region has a low population density, but higher population densities are found in several Cities in Valley areas near the western boundary.

Several important resort communities are also present including Huntington Lake, Shaver Lake, Hume Lake/Lakeshore, Silver City, Wilsonia and others. The balance of the population is spread throughout the Region in small pockets and individual rural residences. Most residences utilize the limited and variable (quantity and quality) supplies of groundwater pumped from fractured rock aquifers, a limited resource that is not yet fully understood.

Sequoia and Sierra National Forests, Sequoia and Kings Canyon National Parks, and Devils Post Pile National Monument cover much of the Sothern Sierra Region, all of which are managed by federal agencies with different mandates but with many common goals. Important and critical resources like the Giant Sequoia groves, mountain meadows, geologic resources, abundant and unique flora and fauna are present within the Region. Over two million visitors per year are drawn to these features and many stay in local hotels, resorts, camps and campgrounds. This visitation is critical to the economic welfare of the Region yet places a large burden on the Region's poorly developed water supplies and infrastructure and limited ability to treat and dispose of wastewater. With the exception of a few small community wastewater systems and those present in Sequoia and Kings Canyon National Parks, a majority of areas use septic systems and the wastewater is only partially treated and disposed in septic tank/leach field systems, many near vital surface water bodies.

Fishing on the Tule River

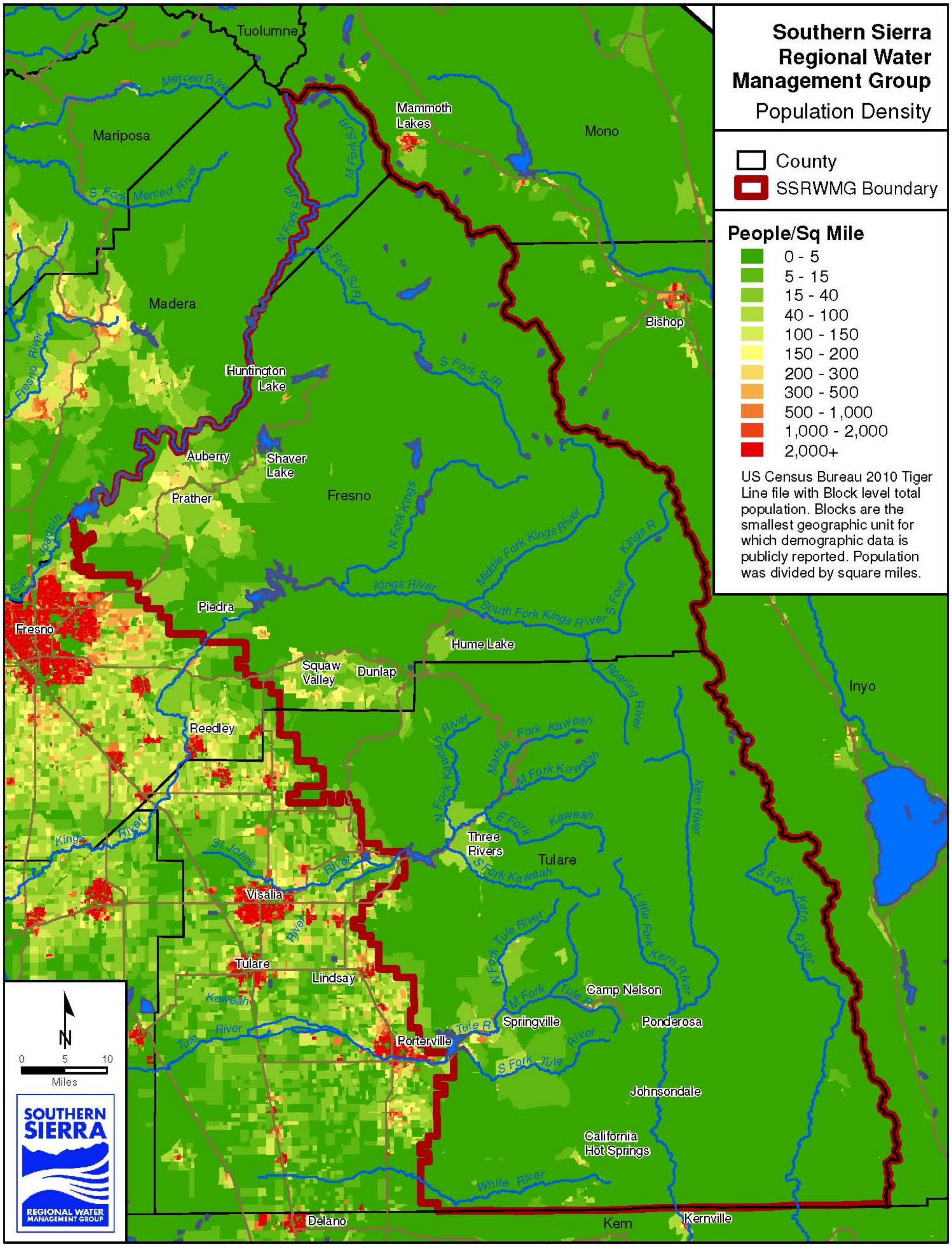


Figure 3-6 Population Density

3.3.4 Land Ownership

Figure 3-7 depicts land ownership in the Region, and **Figure 3-8** details public versus private ownership. The Region is dominated by land under federal agency management (76%); the Forest Service followed by the National Park Service are the two largest land managers. Only 23% of the Region is in private ownership, and 1.4% is tribal land. The western foothill region is largely privately owned, but the interior is primarily owned by Native American Tribes and the Federal government including the National Forest Service, National Park Service, Bureau of Land Management, and other federal agencies. Private lands are largely ranches and conservation areas owned by non-profit groups. There are four federally recognized Native American Tribal Reservations or Rancherias in the Region: Big Sandy, Cold Springs, Table Mountain and Tule River. These tribes, and tribes in neighboring IRWMP regions, are shown on **Figure 3-9**.

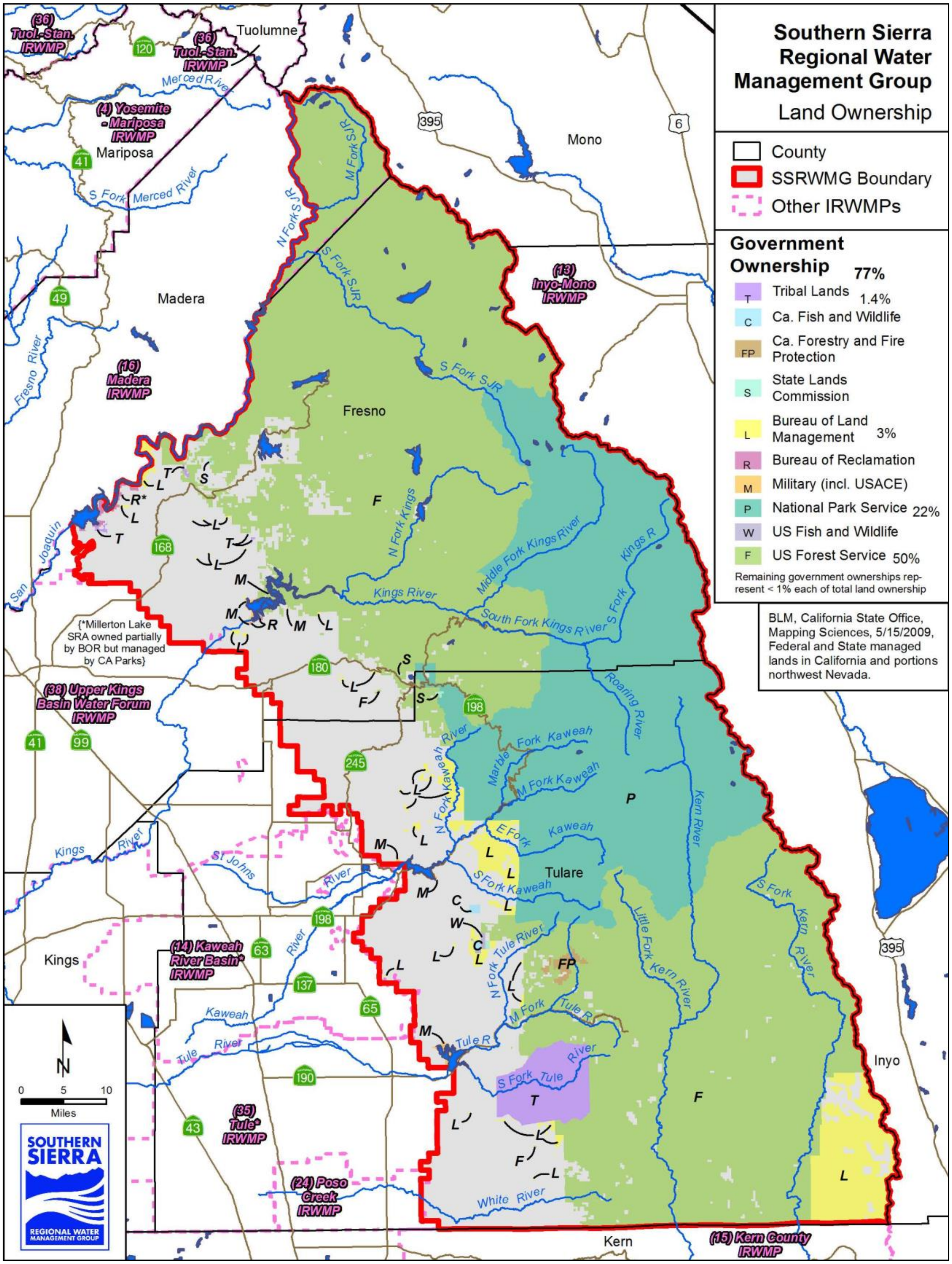


Figure 3-7 Land Ownership

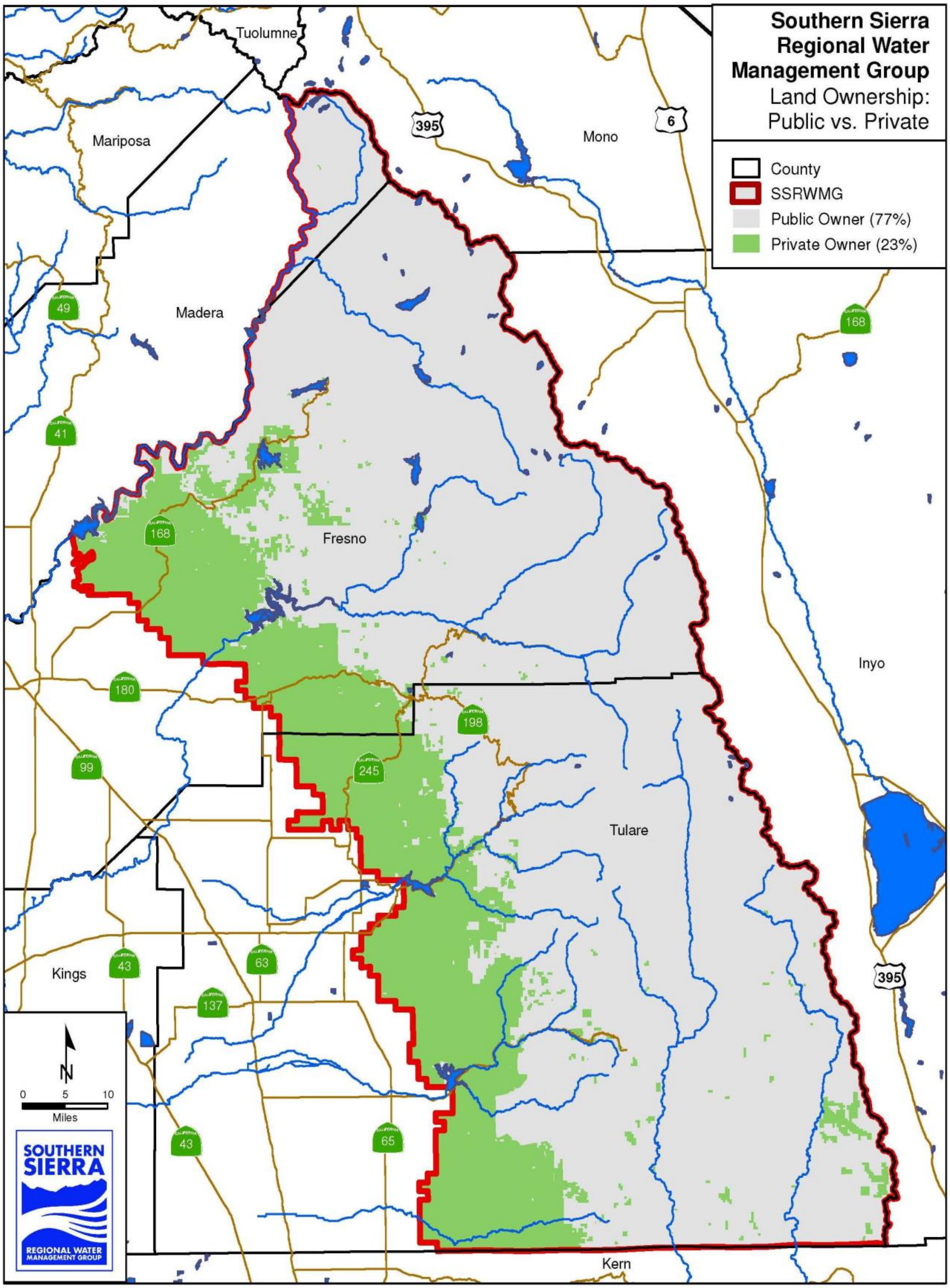


Figure 3-8 Land Ownership: Public versus Private

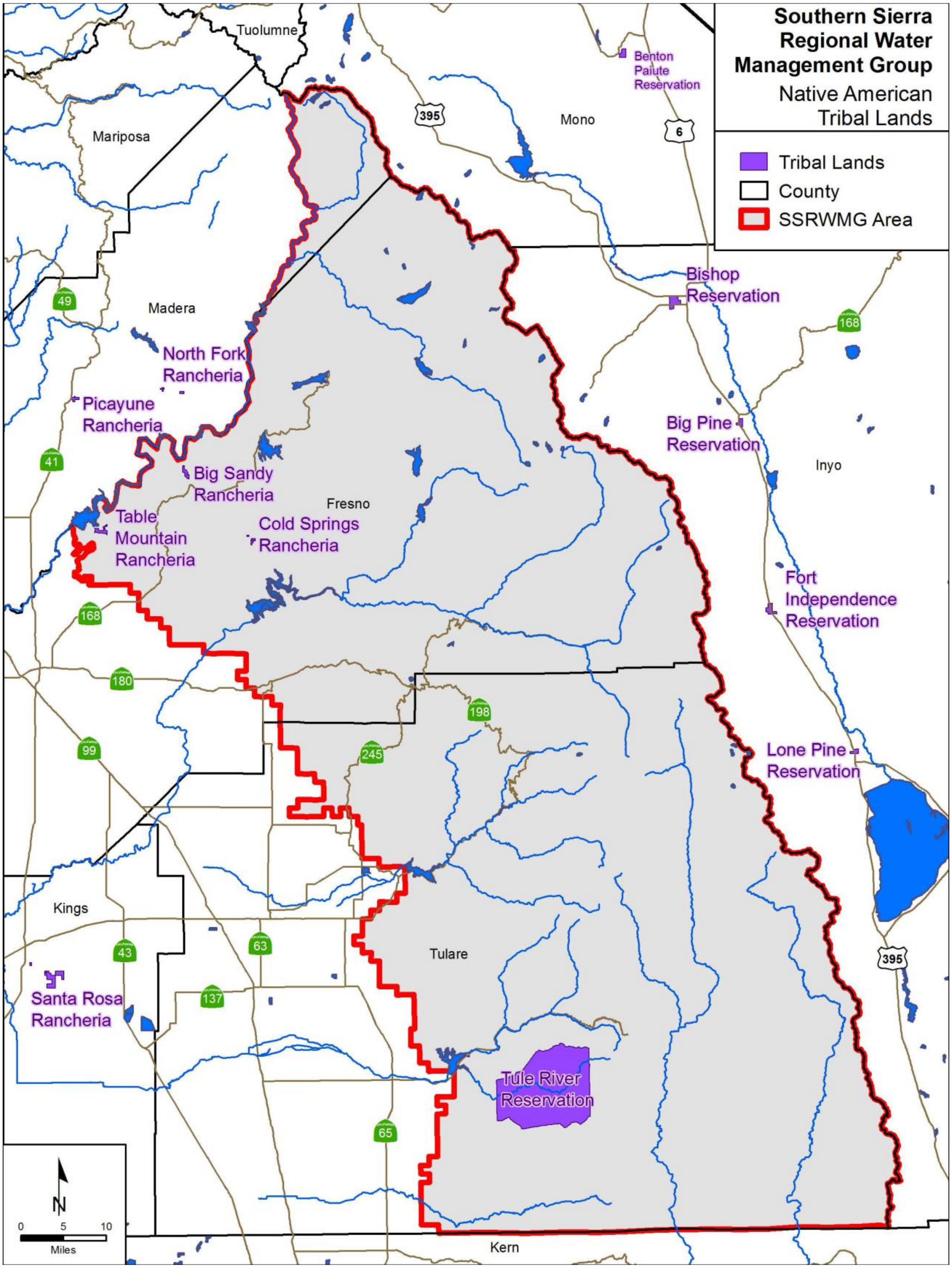


Figure 3-9 Native American Tribal Lands

3.3.5 Dams and Reservoirs

An established network of over 30 dams and reservoirs provides water storage, flood control, energy and infrastructure protection for the Southern Sierra Region and the Southern San Joaquin Valley. These dams supply 1,700 megawatts (MW) of hydroelectric power, and provide annual storage of over 2,500,000 acre-feet of water. When released, the water is a critical component of the Region's scenic resources, water-dependent wildlife, a significant portion of the Central Valley's agricultural water supply, and groundwater recharge efforts. Maintaining, protecting, and preserving the water supply and quality of the Southern Sierra Region's water is of critical importance to the goals and objectives in this IRWMP. A list of dam and reservoirs with information concerning power production is presented in **Appendix C – Dams and Reservoirs in the Southern Sierra**.

3.3.6 Domestic Water Supply

Water for the Southern Sierra Region is a combination of groundwater and surface water that is delivered by a combination small rural systems and open ditches, flumes, and pipes and primarily by private wells. The majority of the population relies on groundwater for domestic use, because most of the surface water rights are held by agencies in the San Joaquin Valley. Local water agencies continue to evaluate improved methods to conserve water while preserving the rural and historic characteristics of their raw water delivery systems. In areas served by water agencies extensive end user water conservation efforts have also been implemented over the recent years. For residences, communities and other users dependent on well water a heightened level of awareness of falling water levels, fractures running dry and diminishing water quality has resulted in an urgency to improve water knowledge, supply and quality. **Figure 3-10** shows the known water purveyors in the Region. The large number and variety of purveyors provides many challenges for the development of projects that impact large numbers of the population. Most of the water purveyors are small, and are managed and operated by a single part-time staff member or volunteer Board of Directors. These small water agencies/companies have difficulty participating in the RWMG due to their limited staff and resources and the large geographic area

Groundwater resources within this Region are scarce and generally not a reliable source of long-term significant water supplies, though a majority of the population relies on well water. Wells can also be subject to water quality problems. There are limited opportunities for water resource movement across landscapes due a lack of interconnectedness between fractures systems as indicated by incised canyons of the watersheds. Therefore many of the traditional water management options identified in Bulletin 160-09, such as water transfers and conjunctive use projects, are not possible or produce little benefit within the Region.

The Department of Water Resources (DWR), on behalf of the RWMG, conducted an evaluation of published data and prepared a preliminary technical presentation concerning the potential water supply and the local demand in the Three Rivers area. A summary of the work is discussed in Chapter 11 – Technical Analysis.

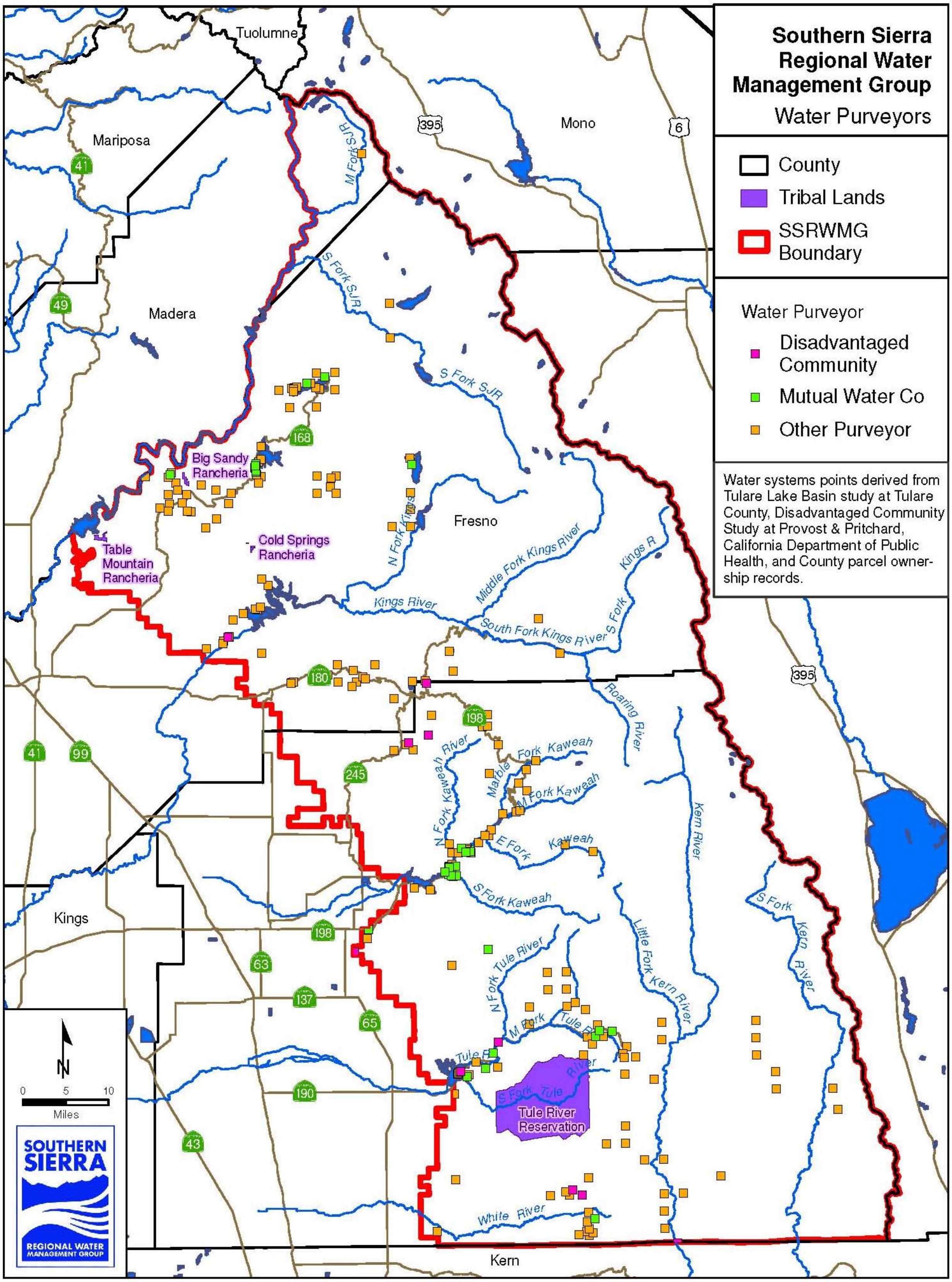


Figure 3-10 Water Purveyors

Vegetation

Figure 3-11 shows the vegetation communities in the Southern Sierra Region. Most of the Region is covered in wildland vegetation and very little is developed for urban uses or agricultural crops, although agriculture still represent a significant portion of the local economy. A large portion of the foothills is used for grazing. Vegetation includes herbaceous plants and woodlands at lower elevations and transition up to hardwoods, chaparral and then coniferous plants at higher elevations. The crest of the Sierra is above the treeline and has alpine or no vegetation.

Ranching in Foothill Area

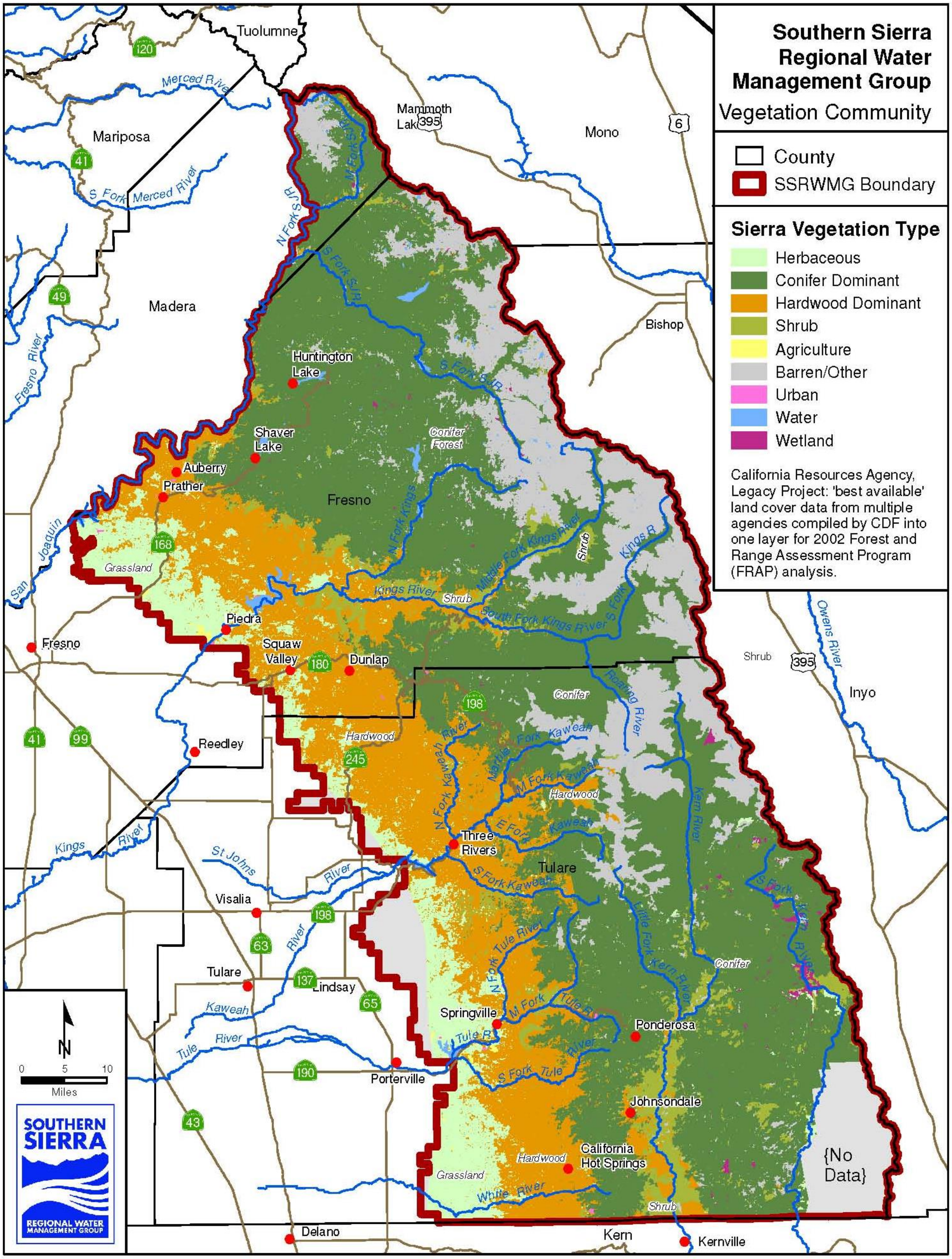


Figure 3-11 Vegetation Community

3.4 - Watersheds

The Southern Sierra boundary include the foothills and mountain headwater regions of the Kern River, Poso Creek, Deer Creek, White River, Tule River, Kaweah River, Kings River, and about half of the San Joaquin River watersheds. These watersheds, shown in **Figure 3-1. Region and Watershed Boundaries**, cover the Sierra Nevada portion of Fresno and Tulare counties, and a portion of Madera County. Within the Region, water generally flows from the crest of the Sierra Nevada mountain range in the east towards the Tulare Basin in the west. The streams flow from high mountain lakes, meadows, snowfields and a few glaciers, out of deeply incised watersheds with extensive coniferous forests in the mountains, through foothill regions with brush and annual grasslands. In the foothills lay the majority of the large dams. As previously discussed, there are few population centers in the Southern Sierra; however, most of the population in Madera, Fresno, and Tulare counties is centered in the Valley portions of the counties outside of the Region.

Some principal stressors common to all of the watersheds include:

<u>Water</u>
- Human demands for groundwater and surface water
- Lower than historical in-stream flows
- Wells in floodplains dewatering streams
- Impaired water bodies (see Table 3.1)

<u>Land Use</u>
- Impacts of changing land use on water quality and quantity
- Land use impacts on native species
- Erosion from forest roads

<u>Fire</u>
- Increase in intensity of wildfires due to fuel buildup
- Wildfire impacts on water quality and water yield

<u>Flooding</u>
- Downstream flooding after wildfires
- Downstream flooding during high water events

<u>Ecosystems</u>
- Invasive species
- Lack of wildlife connectivity corridors
- Grazing management along stream courses
- Littering along waterways

<u>Other</u>
- Illegal marijuana cultivation

- Reduced water quality as a result of recreational activities

All of these watersheds could benefit from projects designed to achieve multiple objectives such as: implementing strategic plans for local water agencies, meadow restorations, fuel breaks and fuel treatments, improved fire management, comprehensive water studies, ecosystem restoration and invasive species removal.

Below are general descriptions of the watersheds in the Southern Sierra Region and their water management portfolios. A watershed map is provided for each major River or Creek that shows hydrologic features, population centers, and land ownership.

3.4.1 San Joaquin River Watershed

Geography

The watershed of the San Joaquin River (SJR) is shown on **Figure 3-12**. The watershed covers an extensive portion of the southern Sierra Nevada (see Error! Reference source not found.). The total watershed area is 1,700 square miles with about 1,130 in the RWMG area. The average annual inflow to the reservoir is about 1.8 million acre-feet. The lower part of the watershed includes the areas near Millerton Lake at 340 feet median sea level (msl). The eastern boundary follows the Sierra crest at elevations around 14,000 feet. Outside of the Southern Sierra Region, the San Joaquin River flows east and north to the Delta. Over 20 towns, villages and communities lie within the SJR watershed, many of which provide some level of water or sanitary service.

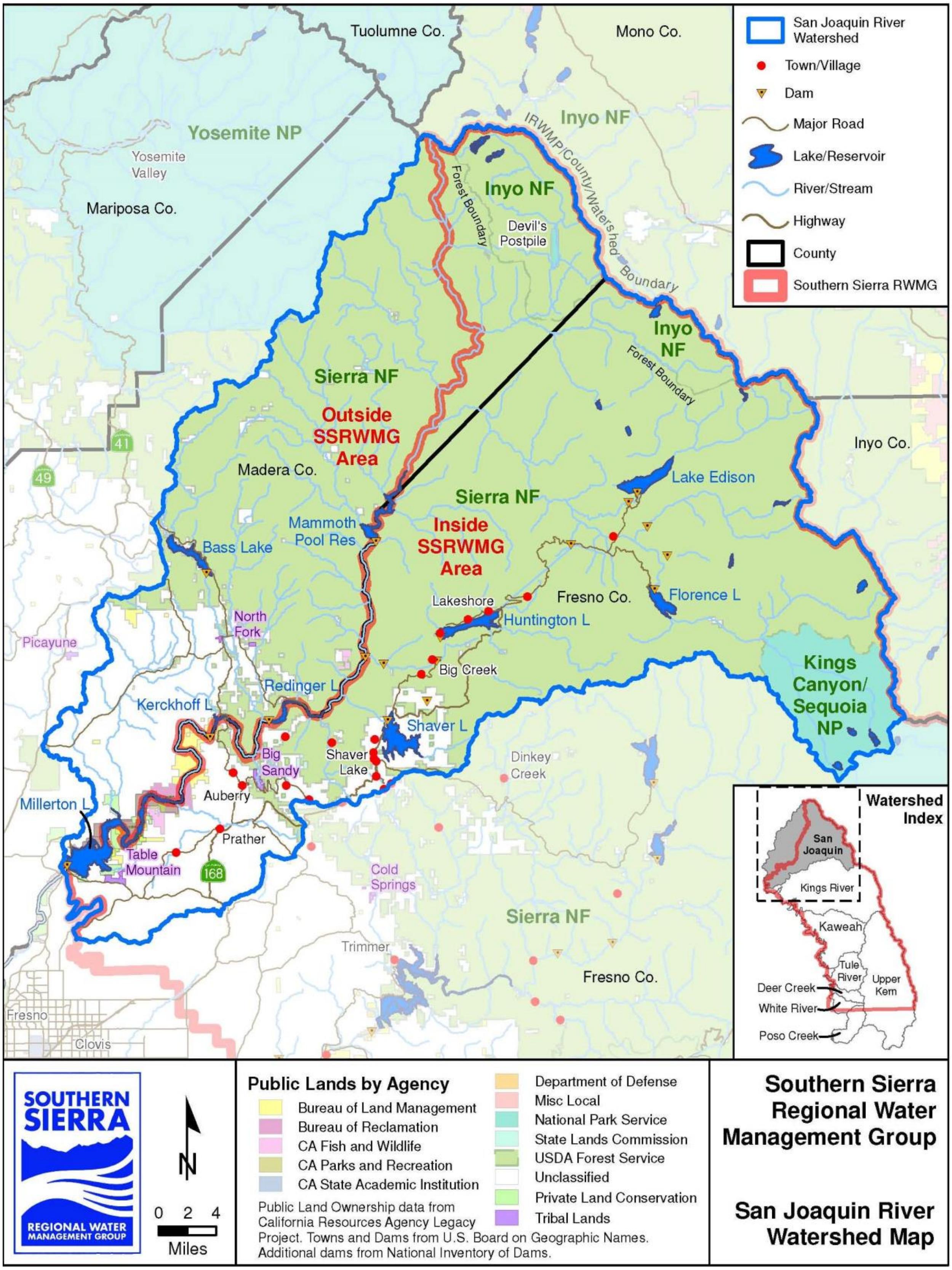


Figure 3-12 San Joaquin River Watershed Map

Stakeholders

Stakeholders in the SJR watershed within the Southern Sierra Region include:

- Sierra Resource Conservation District
- Southern California Edison
- Pacific Gas & Electric
- Fresno County
- Various ditch companies
- The New Auberry Water Association
- National Park Service – Sequoia and Kings Canyon National Parks
- Sierra National Forest
- US Bureau of Reclamation
- California State Parks - Millerton Lake State Recreation Area
- More than 23 named towns or communities

Watershed Stressors

The SJR watershed is under pressure from many directions both natural and human induced. Increasing population together with a sparse water supply provide difficult conditions for local development. Residential wastewater treatment is almost completely accomplished through individual septic tank and leach field, with few community-wide systems. The watershed also experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts

This watershed has the greatest level of water management (planning and implementation) in the Southern Sierra Region, by both public and private agencies. These efforts include the following:

- Groundwater management planning by the Sierra Resource Conservation District (RCD) in the Auberry/Prather area
- The Upper San Joaquin River Watershed assessment
- Historic watershed coordination (there is no current watershed coordinator, but for several years the Department of Conservation funded one)
- Groundwater contamination studies
- The Millerton Area Plan
- Fresno and Madera County General Plans
- Madera IRWMP (the Madera RWMG and the Southern Sierra have an MOU designed to promote co-management of the upper SJR Watershed)
- Dinkey Creek Collaborative Forest and Landscape Restoration Project
- Sierra National Forest's Forest Management Plan
- Sequoia and Kings Canyon National Parks General Management Plan
- Sierra Nevada Conservancy's regional analyses and public symposia
- Meadow ranking on Sierra National Forest watershed improvement database
- Southern California Edison Forest Management Plan
- Various public and private timber harvest plans
- Willow Creek Forest Collaborative

Historic and On-going Research

There are several past and on-going research projects in the SJR watershed, including:

- Long-term research at the USFS's San Joaquin Experimental Range
- Meadow restoration in the Sierra National Forest
- Southern California Edison's Land Management Plan and Timber Harvest Plans
- Prescribed fires on private and national forest lands
- Sierra RCD's groundwater investigation

3.4.2 Kings River Watershed

Figure 3-13 illustrates the Kings River watershed. The Kings River watershed is located just south of the San Joaquin River watershed, and north of the Kaweah River and Kern River watersheds. The watershed covers an area of about 1,850 square miles. The difference in elevation within the RWMG area is about 600 feet in the foothills up to 14,200 feet at the crest of the Sierras. The upper reaches include Sequoia and Kings Canyon National Parks. The average annual inflow to Pine Flat Reservoir is about 1.7 million acre-feet/year.

Sixty-five miles of the Kings River was classified as a Wild and Scenic River by a Congressional Act in 1987. Mill Creek, an important tributary to the Kings River, is located approximately 35 air miles southeast of Fresno, California. This watershed contains the Mill Flat Critical Aquatic Refuge (CAR) which supports the Western Pond Turtle and native fisheries. It provides water for municipal, agricultural, contact and non-contact recreation, and both warm and cold water fisheries. Communities reliant on Kings River surface water include the Cities of Fresno and Clovis. Other communites rely on groundwater from the Kings River watershed; these include Sanger, Reedley, Selma, Parlier and Kingsburg.

A main concern in this watershed is sediment contributions from roads to streams. Watershed inventory work has been completed and shows a significant amount of sediment delivery from the road system that lies within this watershed. Specific road maintenance activities such as, road drainage reconstruction (culvert replacement, over-side drainage repair, etc.), and road decommissioning work was identified in the USFS watershed prioritization process and is needed within this watershed both for watershed restoration and for the beneficial downstream impacts to municipal watersheds, agriculture, recreation and fisheries.

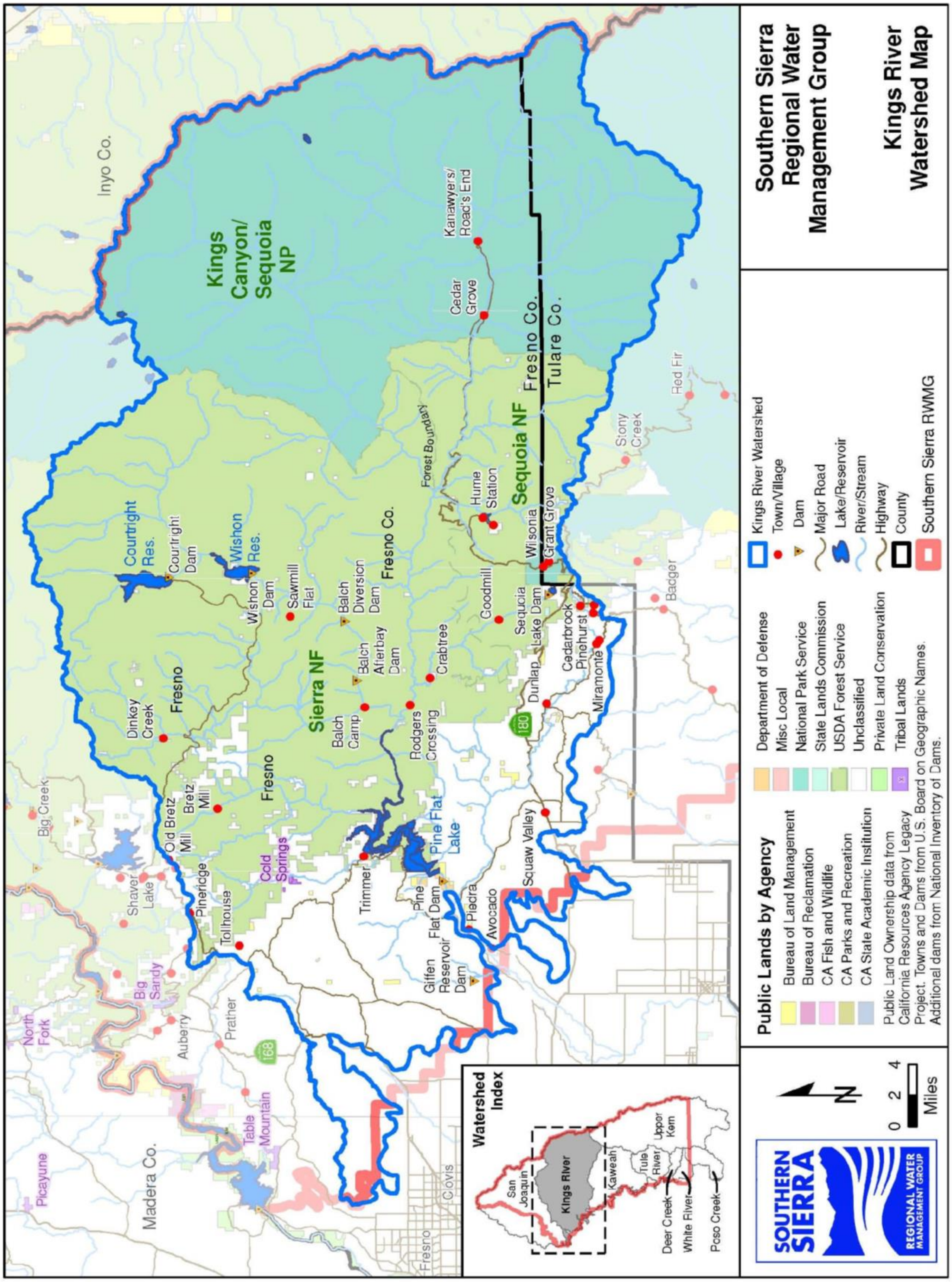


Figure 3-13 Kings River Watershed Map

Stakeholders

Stakeholders entities in the Kings River Watershed include:

- Army Corps of Engineers
- FMFCD
- Sierra RCD
- Sierra National Forest
- Sequoia National Forest
- Southern California Edison
- Pacific Gas & Electric (PG&E)
- ditch companies
- Friends of the Kings River
- Kings River Conservation District
- Kings River Conservancy
- Kings River Water Association
- pKings Basin Water Authority
- National Park Service

Watershed Stressors

The Mill Flat Creek subwatershed has been classified as "Functioning at Risk" (FAR) by the USFS. The FAR designation is attributed to wetland or riparian areas that are functional but an existing soil, water or vegetation component makes it susceptible to degradation[1]. The watershed also experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts

Existing water management planning includes:

- Forest Management Plans of Sierra and Sequoia National Forests
- Sequoia and Kings Canyon National Parks General Management Plans
- Fresno County's general plans
- Sierra Nevada Conservancy's regional analyses and public symposia

On-going Research

On-going public involvement in the Kings River watershed includes:

- Sierra RCD's work on a groundwater management plan for eastern Fresno County
- Kings Basin Water Authority's IRWM planning
- Kings River Conservancy's watershed protection and planning

Research in the watershed includes:

- The Pacific Southwest Research Station's Kings River Experimental Watersheds
- National Science Foundation's (NSF) Southern Sierra Critical Zone Observatory (SSCZO)
- Kings River Conservation District research on the Kings River watershed
- Fresno State University research on the Kings River watershed

[1] http://www.cnhp.colostate.edu/download/documents/2004/South_Park_BLM_Wetlands_Survey.pdf

- Fresno State University's graduate research on aquatic species and the effect of riparian areas on water quality
- Research by the Sierra Nevada Conservancy

3.4.3 Kaweah River Watershed

The Kaweah River watershed is shown on **Figure 3-14**. The Kaweah River watershed is located just south of the Kings River watershed, and is in the geographic center of the Southern Sierra Region. The majority of the upper watershed is included in the Southern Sierra Region (917 out of 938 square miles). The difference in elevation within the IRWM area is about 600 feet in the foothills up to 12,400 feet at the eastern end. The upper reaches include Sequoia and Kings Canyon National Parks.

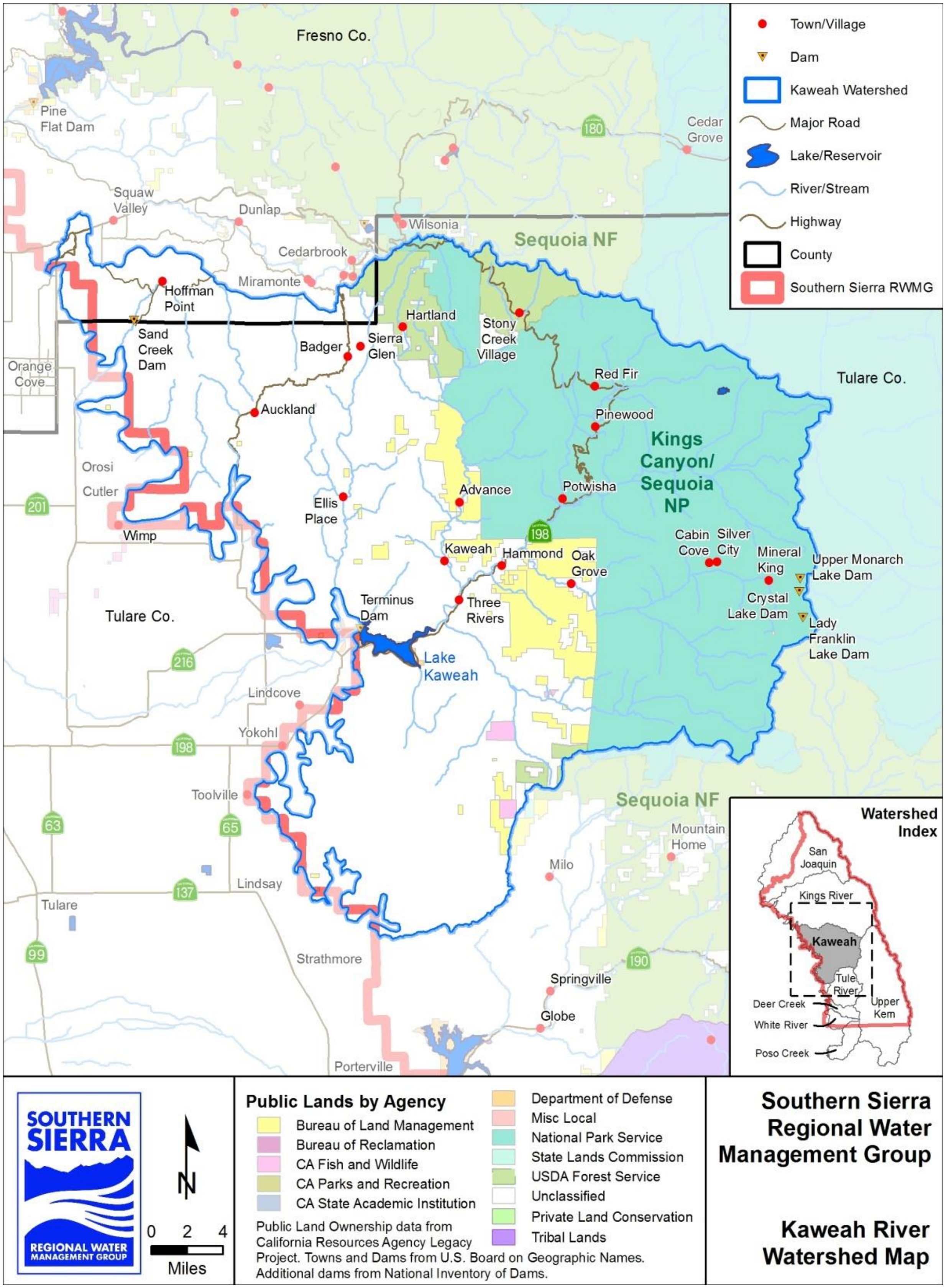


Figure 3-14 Kaweah River Watershed Map

Stakeholders
Stakeholders in the Kaweah River Watershed include the following:

- US Army Corps of Engineers
- Kaweah Delta Water Conservation District
- Tulare County Resource Conservation District
- Southern California Edison
- Various ditch companies
- Alta Acres Water Association
- Three Rivers Community Services District
- Sequoia and Kings Canyon National Parks
- Sequoia National Forest
- Bureau of Land Management

Watershed Stressors
The watershed experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts
Following are lists of collaboration and public involvement, data collection and sharing, and on-going projects in the Kaweah River watershed:

Collaboration and Public Involvement
- Sequoia and Kings Canyon National Parks NEPA processes and symposia
- BLM – Caliente Management Plan
- Tulare Lake Basin DAC Pilot Study

Data Collection and Sharing
- Sequoia Riverlands Trust’s land protection planning, well water-level monitoring, and evaluation of watershed impacts of grazing
- National Park Service’s frog restoration via trout removal in high elevation lakes
- Cahoon Meadow Restoration Planning Project
- Tulare County’s Three Rivers Community Plan
- Flyfishers for Conservation’s Big Meadows Restoration Project’s groundwater and insect data monitoring
- Sierra Nevada Conservancy’s regional analyses and public symposia
- Southern Sierra Partnership’s climate change adaptation program

On-going Projects
- Surface water monitoring by Three Rivers CSD
- Halstead Meadow Restoration Project
- Velvetgrass Removal Project in Sequoia National Park and Sequoia National Forest
- Three Rivers CSD’s groundwater monitoring
- Sequoia Riverlands Trust’s ecological restoration of an abandoned rock quarry in Dry Creek

<u>On-going Research</u>
No information available.

3.4.4 Tule River Watershed

Figure 3-15 shows the Tule River watershed. The Tule River watershed is located just south of the Kaweah River watershed and north of the Deer Creek watershed. The watershed covers an area of about 400 square miles. A significant portion of the southern end of the watershed is governed by the Tule River Indian Reservation. The watershed does not reach the crest of the Sierras. The difference in elevation within the RWMG area is 500 feet in the foothills up to 10,200 feet in the eastern end.

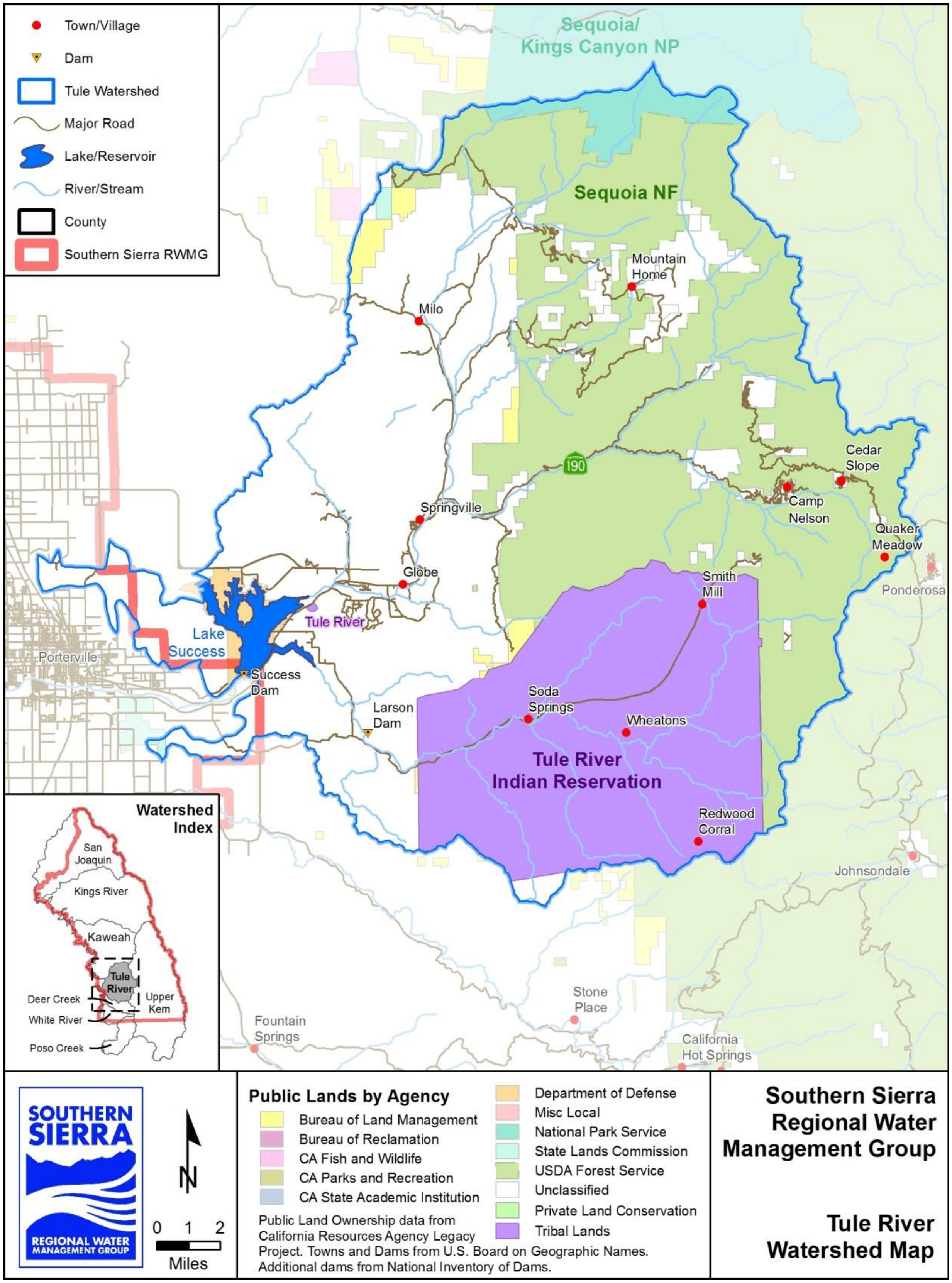


Figure 3-15 Tule River Watershed Map

Stakeholders
Stakeholders in the Tule River watershed include:

- US Army Corps of Engineers
- Cal Fire
- Southern California Edison
- Tulare County RCD
- various ditch Companies
- Springville PUD
- Sequoia National Forest
- Tule River Indian Reservation

Watershed Stressors
Local watershed stressors include high demand for water supplied in the Springville Public Utilities District and Tule Indian Reservation. The watershed also experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts
Following are lists of water management planning, data collection and sharing, and on-going projects in the Tule River watershed:

Water Management Planning

- Forest Management Plan of Sequoia National Forest
- Tulare County General Plan
- Sierra Nevada Conservancy's regional analyses and public symposia
- Sequoia National Forest's NEPA processes

Data Collection and Sharing
An example of data collection and sharing in this watershed is the climate change adaptation and ecosystem benefits work being completed by the Southern Sierra Partnership.

On-going Projects

- Southern California Edison's Tule Flume Replacement Project
- Partnerships among Wild Places, USFS, and Community Services and Employment Training (CSET) to monitor river areas and clean up trash
- An education program with language interpreters about litter clean up and stewardship of river resources
- Marijuana eradication on Tule River Indian Reservation
- Long Meadow Restoration Planning Project

<u>On-going Research</u>
Ongoing studies in this watershed include the Forest Service's streams and water yield research.

3.4.5 Southwestern Watersheds

Figure 3-16 shows the watersheds for Deer Creek, Poso Creek and White River (Southwestern Watersheds). These three watersheds are in the same geographic vicinity, cover relatively small areas in lower elevations, and are therefore collectively shown on the same map. Each watershed will be discussed separately below.

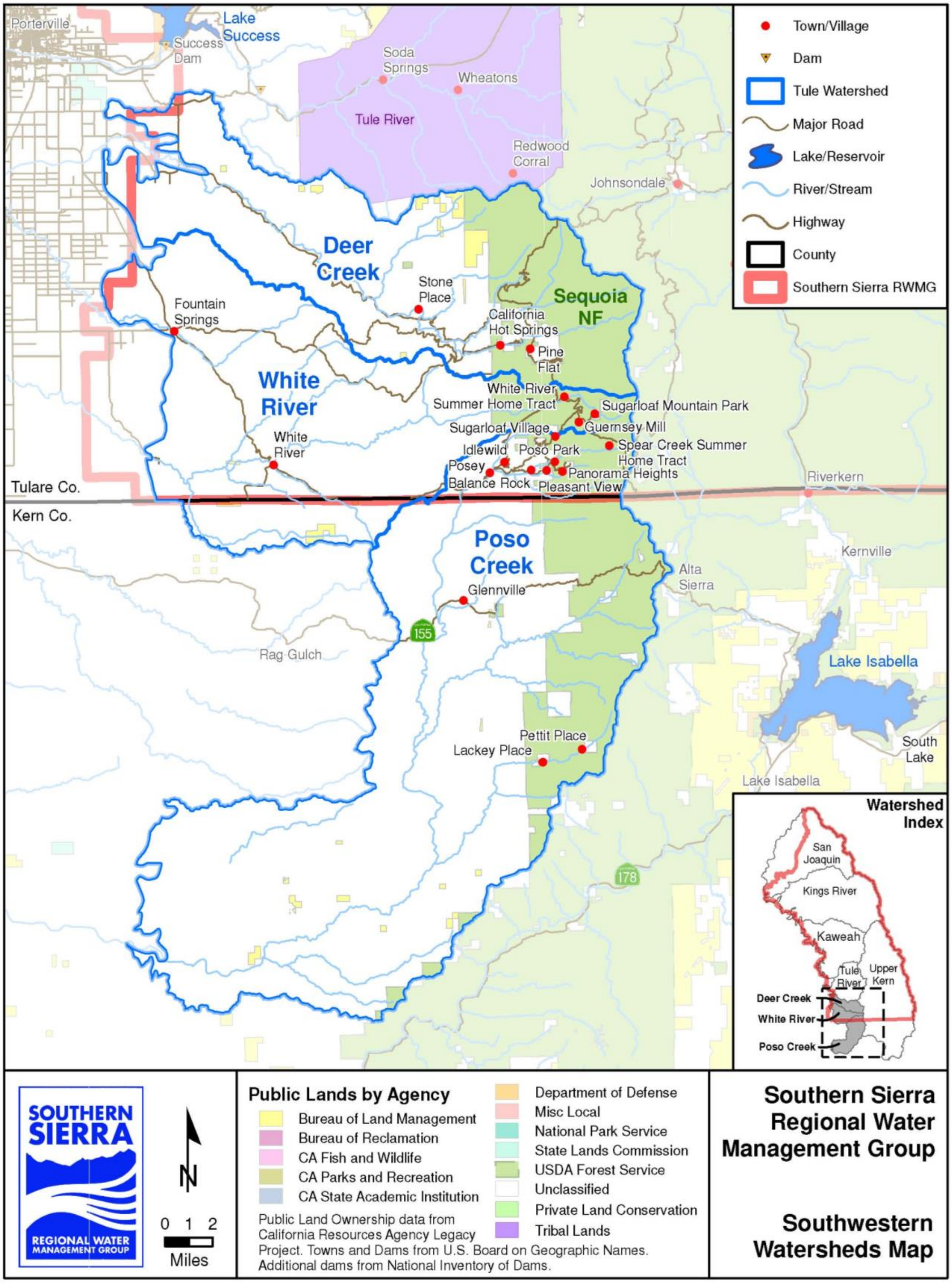


Figure 3-16 Southwestern Watersheds Map: Deer Creek, Poso Creek

3.4.6 Deer Creek Watershed

Geographic Setting

Figure 3.16 shows the Deer Creek watershed. The Deer Creek watershed is located just south of the Tule River watershed and north of the White River watershed. The watershed is fairly small and covers only 125 square miles. The watershed elevation ranges from 560 feet to 8,300 feet msl.

Stakeholders

Stakeholders in this watershed include:

- Tulare County RCD
- PG&E
- Sequoia National Forest
- Deer Creek Hydroelectric

Watershed Stressors

The watershed experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts

Data Collection and Sharing Activities

- Sierra Nevada Conservancy's regional analyses and public symposia
- Tulare County General Plan
- The Southern Sierra Partnership's work on climate change adaptation and ecosystem services
- Forest Service's stream conditions inventory
- Regional Water Quality Control Board's sampling for impaired water bodies

Existing Water Management Planning

- Sequoia National Forest's Forest Management Plan
- Tulare County's General Plan

Ongoing Projects

- Restoration along Deer Creek at the Moure Preserve
- Restoration, invasive species removal, and riparian fencing along Tyler Creek

On-going Research

The National Park Service is conducting a western pond turtle study throughout the southern Sierra, including some private ranches on Deer Creek.

3.4.7 White River Watershed

Geographic Setting

Figure 3.16 shows the White River watershed. The watershed is located just south of the Deer Creek watershed and just north of the Poso Creek watershed. The watershed is fairly small and covers only 135 square miles, with 118 square miles included in the Southern Sierra Region. The watershed elevation ranges from 580 feet to 8,300 feet msl.

Stakeholders
Stakeholders entities in the White River Watershed include:

- Tulare County RCD
- Southern California Edison
- Ditch companies
- US Forest Service

Watershed Stressors
The watershed experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts
Collaboration and public involvement activities include:

- USFS NEPA processes
- BLM – Caliente Management Plan
- Tulare County General Plan
- Sierra Nevada Conservancy's regional analyses and public symposia
- Sequoia National Forest's Forest Management Plan

On-going Research
Data collection and sharing activities include:

- Southern Sierra Partnership's climate change adaptation and ecosystem services work
- Sequoia National Forest's stream condition inventory

3.4.8 Poso Creek Watershed

Geographic Setting
Figure 3-16 shows the Poso Creek watershed. The watershed is located at the southwestern corner of the Southern Sierra RWMG area. Only a small portion of the watershed is in the RWMG area. The total watershed area is 268 square miles with only 20 square miles in the RWMG area. The water flows south into the Kern County IRWMP area.

Stakeholders
Capacity to enhance the water management portfolio is very limited in the Poso Creek Watershed. Stakeholders in this watershed include:

- Kern County RWMG
- Kern County Water Agency
- Tulare County RCD
- Southern California Edison
- Sugarloaf Mutual Water Company

Watershed Stressors
The watershed experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts
Existing water management planning in this watershed includes:

- Sequoia National Forest's Forest Management Plan
- Tulare County General Plan
- Sierra Nevada Conservancy's regional analyses and public symposia

On-going Research
Data collection and sharing activities include:

- Southern Sierra Partnership's climate change adaptation and ecosystem services work
- Sequoia National Forest's stream condition inventory

3.4.9 Upper Kern River Watershed

Geographic Setting
Figure 3-17 illustrates the Upper Kern River watershed in the RWMG area. The Southern Sierra Region includes the upper portion of the Kern River Watershed, with the lower portion falling under the Kern County IRWMP. The watershed is located at the southeastern corner of the Southern Sierra RWMG area. The total watershed area is 2,074 square miles with the upper 1,553 square miles in the RWMG area. The elevations within the RWMG area are 2,800 feet on the western end up to 14,500 feet on the eastern end, which is the crest of the Sierras.

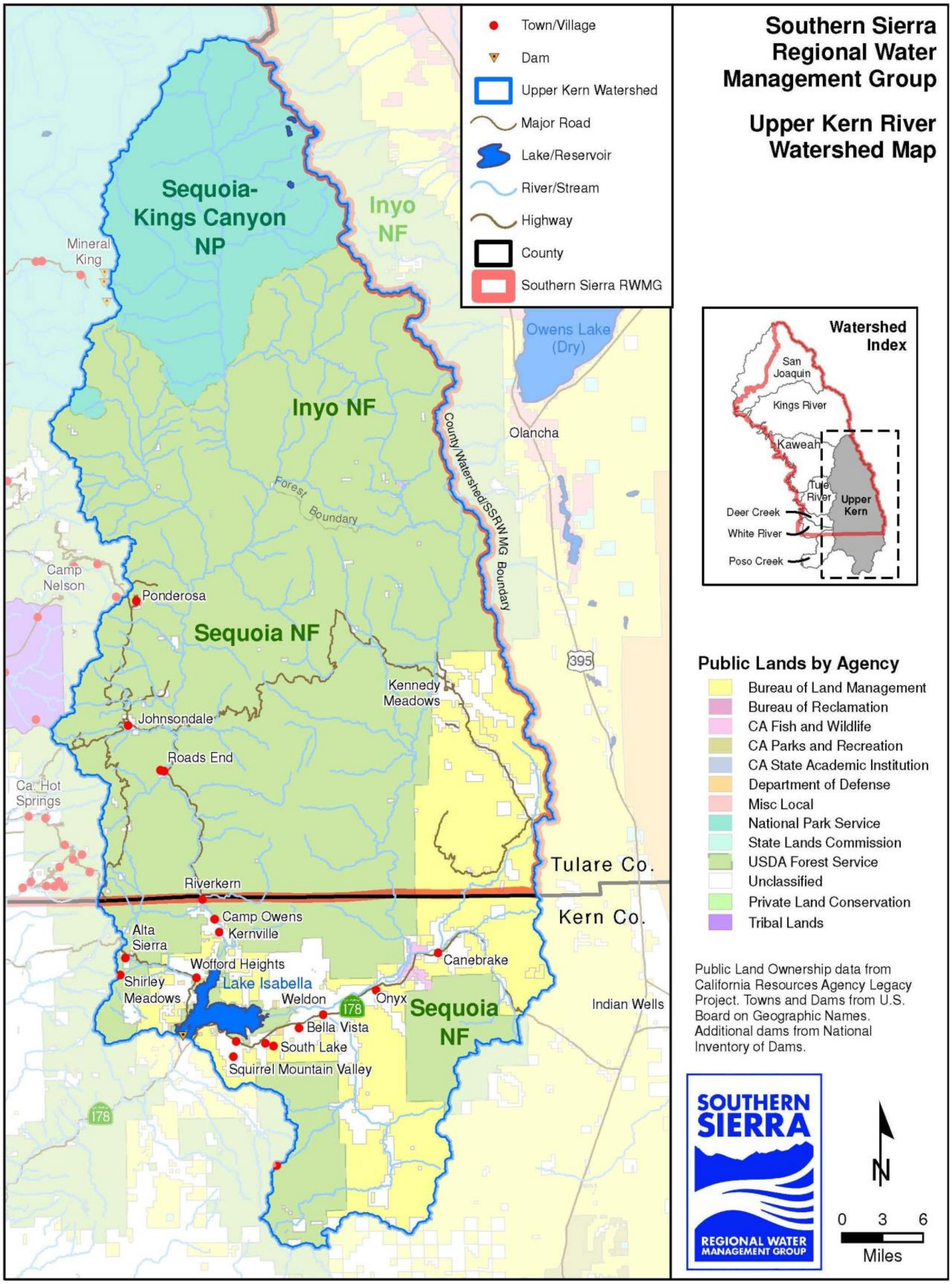


Figure 3-17 Upper Kern River Watershed Map

Stakeholders
Stakeholders in the watershed include:

- US Army Corps of Engineers
- California Audubon Society
- Desert and Mountain Resource Conservation & Development Council (RC&DC) California Department of Fish and Game
- Tehachapi RCD
- PG&E
- Cal Water
- Various ditch companies
- Kern County Water Agency
- Native American Tribes

The Southern Sierra RWMG and the Kern County RWMG collaborate to co-manage the watershed.

Watershed Stressors
The watershed experiences the common stressors listed in Section 3.4.

Public and Private Management Efforts
On-going work for the Kern River Watershed includes:

- Existing water management planning including the Sequoia National Forest's Forest Management Plan, Tulare and Kern Counties General Plans, and California Department of Fish and Wildlife's Fishery Management Plan.
- Sierra Nevada Conservancy's regional analyses and public symposia
- Collaboration/public involvement activities include Kern County's IRWMP effort, Sequoia and Kings Canyon National Parks General Management Plan and other NEPA processes, USFS NEPA processes, BLM – Caliente Management Plan, Tulare County's General Plan, and the Upper Kern Recreation Management Plan.

On-going Research
Data collection and sharing activities include:

- The Southern Sierra Partnership's climate change adaptation and ecosystem services work;
- Sequoia National Forest's stream inventory assessment and watershed yield work;
- Water quality sampling in the Upper Kern Watershed by the Watershed Coordinator.

Studies and research activities include USFS recreation planning, water quality sampling, and fishery management for golden trout.

3.5 - Infrastructure

3.5.1 Major Water Related Infrastructure

The Region includes significant man-made water resource facilities that export water to other (downstream) areas for consumption, recreation and wildlife habitat. The San Joaquin River at Friant Dam is diverted for irrigation via the Friant-Kern Canal south as far as Kern County and a lesser amount is diverted by Madera Irrigation District and Chowchilla Water District through the Madera Canal. Southern California Edison operates Edison, Florence, Huntington, Shaver and Redinger Lakes, and Mammoth Pool Reservoir in the San Joaquin River watershed. PG&E also operates two large, high elevation reservoirs in the Kings River Drainage: Courtwright and Wishon. The US Army Corps of Engineers operates the Pine Flat Dam in the foothills of Fresno County. The Army Corps of Engineers also operates dams on the Kaweah and Tule Rivers in the Southern Sierra Region. Refer to **Appendix C** for a detailed list of these and other dams, reservoirs and their hydroelectric capacity.

3.5.2 Flood Management Infrastructure

Heavy winter rainstorms, spring snowmelt, remnants of Pacific hurricanes, high-intensity non-tropical storms, and landslide dam failures make the potential for flooding a widespread issue in the Southern Sierra Region. During storms, ten to twenty inches of precipitation could fall over a single watershed, creating peak flows in excess of 50,000 cubic feet per second in major rivers. Spring snowmelt causes locally and regionally significant peak flows nearly every year after hot weather. Remnants of Pacific hurricanes could also create flooding through locally intense precipitation events, although they are rarer. High intensity non-tropical storms can also produce large amounts of precipitation. These storms are usually called cloudbursts and cause flash floods overwhelming drainage systems and potentially creating water quality problems. Although they could be typically thought of as summer storms, these could happen any time of the year. The Region does not have typical floodplains like the San Joaquin Valley where vast areas can be inundated with shallow water. However, the intense storms described above can cause significant damage in the vicinity and any brook, stream or river.

Preparing for future floods is an important aspect of regional water management that will need to be further analyzed and mapped. Flooding is expected to be exacerbated by climate change because of greater storm and precipitation intensity, more rain on snow events and more rapid runoff and higher landslide risk.

Landslides are significant sources of flood-related damage and risk in the Southern Sierra. Steep slopes in narrow, incised or broad canyons with narrow bottoms and dramatic elevation gradients characterize the Region. Thus, landslides can form landslide dams, some as high 400 feet tall, blocking a river and impounding significant flood waters. Landslide dams could result in a 200 foot high wall of water, such as the one that came out of the Kern Canyon in Bakersfield during New Year's Day in 1868. Thus, landslide risk in the river corridors is linked to flood risk. Areas with high landslide risk should be mapped and contingency plans constructed for areas with high landslide and flood risk. Prominent areas with great flood potential because of the landslides include the Kings River Watershed (especially in and around the Cedar Grove Area), the Kern River Watershed, and the Kaweah Watershed (especially in and around the town of Three Rivers, where much of the private property is located near the River corridor).

Strategies such as watershed protection, forest restoration, riparian/floodplain restoration and protection, risk analysis and mapping, and contingency planning can help to mitigate flood risk and minimize damage caused by inevitable flooding.

Much of the Sierra Nevada is covered with forests that are dramatically denser than before fire suppression policies led to extinguishing all wildfires over a hundred years ago. Today's denser forests are more prone to experiencing high severity fire in which most trees are killed and forest litter is consumed. This can lead to soil erosion, reduced ability of forests to absorb precipitation, and increased risk of flooding (Sierra Nevada Watershed Ecosystem Enhancement Project website).

A detailed summary of flooding in the Tulare Lake Basin and Southern Sierra watersheds is provided in "*Floods and Droughts in the Tulare Lake Basin*" (Austin, 2012). The report provides details on floods and droughts going back several hundred years, and has an extensive bibliography of other studies and reports. This report is currently being updated.

3.6 - Geology and Hydrogeology

3.6.1 Regional Geology

A brief synopsis of the Southern Sierra geology is included here in order to understand the significant role that the area's geology plays in developing an integrated approach to regional water management. The Southern Sierra Region lies almost entirely within the southern half of the geomorphic province of California known as the Sierra Nevada Province-basically the Serra Nevada Mountains and foothills from south of Bakersfield to north of Chico. Generally, the Sierra Nevada Province is bounded on the east by a series of north to northwestward trending normal faults collectively known as the eastern Sierra Fault system which are the most westward faults in the extensional Basin and Range geomorphic province, on the west by the alluvial deposits of the San Joaquin/Sacramento Valley, on the north by the southern extension of the Cascade Range Province (Modoc Plateau), and to the south by the Garlock Fault which marks northern boundary of the Mojave Dessert geomorphic province.

Geologically recent, i.e., late Cenozoic, uplift along the eastern Sierra Fault system accounts for the steepness of the eastern front of the Sierra Nevada Mountains. Uplift along the eastern Sierra fault system has been accompanied by westward tilting of the Sierran block which has lead to the gently sloping western slope of the Sierra Nevada Mountains. This period of mountain building, known as an orogeny, is still happening today. Tectonic uplift and the subsequent mountain building was greater in the southern portion of the Sierra Nevada Mountains, and in the Southern Sierra Region has lead to the formation of the state's highest mountain peak, namely Mt. Whitney and 10 other mountain peaks that reach elevations above 14,000 ft (Harden, 2004). Multiple periods of alpine glaciations, the most recent being between 20,000 to 160,000 years ago, have carved the high Sierra into the spectacular landscape seen today. This fortunate location of California's highest mountains and the high average elevation of the crest, are the main reason that the major rivers in the Southern Sierra have relatively high annual discharge.

While the Sierra Nevada Mountains are relatively young, the rocks from which they are dominantly composed are much older. According to the 2010 version of the Geologic Map of California there are 24 different rock types mapped in the Southern Sierra Region. These rocks types fall into 4 broad categories including granitic rocks, sedimentary rocks and deposits, volcanic rocks, and metamorphic rocks. For more detailed information on the geology of the area the reader is referred to the 2010 version of the Geologic Map of California (DWR, 2010). The descriptions below are meant to provide a general understanding of the type and distribution of the various rock types in the Southern Sierra (**Figure 3-18**).

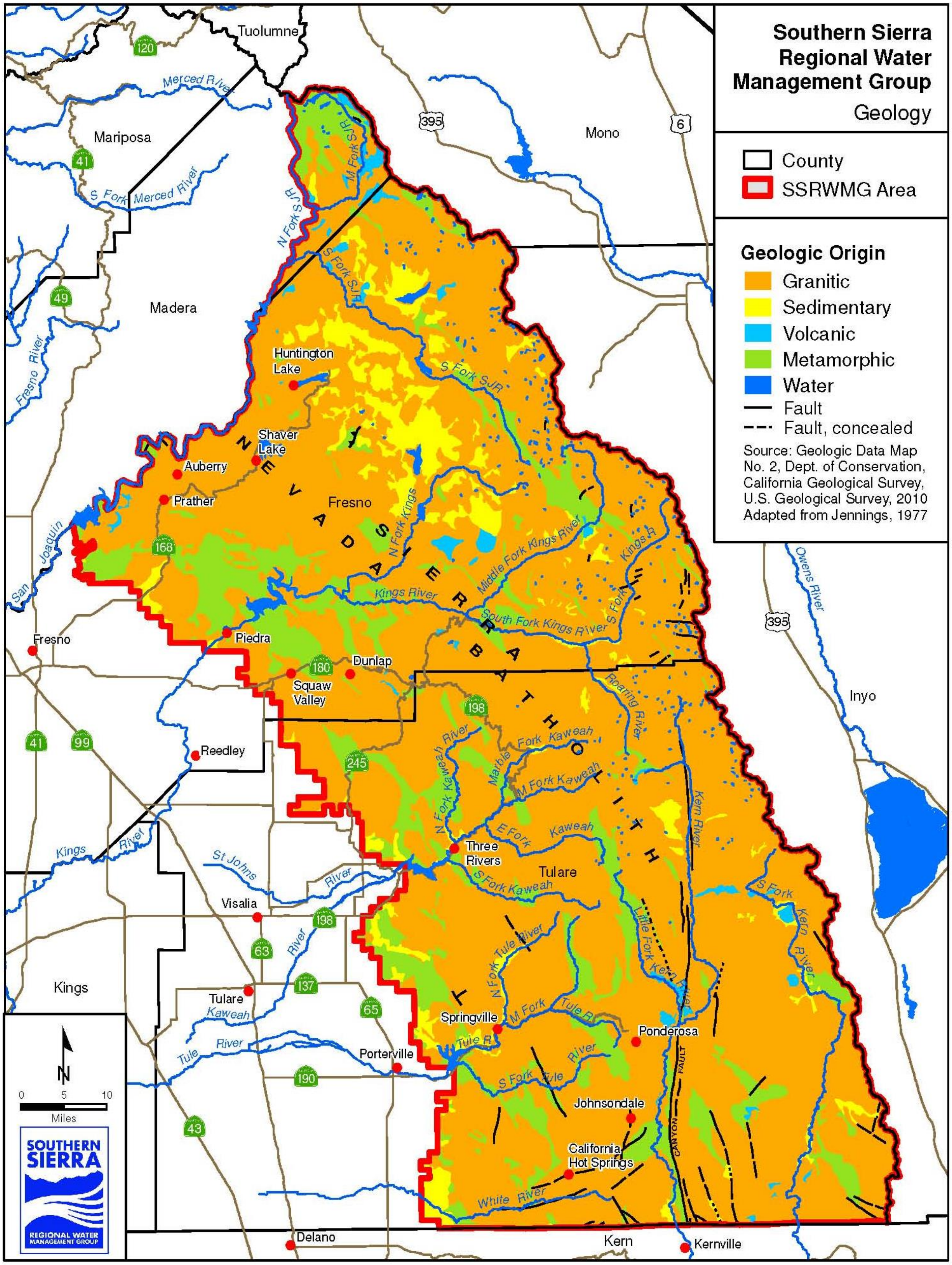


Figure 3-18 Regional Geology

Granitic Rocks
Granitic rocks are by far the most abundant rocks and underlay about 79 percent of the Region. The majority of the granitic rocks are Mesozoic (80 to 210 Ma) in age and consist of granite, quartz monzonite, and quartz diorite, with considerably lesser amounts of darker gabbro and diorites.

Sedimentary Rocks and Deposits
Sedimentary rocks and deposits underlay about 6 percent of the Southern Sierra Region. These rocks are relatively young in age dating from the Miocene to Holocene (about 34 Ma to recent). The older Miocene age rocks consist of moderately to well consolidated marine and non-marine sandstone, shale, siltstone, conglomerate and breccia. The younger, Pliocene through Holocene, sediments consists of loosely consolidated to unconsolidated alluvial, lake, and terrace deposits. Also included in the younger deposits are glacial till and moraines found at high elevations.

Volcanic Rocks
Volcanic rocks underlay slightly more than 1 percent of the area. These rocks are Tertiary to Holocene in age making them relatively young. These rocks consist of volcanic flow deposits, volcanic mudflow deposits, and pyroclastic deposits.

Metamorphic Rocks
Metamorphic rocks underlay about 14 percent of the Southern Sierra Region. This group has the oldest rocks in the area with some dating to pre-Cambrian times (older than 543 mya). Rocks in this group form roof pendants that are the remnants of the terrain intruded by the Sierra Nevada batholiths. While there are some rocks in this group described as non metamorphic, it is likely that most of rocks of this age have been metamorphosed to a certain degree. The majority of rocks in this group include metamorphic marine sedimentary and meta-sedimentary rocks, ultramafic rocks-mostly serpentine, hornfels, shale, limestone, dolomite, sandstone, slate, phylite, gneiss, schist, and quartzite.

Top Soils
The Natural Resources Conservation Service (NRCS) is the main government agency responsible for preparing soil surveys. NRCS soils data coverage exists along the western foothills and in the Kennedy Meadows area, an area covering approximately 25 percent of the Region. The higher elevations of the Region have not been mapped with the exception of some soils maps done for specific projects including the Marble Fork and Middle Fork drainages of the Kaweah River, and from Silver City to the Mineral King valley. However, soils across all of the National Park's acreage are scheduled to be mapped in the near future by the NRCS.

3.6.2 Hydrogeologic Setting

The RWMG recognizes that within this Region, groundwater resources are scarce and little is known about the long-term reliability of this source, as a majority of the groundwater is held in fractures of the bedrock. Bedrock fractures are hydrologically influenced by local recharge and regional infiltration. Both are poorly understood. Arguably the long-term reliability of groundwater in the area is directly linked to the amount of local precipitation. The aquifer in this area is, for all intents, entirely a fractured bedrock aquifer, and only a small part of the area is within a DWR defined Groundwater Basin (see **Figure 3-19**). Fractured bedrock aquifers are characterized by very low storativity (ability to retain) and highly variable transmissivity (ability to allow flow) - two key aquifer parameters. Fractured rock aquifers are dual porosity systems with the majority of the fractured rock mass having essentially no pore space which indicates that most of the water is contained within fractures. Compared to the same volume of aquifer in typical valley alluvial sediments, the fractured bedrock aquifer in the Region has a much lower storage capacity. Due to the highly variable nature of the void spaces within fractured rock aquifers, wells drawing from them tend to have less capacity and less reliability than wells drawing from alluvial aquifers (Draft California Water Plan Update, 2013). The ability of the aquifer to transmit water is limited to how well fractures or sets of fractures are interconnected. This also leads to highly variable discharge capacity and sustainability of wells completed in fractured bedrock with wells tapping interconnected fractures typically being more reliable. This generally indicates that wells selected through an evaluation of fracture patterns are more likely to produce water than those selected by other means. Recharge of the fractures is primarily directly from snow melt and direct precipitation, thus recharge of water consumptively used annually is directly linked to the hydrologic cycle. Wetter years will cause significant increases in water levels, while dry years will not have as pronounced an effect.

Specific yield is the quantity of water which a unit volume of aquifer, after being saturated, will yield by gravity. In other words it is a measure of the water available to wells. Specific yields in the Valley range from about 5 to 15%. In contrast, the Department of Water Resources publication "*Water Facts – Ground Water in Fractured Hard Rock*" states that the specific yield of fractured hard rock is estimated to be less than two percent. This emphasizes the groundwater challenges in the mountain areas with aquifers that have very limited ability to store water.

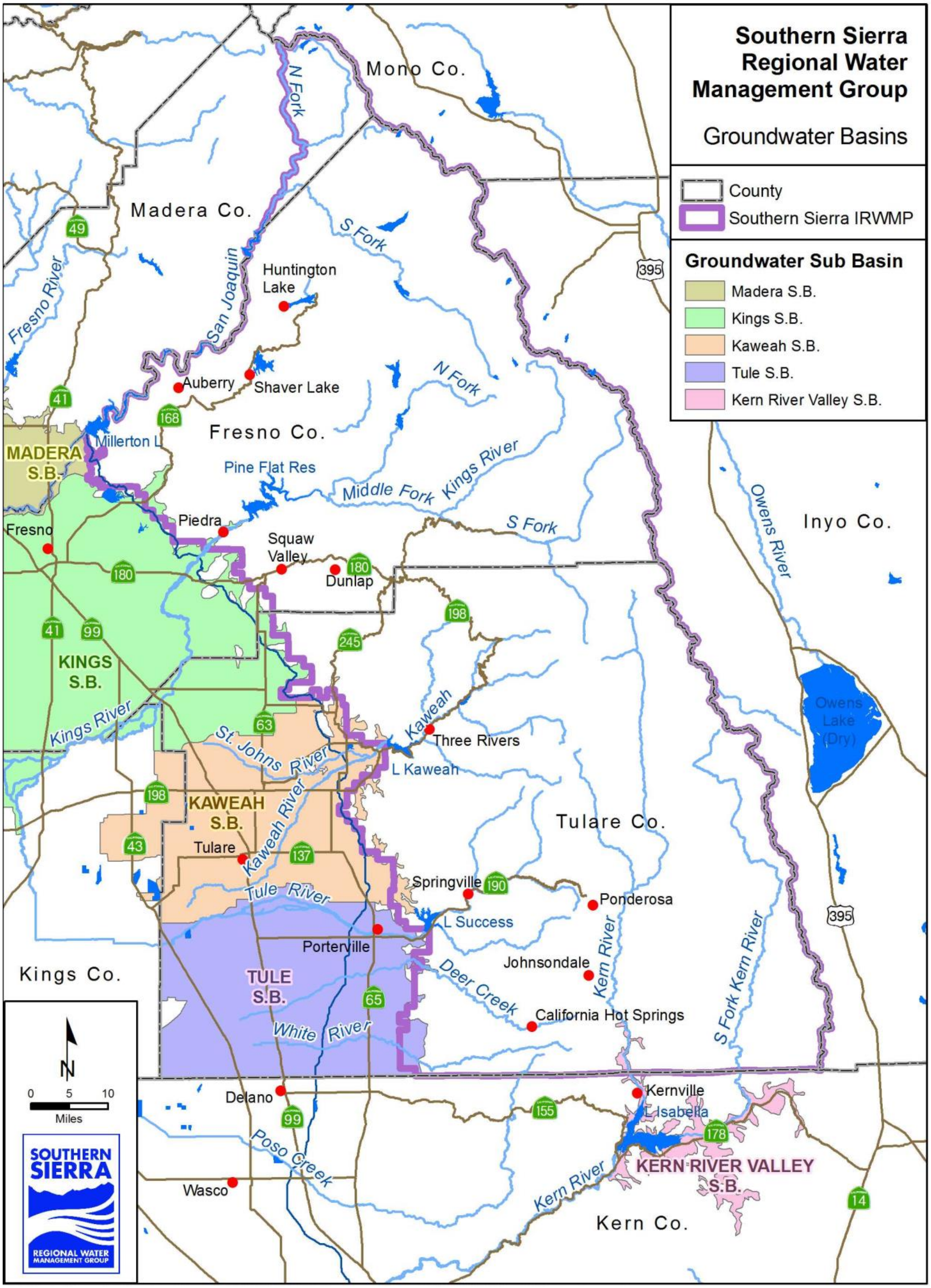


Figure 3-19 Groundwater Basins

3.6.3 Groundwater Quantity

The quantity of groundwater stored in the Region's fractured bedrock aquifer is unknown at this time. However, groundwater stored in the fractures constitutes the majority of water stored in the subsurface in the Region. Arguably there is groundwater stored in the thin veneer of alluvium associated with the larger streams and rivers in the area, but compared to the massive size of the fractured bedrock aquifer the amount of water stored in the alluvial material is likely minimal. The minimal amount of alluvial material and its localized distribution in the Region's valleys also poses problems for direct or intentional recharge of the aquifer. Any water that is able to be recharged in these areas would benefit a small localized area and likely not provide a significant benefit to the larger Region. Also, problematic for intentional recharge is that given the small amount of alluvial material available for recharge and storage of recharged water, only small amounts of water could be recharged in a given area.

Some data was collected and analyzed for the Three Rivers Water Supply Study (see **Appendix D**) performed by DWR in 2014. More details on this study can be found in **Section 3.9 – Water Supply and Demand**.

There are limited opportunities for water resource movement across landscapes due to the deeply incised canyons of the upper watersheds. This limits regional movement of groundwater. If groundwater replenishment is abundant it may surface in springs, where fractures intersect the ground surface, due to the limited storage and ability to move laterally.

3.7 - Surface Water Resources

The Southern Sierra Region is home to a significant portion of the Sierra snowpack. The forested watersheds of the Sierra Nevada are the origin of more than 60% of the state's developed water supply. Water is first stored in that snowpack and later captured in reservoirs and aquifers that provide water for domestic, agricultural and environmental use.

Water is the number one resource exported from the Sierra Nevada Mountains (CA Water Plan Update, 2014). A few water purveyors, such as Springville Public Utility District and Three Rivers Community Services District and some local ditch companies rely primarily upon surface water that is delivered by a combination of open ditches, flumes, and pipes. Local water agencies continue to evaluate improved methods to conserve surface water while preserving the rural and historic characteristics of their raw water delivery systems.

Extensive end user water conservation efforts have also been implemented over the years.

Additionally, there are limited opportunities for new surface water developments due to the number of existing facilities and senior water rights holders. However, with limited groundwater supplies, and vast surface water resources, fully utilizing existing surface water rights is an important strategy for the Southern Sierra Region.

3.8 - Other Water Resources

Reclaimed water is not currently used in the Region, but represents a potential water source, especially in the larger communities that face groundwater supply problems. Most areas do not have central water treatment facilities and use individual or communal septic systems. A few treatment plants are found in the Region, but the water is not treated to the level needed for water reclamation. Advanced treatment and use of the water for non-potable demands could help reduce stresses on local groundwater supplies.

Water is generally not imported to the Region due to the topographical relief and the difficulty conveying it against gravity. Desalinated water is not used in the Region either. The Region is over 100 miles from the ocean and could not feasibly use desalinated ocean water. In addition, there are few groundwater resources that have high salinity, and treating them would be less economical then installing new wells at different depths to acquire better quality water.

3.9 - Water Supply and Demand

Historical Water Production

Agricultural water use in the Southern Sierra Region consists primarily of stockwater ponds, irrigated pastures and limited areas of citrus and other tree crops. Very little area within each drainage is dedicated to irrigated agriculture. The use of water for agricultural/livestock purposes in the Region has not changed much in the last 100 years. It is very difficult to determine the historical agriculture use and production because there are very few records. The use was spread over great area and left little evidence in the landscape.

Urban and rural nonagricultural water use in the Region consists of small towns and individual landowners who irrigate lawns, landscaping and use water for urban consumption. Urban and rural water use has increased over the last 100 years because of population growth, associated landscaping, and water-intensive appliances and facilities. Water is used by the Regions approximately 30,000 permanent residents and 1.6 million annual visitors, but detailed estimates are not available.

The Region is supported by a small number of public districts, including Three Rivers Community Services District, Springville Public Utilities District, several small water associations, many private ditch companies and mutual water companies, two resource conservation districts, and two resource conservation and development councils.

Twenty-year Groundwater Supply and Demand

Increasing populations in the new and existing towns and increasing in tourism mean greater demand for water resources. Because most towns and residents use groundwater, it is important to understand the sustainable use rate of the aquifers in each individual location.

Residents are pumping groundwater largely from fractured rock aquifers with unknown quantities. Fractured bedrock aquifers have limited supplies, replenishment is unpredictable, and little is known about the nature of the supply. As water demand increases with population growth, supply to meet this increased demand will become difficult to accommodate. The Region's water supports over 1.6 million visitors per year in addition to over thirty thousand permanent residents in the Region. Visitors are a great economic resource to the Region, but add significant seasonal demands to the local groundwater supply that must also support the Region's permanent residents. Very little groundwater information is available and accessible for resource planning in the Region. The Region has no incorporated cities, only a few small water treatment plants, and the majority of the Region utilizes wells and septic tanks. County general plans call for development in foothill and mountain communities; however, sustainable use rates have yet to be established for existing communities who rely almost exclusively on fractured-rock aquifers.

In summary, the long-term (20-year) groundwater supply and demands are not known and regional and local studies are needed to provide reasonable estimates.

Twenty-year Surface Water Supply and Demand

Surface water usage in the Region is limited since most surface water rights are held in the San Joaquin Valley, but some landowners and communities do use limited quantities of surface water. According to the State of California Water Resources Control Board, Water Right Order 98-08.1, Declaration of Fully Appropriated Stream Systems, the following rivers/streams within the Region are fully appropriated: Kings, Tule, San Joaquin, Middle Fork Kings, South Fork Kings, North Fork Kern, Poso Creek, and Kern, main and South Fork. Because the Region's surface waters are fully appropriated, additional supplies for local residents and downstream users will only come from water right holders who are willing to negotiate water leases or sell water rights.

Water demand in the Southern Sierra Region is therefore a concern because, with all the rivers fully appropriated, additional demand will potentially create conflicts or shortages. Due to population growth and potential climate change, the 20-year demand for surface and groundwater will increase and supplies may decrease.

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[1] State of California Water Resources Control Board. (1998). *Order Revising Declaration of Fully Appropriated Stream Systems* (No. WR 98-08).

Three Rivers Water Supply Study

The California Department of Water Resources performed a water supply study on the Three Rivers Community at the request of the RWMG. The work was performed through DWR's Technical Assistance Program. A presentation summarizing the study can be found in **Appendix D**. The study concluded that most of the local parcels are next to Kaweah Riover or its tributaries and benefit from local recharge. However, most of the recharge occurs in the upper watershed areas. Almost all water is provided from groundwater. One third of the wells are less than 100 feet deep, and are therefore very susceptible to extended droughts. This study could serve as a model for evaluating other communities and watersheds in the region.

Water Budget

Little is known about the regional water budget due to limited monitoring and the difficulty in monitoring and predicting water supplies in hard rock aquifers. Similarly, little is known about water budgets in most local areas. However, in general, most of the water used in the Region is groundwater, since most surface water rights are held in the San Joaquin Valley. The quantity of groundwater available on a regional or local scale is not well known. Development of a regional and local water budgets is a high priority for the Region.

3.10 - Reducing Dependence on Delta Water Supply

This Region does not receive water from the Sacramento-San Joaquin Delta. Some waters in the Region (i.e. San Joaquin River and Kings River watersheds) do ultimately flow to the Delta. However, it is uncommon for Kings River water to reach the Delta; Kings River water has reached the Delta in perhaps 2 or 3 out of the past ten years. Therefore, certain watershed management actions could help improve both water supply and water quality in the Delta, such as forest-fire interval restoration through forest thinning, and erosion reduction.

3.11 - Water Quality

The Southern Sierra RWMG has identified several issues that relate to water quality including:

- Several areas in the Region have drinking water that does not meet California and national standards;
- Some water treatment systems do not meet standards, or have very limited capacity;
- Sediment buildup in storage facilities;
- Agricultural runoff;
- Post-fire sediment;
- Groundwater pollution;
- Septic systems are not updated, serviced or monitored to meet standards;
- Increasing atmospheric nitrogen deposition has potential to cause water nitrogen increases and acidification;
- Rising stream water temperature;

- Toxic algae bloom in lakes and waterways; and
- Water quality impacts from recreation.

These water quality issues are a primary concern for the RWMG and are considered a high priority.

In 2014 the California Legislature signed into law Assembly Bill No. 1249 (AB1249), "an act to amend Section 10541 of, and to add Sections 10544.5 and 10545 to, the Water Code, relating to water quality". A component of AB1249 requires IRWMPs to address nitrate, arsenic, perchlorate, or hexavalent chromium (Cr6) contamination within the IRWM boundary. Discussion must include the location and extent of any contamination in the region and the impacts caused by any contamination to communities within the region. Assembly Bill 1249 also requires that, to the extent that nitrate, arsenic, perchlorate, or hexavalent chromium contaminants occur, the IRWMP shall describe any actions currently being undertaken to address the contamination, and any additional actions that are needed to address the contamination. This update to the water quality section was undertaken to comply with this regulation, and as such focuses on these four constituents. Additional information is included when it helps provide a more comprehensive understanding of overall water quality.

Numerous resources were consulted during the compilation of this water quality update. Among the most informative was *Groundwater-Quality Data for the Sierra Nevada Study Unit, 2008: Results from the California GAMA Program, USGS Data Series 534 (*Shelton et al., 2010)*. A natural resource condition assessment for Sequoia and Kings Canyon National Parks, Appendix 6 – Water Quality* (Day and Conklin, 2013), also provided useful information. A study by the California Department of Water Resources titled *Geology, Hydrology, Quality of Water, and water supply of the Three Rivers area, California* provided relevant information for the Three Rivers area. Minimal information is available from water quality reports for public water supplies, as they are not wide-spread in the sparsely populated southern Sierra Nevada.

<u>Surface Water Quality</u>
Surface waters originating in the Southern Sierra Region are generally of high quality and flow to the Tulare Lake and San Joaquin River Hydrologic Regions of the southern San Joaquin Valley. In fact, water is the single largest export of the SSIRWMP Region. However, several water bodies are listed under the Clean Water Act as impaired (see **Table 3-1** below). Humans and domesticated livestock have impacted the water supplies with nitrates and other compounds that limit the usefulness of some surface waters and groundwater. These effects have a disproportionate impact on disadvantaged communities (DACs) that do not have the capital resources necessary to drill new wells, treat water, improve wastewater systems, or provide other support to important water projects. For additional discussion concerning DAC refer to the **Section 3.14 - Social/ Cultural Makeup and Disadvantaged Communities.**

As previously mentioned several water bodies within the Region are impaired, and with funding the RWMG could take measures to help restore the water quality. The current impaired water bodies, which include creeks, rivers and lakes, are listed in **Table 3-1**.

Table 3-1 Impaired Water Bodies in the Southern Sierra Region

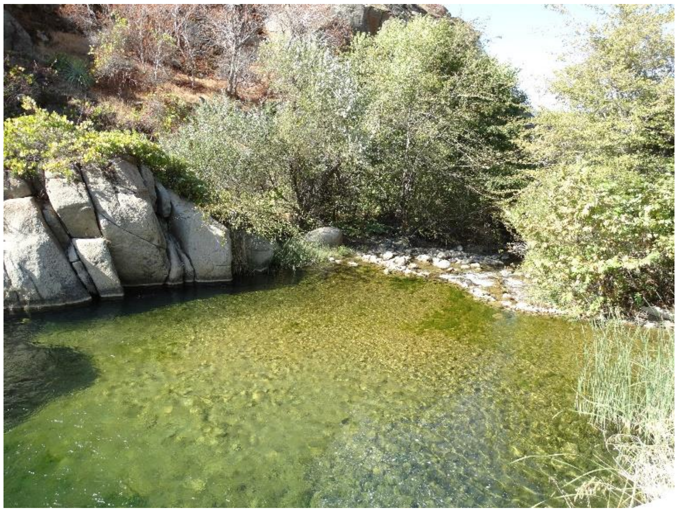
Waterbody Segment	Pollutant
Deer Creek (Tulare County)	High pH
	Unknown Toxicity
Hume Lake*	Oxygen, Dissolved
Isabella Lake	Oxygen, Dissolved
	pH
Kaweah Lake	Mercury
Kaweah River	pH
	Unknown Toxicity
Kings River	Unknown Toxicity
Millerton Lake	Mercury
Poso Slough	Sediment Toxicity
Success Lake	pH

These rivers and water bodies lie within or immediately adjacent to the SSIRWM Region boundaries.

The State and Regional Water Boards assess California's surface waters every two years to determine if they contain pollutants at levels that exceed protective water quality standards. Water bodies that exceed protective water quality standards are placed on the State's 303(d) List. For several reaches of the rivers, the source of the contamination is unknown, or the type of contamination is unknown. In California this determination is governed by the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. USEPA must approve the 303(d) List before it is considered final.

Placement of a water body on the 303(d) List initiates the development of a Total Maximum Daily Load (TMDL). Deer Creek's listing, for example, prompts the Regional Water Quality Control Board to seek improvements along this creek in order to remove the water body from the list.

Of the constituents identified in AB1249, nitrate contamination is a concern in surface waters. In the upper watersheds of the Southern Sierra Region, aerially deposited nitrates from automobile exhaust and agriculture are being studied for their impacts on aquatic and terrestrial ecosystems (Day & Conklin, 2013; Heard & Sickman, 2016; Sickman et al., 2003). Even at concentrations that have no impact on human health, anthropogenically added nitrogen and nitrates can have major impacts on the sensitive



ecosystems of the high Sierra Nevada (Heard & Sickman, 2016; Sickman et al., 2003). Little surface water quality data was found for the area, especially for the four constituents requiring evaluation under AB 1249. No evidence was found that any of these four constituents are problematic in surface waters.

Wildfire is a reoccurring threat to surface water quality in the Southern Sierra Region. For several years following wildfire, higher nutrient levels, dissolved organic carbon and turbidity levels may be observed in streamflow. When wildfires are followed by large storm events, sediment production and debris flows can also dramatically increase. This sediment can become trapped in downstream reservoirs, decreasing reservoir capacity and longevity. Due to climate change and higher fuel loads across the Region, large severe wildfires, such as the 2015 Rough Fire in the Kings River watershed, are expected to become more frequent. Mitigating of the effects of wildfire will be increasingly important for preserving surface water quality.

Rising air temperature and subsequent warming of water bodies in lakes and streams is another water quality concern for the region. Water temperatures are rising and will continue to do so in the future (Ficklin et al.,2013; Null et al., 2013; Isaak et al., 2017), causing further loss of cold-water habitat and algae bloom (Derlet et al., 2009).

Groundwater Quality

The majority of domestic, commercial and agricultural water demands in the region are met with groundwater. Therefore, understanding the occurrence and distribution of chemical constituents of significance to water quality is important for the long-term management and protection of groundwater resources (Shelton et al., 2010). The natural chemistry of water from springs in the fractured aquifers within the Region is mixed-cation bicarbonate type (Feth et al, 1964). In a recent study completed by the USGS as part of the Groundwater Ambient Monitoring & Assessment Program (GAMA), the authors (Shelton et al., 2010) indicate that "*All organic and most inorganic constituents that were detected in groundwater samples from the 30 primary grid wells in the Sierra Nevada study unit were detected at concentrations less than drinking water benchmarks*." Even though they are detected at levels not considered to be a threat to human health there are some naturally occurring mineral constituents present in many hard-rock water supply wells. These include arsenic, uranium, radio nuclei, and others.

The Department of Water Resources (DWR) in technical support of the Southern Sierra Region conducted an initial hydrologic evaluation of the Three Rivers areas as a pilot study for possible future efforts in other watersheds. The results of this study are discussed in the Inorganic Constituents section of this chapter, the Technical Resources Chapter (Chapter 12), and **Appendix D.** Leaking underground storage sites (LUSTs), while less common than in the densely developed valley floor, can cause water quality problems associated with breakdown products of gasoline and diesel, including fuel oxygenates. These contaminants tend to not break down in a fractured rock aquifer and will preferentially be transported through fractures. The complications of this geological environment pose significant challenges to remediation of groundwater at these sites.

Organic Constituents

Volatile organic compounds (VOC) were detected in groundwater samples
in the Region, but at concentrations less than their health-based benchmarks. Compounds detected within the Region's groundwater are methyl-tert-butyl ether, chloroform, dichloro-ethane, and carbon disulfide (Shelton et al., 2010). Pesticides detected in groundwater in the region include simazine, atrazine, deethyl-atrazine, and 3,4-dichloro-aniline. All were detected in concentrations well below the health-based benchmarks for groundwater (Shelton et al., 2010). Since intense cultivation/row or tree crop agricultural activities are not typically undertaken within the region direct application of these constituents is not a major concern, but they are carried in on the wind from agricultural application within the San Joaquin Valley (Heard and Sickman, 2016).

Inorganic Constituents

The four constituents identified in Assembly Bill No. 1249 (nitrate, arsenic, perchlorate, and hexavalent chromium) are all present within the region, usually in concentrations not considered to be hazardous for human health. Each is discussed in detail below. Other constituents of concern (COC's) regulated by the State Water Resources Control Board, Division of Drinking Water (DDW) are also present throughout the Region. Radioactive constituents (primarily Gross-Alpha and Uranium) are the greater portion of the remaining COCs typically found in groundwater in fractured granitic rocks. Other COCs in groundwater in the Region with secondary California maximum contaminant levels (MCLs) are iron, manganese, and pH. In some geologic terrains sodium and chloride can lead to elevated Total Dissolved Solids (TSD). For more details on other constituents the reader is referred to Shelton et al.(2010).

Nitrate

Nitrate is commonly present throughout the region's groundwater in concentrations not recognized as a threat to human health (Shelton et al., 2010). Occasional exceedances of the California MCL have been reported. The DWR hydrologic investigation found that two water systems in the Three Rivers area had periodic exceedances of nitrate from 1974 to 2014. Two sites of high nitrate were identified in Day and Conklin (2013) within the Region's national parks. One site in Kings Canyon National Park was historically subjected to unrestricted grazing. The other site, on the border of Sequoia National Park, is at the location of a parking lot and public toilets. In the water quality reports of public water supplies for communities surrounding Lake Isabella from 2014-2016, nitrate was commonly detected within drinking water supplies but was not reported in amounts exceeding the MCL.

Anthropogenic sources of nitrate in the region are failing or failed septic tanks, improperly managed rangeland, and improperly sealed wells. Once nitrate enters groundwater there are minimal denitrifying bacteria to break it down. It is highly mobile and can spread through the fractured rock media, potentially causing contamination in wells distant from the source. Nitrate is soluble in water, can easily leach through soil, and can persist in shallow groundwater for decades (Nolan, 2001).

The impacts caused by nitrate contamination in the groundwater supply include acute toxicity resulting from the natural conversion of nitrate to nitrite which inhibits the oxygen-carrying abilities of the blood, colloquially referred to as “bluebaby syndrome”. These impacts are most often observed in the very young or elderly segments of the population. None of these symptoms have been reported within the Region in the information consulted for this study.

Methods for mitigating nitrate in drinking water supplies include blending or treatment techniques. Blending involves combining a water supply without nitrate contamination and a water supply with nitrate contamination to achieve a blended water supply that meets drinking water standards. Treating water for nitrate is an expensive and complicated process, and generally not implemented in the region.

Arsenic

Concentrations of arsenic well below the California MCL were detected in most wells in the GAMA study. Of wells containing arsenic, levels exceeding the MCL-US benchmark were detected in three wells throughout the Region (Shelton et al., 2010). Two of the water systems in the DWR hydrologic investigation of Three Rivers had exceedances of the MCL-US benchmark for arsenic during the period between 1974 and 2014. In the water quality reports of public water supplies for communities surrounding Lake Isabella from 2014-2016, arsenic is often present within water systems but in levels compliant with the MCL.

Arsenic is a naturally occurring substance within the crust, and commonly makes its way into groundwater through erosion. It is also a component in some pesticides and herbicides. The impacts caused by arsenic contamination in the groundwater supply include acute and chronic toxicity that can result in damage to the liver and kidney or blood hemoglobin decline. Long-term consumption of drinking water with arsenic contamination is carcinogenic. None of these symptoms have been reported within the Region in the information consulted for this study.

Perchlorate

Perchlorate was detected in samples from ten of the wells in the Region during the GAMA study. Detected concentrations ranged from 0.11 to 1.20 µg/L, all less than the MCL-CA of 6 µg/L, and most concentrations were below 1/10 of the benchmark. These detections were primarily in wells drawing from granitic and metamorphic rocks (Shelton et al., 2010).

Perchlorate can occur naturally in small amounts, though the process via which it is naturally formed is poorly understood. Most perchlorate found in drinking water is the result of anthropogenic activities. It is used primarily as a component of rocket fuel for its oxidizing properties. The impacts caused by perchlorate contamination in the groundwater supply include eye and skin irritation, coughing, nausea, vomiting and diarrhea. None of these symptoms have been reported within the Region in the information consulted for this study.

Hexavalent Chromium

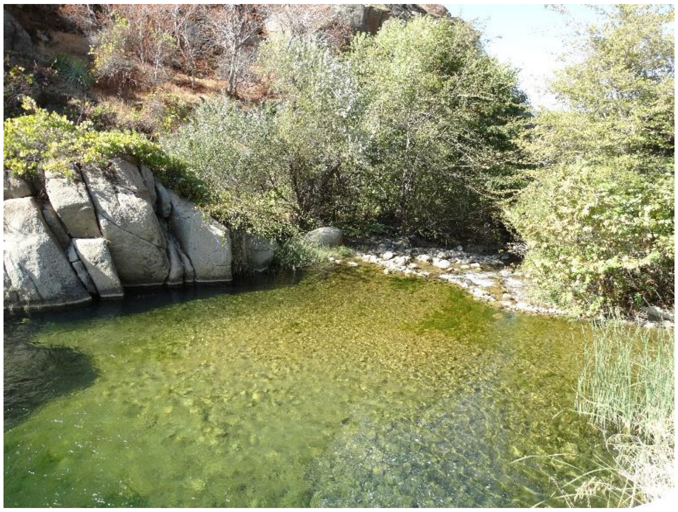
Cr6 is mentioned as a contaminant in the water quality reports of public water supplies for communities surrounding Lake Isabella from 2014-2016. It appears in several of the water supplies during multiple years, always in levels compliant with the MCL. It is not mentioned as a contaminant found anywhere else within the Region in any other source.

Most hexavalent chromium found in groundwater is produced anthropogenically by an industrial process. Essentially all chromium ore is processed via Cr6. It is also used during the production of textile dyes, wood preservation, and anti-corrosion products. Hexavalent chromium can be formed during a natural process whereby Cr(III) within chromite that is associated with birnessite (a Mn mineral) is oxidized (Oze et al. 2007).

The impacts caused by Cr6 contamination in the groundwater supply include liver and kidney damage, internal hemorrhaging, respiratory damage, dermatitis, and ulcers on the skin at high concentrations. These symptoms have not been reported within the Region in the information consulted for this study.

Water Quality Protection and Improvement Needs

The RWMG has set a primary goal of improving water quality to help ensure drinking water meets California health standards, and natural water bodies can support livestock and native wildlife. A variety of strategies to protect and improve water quality are elucidated in Chapter 5 – Goals and Objectives and Chapter 6 – Resource Management Strategies.



The Region's water resources serve many functions including: maintaining vast and significant mountain and foothill ecosystems, groundwater recharge for the Tulare Basin, surface water for the Delta, human use and consumption, irrigation water for ranchers and valley-floor agriculture, and important recreational uses. In summary, the Region provides source waters for many uses and many geographical areas, and protecting water quality and quantity is very important.

3.12 - Environmental Issues

3.12.1 Environmental Resources

The Southern Sierra Region is California's fourth largest IRWM Region, covering approximately 6,195 square miles (3,964,800 acres). This Region is of great importance to the overall well-being of the state, not only for its natural resources and abundant and unique recreational opportunities, but also as a main source of water for California's thriving agriculture, energy production, wildlife species, habitats, and corridors, and domestic water needs.

The Southern Sierra Nevada includes some of the most iconic natural resources and complex socioeconomic landscapes in the United States. Steep canyons, cut by powerful rivers bisect and transect high mountains and foothills. This, together with giant forests and woodlands which clothe the slopes causes a strong biophysical gradient. Over the span of about 40 miles, ecosystems range from foothill woodlands at about 500 feet elevation through montane chaparral and forests, and into alpine communities above 14,000 feet. The Southern Sierra Nevada Mountains are highly valued for their native biodiversity, recreational opportunities, and as a main source of water for California agriculture, energy generation, and domestic needs. The SSIRWM is relatively unfragmented by development and its headwaters and middle elevation watersheds are almost entirely administered for public benefits. The Region is also the largest contiguous area within the Sierra Nevada suited for the management of wildland fire for multiple resource benefits. The Region contains the largest contiguous wilderness area in California.

Strong bio-physical gradients characterize the Region. In this portion of the Sierra Nevada, the proportion of the land in middle elevations is small, compared to regions further north. The lower elevations in the foothills are steep, with incised canyons. These lower elevation communities rise rapidly in elevation to chaparral, mixed conifer and true fir communities. These communities form relatively narrow bands in this portion of the Sierra, while the foothill and alpine communities include more acreage relative to the other communities listed above and other regions in the Sierra.

Extensive hydroelectric facilities characterize the hydrologic regime in the San Joaquin River watershed, while single, large facilities and numerous small structures and diversions impound water in the Kings, Kaweah, Tule and Kern River watersheds. Deer Creek, White River and several small creeks are not impounded at all. The lack of impoundment, overall unfragmented character of the lower elevations and the number of Special Status Species make Deer Creek and White River watershed very valuable for aquatic and terrestrial species.

Much of the foothill zone in private ownership in the southern Sierra between 500 and 2,500 feet is undeveloped and unfarmed. It is used primarily used for grazing, a use that is highly compatible with wildlife movement corridors. Wildlife corridors with intact riparian and wetland areas may be especially useful for neotropical migrant birds, deer and other upland-associated species and house a number of special status species (species tracked by the California Natural Diversity Database, listed under the California or Federal Endangered Species acts). Because grazing is one of the most important agricultural practices in Tulare and Fresno Counties, conserving foothill rangeland protects habitats and species as well as economic activities. The impact of hobby farms and housing development expansion in this Region has already begun to impact the integrity of wildlife corridors.

The lands comprising the Region’s headwaters and watersheds’ mid-elevations are relatively intact. Federal agencies manage these areas for public benefits. Although intact from an ownership standpoint, there is a considerable backlog of restoration and other projects on federally-owned lands that require immediate attention to protect, restore or steward. Moreover, rapid climate change, development-caused habitat fragmentation, some of the worst air pollution in the nation, altered fire regimes, and invasive species stress and threaten these landscapes. Changing population demographics, wildland/urban interface development, and other land use and natural resource demands already threaten the traditional working landscapes of the foothills at lower elevations.

There are multiple critical issues such as water quality and quantity for disadvantaged communities, climate change adaptation and mitigation, environmental degradation and sensitive wildlife species and watersheds which transcend the human-natural ecosystem divide. Wetlands and riparian habitats are effective filters and buffers for water quality improvement. Runoff is effectively filtered by riparian systems, and wetlands filter stream flow removing many pollutants. Wetlands and riparian habitats can improve water quality and provide important habitat for aquatic and terrestrial species. Also, healthy forests can retain a winter snowpack, providing water during dry summer months. The Southern Sierra RWMG has established goals to restore and protect these habitats in the Region’s watersheds. In addition to improving water quality, best management practices that protect stream-banks and riparian systems can be incorporated into land use and development plans. Eroding water courses, hillsides, and roads all contribute to unnatural levels of erosion and sedimentation. This negatively impacts wetlands, water courses, and the storage capacity of the reservoirs.

3.12.2 Important Ecological Processes

Natural and ecological processes such as fire, floods, drought, grazing, insect and disease outbreaks, landslides, and others dominate this Region with low population, large wilderness and wildland expanses.

Fires and floods are two key ecological processes humans often seek to control, minimize or eliminate entirely. Since federal fire suppression policy over 100 years ago, fires have been extinguished as soon as possible after detection. This diminished and altered the role of fire in Sierran forests temporarily. Fires nearly ceased to remove small diameter trees and brush, dense fuels accumulated. Now when fires do burn, they burn with high intensity and are difficult to extinguish. The result is an intensity and size of fire that may be outside of the range of natural variability. Often, large intense fires are associated with drought, landslides or erosion and a concurrent decreasing water quality. Fire as a process, cannot be restored without altering vegetation and fuel structure and arrangement in Sierran forests through managed natural fire, prescribed fire, thinning or other fuel treatments.

At lower elevations, fire may have played a significant role in woodland ecology. But unlike high elevation forests which retain most of the native vegetation structure and diversity, low elevation grasslands and woodlands were significantly modified by land use and exotic species. In these low elevation woodlands and grasslands, livestock grazing is the dominant vegetation treatment, land use and economic activity. Grazing is an effective method to reduce fuel loads and is an important strategy to reduce non-native species.

Floods and flooding are controlled to a certain extent by diversions, structures and other impoundments in the river courses and floodplains in the southern Sierra. The steep, incised channels in much of the Region are relatively easy to impound from an engineering standpoint, but structures are vulnerable to large events that were not predicted or which rapidly onset and leave little room in reservoirs. In frequent, massive flood events characterize nearly all of the watersheds in the Region. It is possible that existing records do not capture the full capacity of this portion of the Sierra to deliver millions of acre feet of water to the Valley floor in a very short time. Culverts installed based on existing records may not be sufficient to withstand high flow events. Thus, small stream systems and flood plains in upper watersheds may sustain great damage from relatively small, but intense events.

Thus, floods are also a key process that are difficult to minimize or eliminate altogether. The Poso and Deer creeks and White River watersheds have minimal or no impoundments. While this is an important aspect of the watersheds ecologically, maintaining native fisheries and riparian vegetation, the lack of impoundments and diversions in the mountains create downstream flooding problems.

Drought is a regular occurrence in the southern Sierra and a process over which humans have little to no control. Human communities can develop resilience to drought, but cannot create additional water supplies. Some cloud seeding does occur in the Kaweah Watershed, but little is known about how effective the practice actually is.

Ecologists view ecological processes as key in maintaining ecosystems and preserving the underlying processes that generate ecosystems to begin with. Restoration of key processes is often prescribed by researchers and managers managing dynamic ecological systems and their associated processes. This is difficult to accomplish when human infrastructure or communities are at risk from the same processes that are valuable to maintain ecosystems. In the Southern Sierra Region, restoring processes is easier because of the limited population and infrastructure. However, because of the extensive recreational use of the Region, public and local education are key to convey the importance of ecological processes in managing this dynamic landscape.

A central theme of a report entitled *Science Synthesis to Support Socioecological Resilience in the Sierra Nevada and Southern Cascade Region* (Long et al. 2014) is the importance of restoring key ecological processes to mitigate impacts of widespread stressors to socioecological resilience, including changes in climate, changes in fire deficit and fuel accumumulations, pollution, and invasive species. The effort included a team of scientists who integrated recent research to inform forest managers, stakeholders, and interested parties concerned with promoting socioecological resilience in the Sierra Nevada, southern Cascade Range, and Modoc Plateau. Among the focal topics were forest and fire ecology; soils; aquatic ecosystems; forest carnivores; air quality; and the social, economic, and cultural components of socioecological systems. The results of this study should have broad applicability to the Southern Sierra region.

3.12.3 Water-Related Environmental Resources

The lakes, creeks, meadows and other water features in the Region provide important habitat for many of California's most important aquatic and terrestrial species, including many fish and wildlife species. Fish such as rainbow and golden trout continue using its waterways for spawning as far upstream as the waterfalls that did not allow further fish passage.

Two hundred and thirteen Special Status Species are found in the Region today (See **Appendix E – Special Status Species**), many of which are federally or state listed species. Protection and restoration of these species is an important aspect of this IRWM program.

A mix of steep, confined channel types (with few floodplains) and lower gradient, less confined reaches (with significant floodplain areas) characterizes the Region’s rivers and streams. It is important to river health to maintain connectivity with floodplain areas to sustain riparian habitat and recharge groundwater resources. Streams are a function of the connectivity between geomorphic surfaces (such as floodplains) and stream banks that form the channels that convey the water. Groundwater and water tables adjacent to the stream channels play a critical role in water storage during wet months and water release back into the channels during dry months. (As the water level goes down in streams from spring to late summer, stored water moves back into the channels from the adjacent aquifers to maintain dry season base flows.) The connectivity of these aquatic ecosystem components must be protected or restored in order to maintain a functioning stream system, improve water quality, and reduce fluctuation in water variability.

The wild and scenic river system, created by Congress in 1968, preserves selected rivers with remarkable scenic, recreational, geologic, fish, wildlife, historic, cultural or other similar values. The goal is to counterbalance dams and other construction in order to preserve these selected rivers/portions of rivers in their free-flowing condition to protect water quality and wildlife habitat for the benefit of future generations.

Portions of the Kings and Kern rivers are designated as Wild and Scenic Rivers by Congress. The Kern River is a designated Federal Wild and Scenic River (approximately 130 miles total, 123.1 miles Wild; and 7.0 Scenic). The upper watershed stretches from near the city limits of Bakersfield to deep within Sequoia National Park and includes miles of steep canyons and subwatersheds feeding the North and South forks of the Kern Rivers, rich in riparian and meadow habitats. These habitats are important for wildlife and indigenous people during the dry summers in California, and provide critical benefits such as snowmelt water retention, flood control, water quality and drinking water supplies. The clear, cold water that remains throughout the summer contributes to the lush vegetation, cohesive soils and expansive floodplains and support three golden trout species and many other native wildlife. Sixty-five miles of the Kings River are classified as Wild. This watershed contains the Mill Flat Critical Aquatic Refuge (CAR) which supports the Western Pond Turtle and native fisheries. It provides water for municipal, agricultural, contact and non-contact recreation, and both warm and cold water fisheries.

Terrestrial Ecosystems

Native forest and woodland is the dominant vegetation in the Region, covering roughly two-thirds of the land area. Major tree species found in the lower elevation zones at 2,000 feet foothill-woodland zone include blue oak, interior live oak, and gray pine. The lower montane forest around 5,000 feet elevation include California black oak, Ponderosa pine, white fir, and incense cedar. This Region houses the greatest density of giant sequoias groves of any place in the world, many in the Kings, Kaweah and Tule River watersheds, in the montane forest zone. The southern-most grove of sequoias occurs near the headwaters of the Deer Creek watershed. The upper montane forest begins at elevations near 7,500 feet and includes trees such as red fir, lodgepole pine and Jeffrey pine. The subalpine forest, at elevations near 9,000 feet and above, includes species such as foxtail pine, mountain hemlock and lodgepole pine.

Riparian areas found along the banks of the rivers and creeks are among the most productive and diverse of the Region, and they serve an important water resource function in their ability to stabilize streambanks and provide filtering. Riparian vegetation in the lower portions of the Region is typically dense, with the overstorey consisting of willows and Fremont or black cottonwoods, valley oaks, California sycamore, and Oregon ash. Willows, cottonwoods and valley oak are particularly important in that they provide habitat for a variety of birds including egrets, herons, osprey, ducks, and bald eagles. The understorey consists of willows and herbaceous plants such as buttonbush, honeysuckle, elderberry, and gooseberry which are attractive to certain birds including sparrows and warblers. Smaller plants typically include polson oak, nettle, mule fat, wild grape and grasses. The dense understorey provides habitat for rodents, deer and their predators. Historical riparian habitat in the Region has been lost due to land use management and flow regulation. Additionally native riparian plant species are facing competition from invasive species.

3.13 - Potential Effects of Climate Change

The impacts from climate change are expected to place further demand on water resources in the Southern Sierra Region. As temperatures and evaporative demand by vegetation rise, soils and local aquifers will become drier, creating vulnerabilities due to lower supply and higher demand. The 2011-15 drought was a strong indicator of what is projected to become more widespread in longer, warmer dry periods. Climate change is also projected to result in more variable and intense precipitation and increased flooding. This will be exacerbated as historical large snowstorms transition to becoming large rainstorms. Much of the area already experiences a water deficit each summer, and this will be exacerbated with climate change as vegetation draws on subsurface storage for longer periods each year, making up for lost snowpack storage. All of these topics are discussed in greater detail in **Chapter 16 – Climate Change**

3.14 - Social/Cultural Makeup and Disadvantaged Communities

3.14.1 Economic Conditions and Important Economic Trends

Like many areas rich in natural resources, the Southern Sierra Region consists of small, low-income communities with no incorporated cities. The counties which share portions of this Region (primarily Fresno and Tulare) extend from the mountains down into the fruitful Central Valley and tend to focus their scarce planning resources on the higher population agricultural areas. Although there are State and Federal agencies involved in land management, none of these agencies have the resources to engage in comprehensive regional planning. Historically, very limited state and/or federal financial resources have been dedicated to this Region.

These issues will remain a concern of the RWMG and projects that address these needs will be given special consideration. When the social, economic, and cultural context of water is considered, the supply and demand debate is magnified. Distributing limited resources cannot just be established by market means. Cost, accessibility, and affordability for all users must also be a factor. This will ensure that the people in the Region who have limited access to clean, fresh water will continue to be able to receive it.

3.14.2 Disadvantaged Communities

The RWMG has made it a priority to consider ecological, social, economic and cultural components in water resources management. In early meetings, brainstorming sessions were held between stakeholders that identified primary issues and effects on Disadvantaged Communities (DACs). Some of the primary issues from a social standpoint are pollutants in drinking water, lack of planning and integration, affordability of municipal and private water, substandard water systems in unincorporated communities, tribal water rights, and various cultural water uses and needs.

The counties which constitute almost all of the Southern Sierra Region (Fresno and Tulare) include both valley and foothill/mountain areas within their boundaries. Their major population centers are located in the valley areas. The Tulare Lake Basin Community Water Study is discussed in Section 11.3. The population in the foothill/mountain regions are scattered throughout a large area and are difficult to serve. These two counties are generally poor and have limited resources. Their cities and towns on the valley floor have many needs and are easier to serve than the somewhat less populous communities in the foothills. Consequently these more remote communities have received few services and resources.

The communities in the Southern Sierra IRWM area consist of approximately 17 small towns (population 1,500 or less), none of which are incorporated. Thirteen of these communities are considered economically disadvantaged. **Table 3-2** shows the local communities that have below average income for the State of California.

Table 3-2 Local Communities with Low Income

Community	Zip Code[1]	Median Household Income (MHI)[2]	% of Statewide MHI[2]	Status[3]
Dunlap	93621	11,852	19%	SDAC
Posey/Sugarloaf	93260	25,375	41%	SDAC
California Hot Springs	93207	28,750	47%	SDAC
Miramonte	93641	30,361	49%	SDAC
Orosi/Auckland/Badger	93647	35,053	57%	SDAC
Lemoncove/Ellis place	93244	39,219	64%	DAC
Porterville/White River	93257	41,464	68%	DAC
Yokohl/Tooleville	93221	47,240	77%	DAC
Kennedy Meadows/Upper Kern	93527	50,849	83%	Not DAC
Tollhouse	93667	53,750	88%	Not DAC
Springville/Ponderosa[4]	93265	53,852	88%	Not DAC
Three Rivers/Mineral King	93271	55,268	90%	Not DAC
Auberry/Pineridge/Balch Camp	93602	59,195	96%	Not DAC

1 Income was determined by zip code. Results may be different if census blocks are used in the analysis.
2 Statewide and Median Household Income acquired from the US Census Bureau's 2008-2012 American Community Survey, 5-year estimate with amounts adjusted to 2012 dollars (Statewide MHI is $57,400).
3 SDAC = Severely Disadvantaged Community, a community with an MHI less than 60% of the State's average. DAC = Disadvantaged Community, a community with an MHI less than 80% of the State's average.
4 Springville and Ponderosa are in a similar zip code but are geographically separated. Springville is occupied year round and likely a DAC, while Ponderosa is a seasonal vacation community and may not be economically disadvantaged.

Previous efforts have identified the three Native American Tribal lands in the Region as DACs, but income data for these areas is currently limited to verify their status.

In larger urban areas, DACs are islands of poverty surrounded by a sea of relative wealth, while in the Southern Sierra Region there are very small islands of relative wealth surrounded by a sea of DACs. Additionally, unlike valley farm communities and urban low income areas, there is rarely a central or even identifiable point of contact to reach DAC populations. This makes communication, coordination and meaningful interaction very labor intensive.

Therefore, effectively engaging DAC and incorporating their input is very costly to IRWM programs that service those large, decentralized DAC areas. This additional cost, a pre-existing lack of existing community capacity, and the grant requirement for a local match, place an extraordinary and unreasonable burden on many IRWM programs in the Southern Sierras. In short, some cannot afford to compete with their downstream, more affluent regions that are unfortunately in the same IRWMP funding Region.

Towns in the Region that do not meet the DAC criteria are areas where the tourism industry brings in more money and attracts higher income residents, and may be based on averages skewed by second home owners and commuters working in cities in the Valley, such as Fresno or Visalia.. But historically the populated areas were built around extraction or agricultural industries (mining, cattle and logging) and suffer from low income and poor infrastructure conditions. They are also generally isolated and remote. This has made it a challenge to engage the residents in the IRWM process. The RWMG has made consistent efforts to overcome these challenges, but met with only limited success to date. Based on this the IRWMP planning process included significant tasks and resources to improve the involvement of these DACs.

The initial outreach efforts by the Sierra Nevada Alliance and Sequoia Riverlands Trust included identifying stakeholders in the Region's DACs. Staff put together a list of Tribal representatives, Community Service Districts, Village Foundations, Resource Conservation Districts and nonprofit organizations which served the communities. Continuing efforts have been made to add to this list. In addition, the RWMG project manager arranged meetings with the Community Water Center and Self Help Enterprises, two nonprofit organizations which provide infrastructure assistance to disadvantaged communities. Both of these entities acknowledged the needs of these communities and both stated that they did not have the resources to serve them – all of their resources are currently directed at the needy Valley communities they already serve. They also gave their support to the RWMG effort to include these DACs in their process and direct resources toward their needs.

There have been a few representatives of these DACs who have attended the RWMG meetings, including representatives from Springville, the Cold Springs and Big Sandy Rancherias, and the Tule River Indian Tribe to represent tribal interests. In an effort to better reach the non-participating communities, Southern Sierra RWMG representatives have conducted some direct outreach, but the resources for this were limited and presentations were regularly made in Springville, Three Rivers, Auberry, and Miramonte. The most effective strategy with our limited resources was to contact organizations that represented several of these communities. Meetings were held with the Community Water Center, Self-Help Enterprises, Sierra RCD, the Tulare County RCD, and the Tulare County Public Health department to try to understand the needs of these disadvantaged communities. The Southern Sierra RWMG has also sought additional grant funding to perform better direct outreach and to provide travel stipends to DAC representatives, but to date these grant applications have not been successful.
Based on the direct experience of the difficulties in serving the Region's DACs, the RWMG has identified the following resources to improve DAC participation, including:

- Outreach meetings and briefings in DAC areas;
- Travel/participation stipends for DAC representatives to attend meetings and workshops; and
- Resources to assist the DACs in establishing watershed committees - a sustainable way to promote public education and community involvement in natural resources planning and projects.

The RWMG will need to continue to reach out and engage DACs in planning and implementation to ensure the DAC needs continue to be represented.

3.15 - Major Water Related Objectives and Conflicts

The Southern Sierra Region has many objectives and conflicts. Major areas of concern are discussed in further detail in Chapter 5 – Goals and Objectives. Chapter 6 – Resource Management Strategies describes applicable strategies for managing water supplies in the Region.

This Southern Sierra RWMG focuses on the integration of water management activities including (but not limited to) watershed related stewardship projects, man-made facilities, water quality, flood and fire hazard mitigation, equal accessibility, and water supply and demand. By having a large geographic area, the Region includes a large number of these natural and man-made resources, which can encourage the coordination of planning and management among numerous stakeholders. This is balanced by the need for reasonable access to meetings, as well as the desires of the area stakeholders.

Water management issues for the Region are broad and include water supply, water quality, flood management, environmental stewardship, watershed management, and infrastructure development. There are also social, economic, and cultural implications of water conflicts; successful projects and implementation will take into account this variety of inter-related challenges.

<u>Common Areas of Interest</u>
There are several areas of common interests among members of the RWMG, which result in the following list of regional values:

- Stakeholder input, science and consensus as a basis for natural resource decision-making;
- Inclusiveness and transparency;
- Respect for private property rights;
- Respect for the public trust;
- Equity and fairness in resolution of water conflicts and in developing mutually beneficial approaches and results;
- Integration of management entities, strategies and benefits;
- Coordination with adjacent regions; and
- Sharing of data, information and knowledge in a variety of ways to meet the needs of the stakeholders and the public at large.

Collaboration among stakeholders will be required to successfully address the Region's issues, and implement the strategies to fulfill the regional objectives.

<u>Regional Issues</u>
During various RWMG meetings, the public identified the following water management issues for the Region:

- Competing demands - agricultural vs. development;
- Blocked fish passage from man-made and natural obstacles;
- Upstream and downstream conflicts over pre-1914 water rights;
- Forest management and water yield;
- The need to provide clean, sustainable and affordable water supply for the populations of the RWMG area;
- The presence of water rights holders whose customers are located outside of the Region and its watersheds;
- Inadequate knowledge of flooding risks, hazard areas and landslide dam flood risk;
- Land use in the foothills – urbanization and development moving up from the valley relying heavily on groundwater. The foothill and mountain communities in the Southern Sierra Region are expected to continue to grow as provided for within the land use agency plans, which will provide additional stress on the environment and water supplies; and
- Insufficient information on hard-rock aquifers and groundwater supplies.

Regional Goals and Objectives
This list of issues was a foundation for developing the Regional Goals and Objectives. The Goals and Objectives were identified through a series of public meetings and ranked using a public survey. Refer to Chapter 5 – Goals and Objectives for more details.

3.16 - Maximum Opportunities for Water Management Activity Integration

The Southern Sierra Region has developed numerous opportunities for integrating water management activities. The RWMG is the first truly integrated effort in the Region and has brought together stakeholders that have rarely interacted or shared ideas in the past. This leads to potential opportunities for multi-agency projects. The RWMG has already discussed multi-IRWMP projects with IRWMP groups in lower watersheds, particularly the Kings Basin Water Authority (KBWA), the Kern RWMG and the Madera RWMG. These projects would look at benefits across entire watersheds, including the upper watershed in the Southern Sierra Region, and beneficial impacts to the lower watershed in other IRWMP areas. For instance, there are numerous opportunities to improve forest health in the upper watersheds, while also increasing water supplies and improving water quality for the downstream water users.

Chapter 4 - GOALS AND OBJECTIVES

4.1 - Introduction

The Southern Sierra Regional Water Management Group (RWMG) developed regional goals and objectives to focus their planning and implementation efforts. This chapter describes the goals and objectives, the process for their development, methods of measuring success, and ranking and prioritization of goals. **Figure 4-1** illustrates the hierarchal relationship between a regional vision, goals, objectives, strategies and projects.

Figure 4-1 Goals and Objectives Hierarchy

Below are definitions of the terms found in **Figure 4-1.**

Vision: Image or understanding of what will be accomplished.

Goals: The highest level of desired outcomes that support the vision.

Measureable Objectives: Measurable actions/methods for achieving the goals. A measurable objective can apply to more than one goal.

Resource Management Strategies: Land and water management strategies for achieving the objectives.

Projects and Programs: Projects and programs that can achieve the measureable objectives.

Funding: Internal and external funding to implement projects and programs.

This chapter discusses the goals and objectives. Resources management strategies are discuss in **Chapter 5**, proposed projects are discussed in **Chapter 6**, and funding alternatives are described in **Chapter 10**.

4.2 - Goals and Objectives

The goals and objectives for the Southern Sierra RWMG are summarized in **Table 4.1**, and are discussed in detail below. The goals and objectives are not listed in any specific sequence or priority. Some objectives are found under more than one goal because they have multiple and diverse benefits.

Table 4-1 Summary of Goals and Objectives

G.1 - Improve Water Supply Management a. Promote natural water storage b. Increase understanding of water balance c. Increase capacity of water storage facilities, including targeted recharge, and shallow subsurface storage. d. Improve water use efficiency e. Mitigate and adapt to climate change impacts on water resources, including natural and built infrastructure. f. Promote sustainable water supplies for new human developments	**G.2 - Protect and Improve Water Quality** a. Protect natural water bodies b. Promote best land conservation and management practices to protect water quality or reduce contamination, including polluted runoff. c. Reduce erosion and sedimentation d. Promote storm water management planning and implementation e. Assess water quality of small water systems f. Study septic system impacts
G.3 - Perform Integrated Flood Management a. Address climate change impacts from flooding b. Integrate flood management with other activities c. Protect/restore floodplain connectivity d. Increase water storage capacity, including targeted groundwater recharge.	**G.4 - Improve Watershed and Environmental Resource Management** a. Promote best land management and conservation practices to protect water quality, including polluted runoff. b. Manage vegetation to improve forest health and reduce fire risk c. Reduce erosion and sedimentation d. Promote natural water storage e. Protect and restore floodplain connectivity
G.5 - Expand Stakeholder Education a. Promote community education on water issues b. Increase outreach to Native American Tribes c. Increase outreach to disadvantaged communities d. Create/maintain RWMG website	**G.6 - Protect Unique/Important Environmental Resources** a. Protect areas with high value to water storage and groundwater recharge b. Protect areas with high value to water quality protection and remediation c. Protect areas with high value to other water resources issues d. Enhance water management in already protected areas
G.7 – Reduce Energy Consumption and GHG Emissions a. Promote renewable energy facilities that reduce fossil fuel energy consumption in the water sector for pumping, conveyance, treatment, heating, cooling, and cleaning. b. Improve forest management for water resources, carbon sequestration and other services through fuel reduction treatments and meadow restoration. c. Support innovation in biomass and compost utilization pathways. (AB 32 Scoping Update) d. Incentivize composting and other practices that are known to sequester carbon in agricultural soils and plants (Healthy Soils Program- AB 32 Scoping Plan Update_https://www.cdfa.ca.gov/oefi/healthysoils/) e. Promote all waste as a resource for reuse and recycling.	

Goal No. 1: Improve Water Supply Management - Ensure adequate water supply to meet the Region's expected surface and groundwater needs between now and 2045 while minimizing environmental impacts.

Objective 1a: Promote natural water storage through meadow, stream and forest restoration. Natural features such as streams, meadows and forest landscapes have been impacted and their ability to store water has been reduced. This objective includes reducing live fuel loads and excessive vegetation (where fire has been suppressed), to reduce vegetation transpiration to sustainable levels, and increase water storage in soils and streams. Removal of exotic vegetation, which has higher water use than native vegetation, can also improve water storage. When natural features such as meadows and stream/riparian areas have been impacted, their ability to store water likely has been reduced. Restoration projects can help restore the natural hydrologic functions and provide better storage and release of water.

Objective 1b: Increase understanding of the water balance and subsurface water resources. The Region's natural storage capacity is not well understood, largely because the groundwater is found in fractured bedrock that is not as easily modeled as a typical alluvial aquifer, and groundwater monitoring is limited. The depth of subsurface water in soil, and weathered bedrock is also not well known, but central to forest resilience and summer baseflow in streams. In addition, surface water monitoring is sporadic and inadequate in many areas. Hydrologic studies of the Region and especially near population centers are needed to more fully understand the water budget.

Objective 1c: Increase water storage, including targeted groundwater recharge and shallow subsurface storage. Increasing storage capacity can provide greater water reserves on a short and long-term basis as well as provide flood protection. Capacity can be increased by constructing new storage facilities, raising dams, or removing accumulated sediments. Water resources planning should consider variability in amount, intensity, timing, quality and location of runoff, especially as it relates to climate change. Planning efforts should also consider all types of recharge opportunities and capabilities and techniques at suitable points of water collection. Efforts should be made on identifying and utilizing the excess floodflows during winter that can be re-routed to suitable locations with high infiltration rates for enhancing groundwater recharge. Also determine response of shallow subsurface water storage and snowpack storage to forest treatment and disturbance.

Objective 1d: Efficiently use, conserve and recycle water resources. Water conservation, water recycling, and improved infrastructure efficiencies are important tools to meet increasing water demands throughout the Region. Water use can be optimized through urban water conservation, agricultural water conservation and recycling of treated effluent. The goal here is to help local communities reduce water use by 20%.

Objective 1e: Mitigate and adapt to climate change impacts on water supplies. Climate change is projected to increase evaporation and alter precipitation patterns resulting in more-severe droughts, less overall precipitation, and less snowpack storage.

The Region is currently undergoing an extensive drought-induced forest mortality event that will have an affect on streamflow for decades. In combination with climate change, many previously forested areas may not recover and convert to new vegetation types, permanently altering evapotranspiration, watershed storage and streamflow. **Chapter 15 – Climate Change** includes several strategies to reduce the impacts from and increase resiliency to climate change. The RWMG is encouraging 'no-regret' strategies that would benefit the Region whether or not climate change occurs.

Objective 1f. Promote sustainable water supplies for human development. New and existing developments place additional pressure on water supplies and aquatic ecosystems. This goal includes promotion of comprehensive land use planning policies that require proving sustainable water supplies exist for new developments.

Goal No. 2: Protect and Improve Water Quality – Improve water quality to help ensure drinking water meets California health standards, and natural water bodies can support livestock and native wildlife.

Objective 2a: Protect natural streams, lakes and other water bodies from contamination. Several natural water bodies in the Region are impaired, or are at risk of impairment, from natural or anthropogenic contaminants. These water bodies can be restored to natural conditions and protected from contamination by developing and using best management practices for forest, range, agriculture, and urban land uses and through proper wastewater disposal.

Objective 2b: Promote best land conservation and management practices to protect water quality or reduce water contamination, including polluted runoff. Numerous activities and issues in the Region contribute to the degradation of water quality including septic systems, urban storm runoff, recreation, riparian land use, agriculture, abandoned mines, and illegal marijuana cultivation. This goal includes promoting and implementing best management practices to reduce the impact from these activities and restore the water bodies to their natural conditions.

Objective 2c: Reduce erosion and sedimentation. Excessive erosion and sedimentation can negatively impact wetlands, water courses and storage capacity of reservoirs. Several measures can be taken to reduce erosion and sedimentation including slope stabilization, road maintenance, road decommissioning, grading and drainage improvements, and best management practices during construction. Erosion and sedimentation can also be mitigated through forest management practices that help to reduce the severity of wildfires.

Objective 2d: Promote storm water management planning and implementation. Small communities in the Region must manage stormwater to reduce flooding and protect water quality. Development and implementation of stormwater management plans can help to improve drainage and discharge of pollutants to natural water bodies. This objective also includes promoting Low Impact Development to help increase groundwater recharge, reduce flooding and improve water quality protection.

Objective 2e: Assess water quality problems of small water systems. Several small water systems in the Region have groundwater quality problems including nitrates, uranium, gross alpha radiation and several other constituents. These communities have limited data, funding, or expertise to evaluate groundwater quality and more extensive investigations are needed. Many of these small water systems are in disadvantaged communities.

Objective 2f: Study impacts of septic systems on water quality. Many residents and businesses use septic systems to dispose of wastewater, especially when they are located in small or isolated communities that lack a sewer system. Additional information is needed on how these systems impact groundwater quality, and alternative septic system designs or treatment methods to protect water quality. To address this need, stakeholders need to provide assistance or coordination with counties in developing Local Area Management Plans to address the new statewide policies for on-site wastewater treatment systems.

Goal No. 3: Perform Integrated Flood Management - Develop strategies that improve environmental conditions in floodplain and riparian corridors, maximize natural floodwater retention strategies, and improve flood control facilities.

Objective 3a: Identify and implement projects to accommodate flood related impacts from climate change. Climate change is projected to alter the timing, frequency and magnitude of flooding. A range of future conditions needs to be identified and new policies, programs and projects developed to accommodate the anticipated changes in flooding.

Objective 3b: Integrate flood management with other land management activities. Integrated flood management integrates land and water resources development to maximize the efficient use of floodplains and minimize loss of property and life. This can be accomplished by integrating flood management with transportation, land development, resource management and water resources projects.

Objective 3c: Protect and restore connectivity of floodplains with other water bodies. Floodplains need to maintain connectivity to rivers and streams to provide riparian habitat, perform groundwater recharge, spread out floodwaters and maintain biodiversity of aquatic species. This can be accomplished by identifying, protecting and restoring critical floodplain areas.

Objective 3d: Increase capacity of water storage facilities, including recharge. See objective 1c.

Goal No. 4 - Improve Watershed and Environmental Resource Management - Promote best management and conservation practices for all land uses in the Region: range, forest, agriculture, urban, and wildland-urban interface to protect ecosystems thereby improving water supplies and water quality. Preserve open space and natural habitats that protect and enhance water resources and native species.

Objective 4a. Promote best land conservation and management practices to protect water quality or reduce water contamination, including polluted runoff. See objective 2b.

Objective 4b. Manage vegetation to improve forest health and reduce fire risk and attempt to keep fires within their natural range of variability. Forest and brush fires can lead to erosive conditions that contribute soil, ash, nutrients, and debris to water supplies. Local landowners can be educated and encouraged to reduce fire risk by using fire resistant and retardant landscaping. Land managers can reduce fire risk by creating strategic fuel breaks, conducting fuel treatments and forest restoration, thinning underbrush, and allowing low-intensity fires to consume accumulated fuel.

Objective 4c. Reduce erosion and sedimentation. See Objective 2c.

Objective 4d. Promote water storage in source-water regions through meadow, stream and forest restoration. See Objective 1a.

Objective 4e. Protect and restore connectivity of floodplains with other water bodies. See objective 3c.

Goal No. 5: Expand Stakeholder Education – Expand existing outreach efforts to educate the public, encourage participation, and promote the benefits of integrated regional water management.

Objective 5a: Promote community education about water resources and climate. Some water resources problems result from a lack of awareness and education. This can be remedied by educating the general public, public project planners and elected officials on water-resources and climate issues, water conservation, and practices/policies for protecting water quality.

Objective 5b - Increase outreach and involvement to Native American Tribes. Three federally recognized Native American Tribes are located in the RWMG boundaries. These tribes represent an important stakeholder group and bring important support for ecosystem preservation, elimination of exotic species, and other water management issues, as well as traditional ecological knowledge. The tribes can be further engaged through additional outreach and education to increase their involvement and feedback in the RWMG, regional water planning, and project development.

Objective 5c: Increase outreach and involvement to disadvantaged communities. Many small disadvantaged communities are found in the Region but few are represented on the RWMG. This goal includes performing outreach and education to DACs to increase their involvement and feedback in the RWMG, regional water planning, and project development. Identify capacity-building opportunities and needs.

Objective 5d: Develop and maintain a comprehensive website for Regional Water Management Group. The RWMG launched a new website in 2014 (http://www.southernsierrarwmg.org). The website includes information on the Southern Sierra Region, meetings, educational materials, the IRWMP and other topics. The website is an important tool for stakeholder outreach and information dissemination. The website can still benefit from further expansion and frequent updates to better serve the Region.

Goal No. 6: Protect and Enhance Unique and Important Environmental Resources – Focused protection and enhancement may be needed for certain unique and important environmental resources. Though much of the Southern Sierra is in state or federally protected lands, there may be some areas that are not, but have unique and important areas that merit special protection or conservation. Some lands already have conservation easements through non-governmental organizations and other means. For those areas identified that have high value but are not protected, and are potentially at risk, easements and related methods could provide long-term protection. This goal includes providing further protection for unique areas on public lands, and encouraging private landowners to take voluntary measures to protect their land.

Objective 6a: Protect unique areas of high value for water storage and groundwater recharge. Provide suitable protection for identified areas of high value for water storage and/or groundwater recharge, especially if they are at risk of land use change. For example, the Southern Sierra has numerous meadows and lakes, some of which may be of particular value and are not protected from potential land use changes such as road construction or other development.

Objective 6b: Protect unique areas of high value for water quality protection and remediation. Provide suitable protection for identified areas of high value for water quality protection and/or remediation, especially if they are at risk of land use change. For example, some of the small community water supplies originate in areas that would be impacted if recreation patterns change or intensify.

Objective 6c: Protect unique areas of high value for other important water resources related issues. Provide suitable protection for identified areas of high value for other unique water resources related issues such as flood control, educational opportunities, or fire management, especially if they are at risk of land use change. For example, some areas within the Southern Sierra offer unique opportunities for public education regarding water resources and could be integrated into projects so that educational opportunities are enhanced.

Objective 6d: Enhance water resources management in areas already in protected status for their unique and high value natural resources. Provide additional enhancements in areas already set aside/protected for unique and high value resources related to water conservation, water quality or other water issues. For example, the Southern Sierra is home to the Giant Sequoia, of which some groves that have high public traffic may have need for focused management to protect the local water quality and prevent erosion.

Goal No. 7: Reduce Energy Consumption and GHG Emissions – Promote "all of the above" best practices in land and water management actions that contribute to achievement of the adopted 2008 Climate Change Scoping Plan[1] and the proposed 2017 Climate Change Scoping Plan Update goals to "…reduce climate change… and guide the State toward an equitable clean energy economy and prosperous future."[2]. A key goal of the Plan in addition to an overall reduction in use of fossil fuels is more conscious management of farm and rangelands, forests, and wetlands so they can store carbon. Reduced dependence on fossil fuels, absolute reductions of energy consumption and carbon sequestration in soils of natural and working landscapes will work in aggregate to reduce greenhouse gas emissions.

Objective 7a: Promote renewable energy facilities that reduce fossil fuel energy consumption in the water sector for pumping, conveyance, treatment, heating, cooling, and cleaning. Knowing that population growth will drive demand for water, agency, on-farm and on-business scale energy-reduction and sustainable energy generation facilities for domestic water and waste-water operations including use of recycled water for irrigation should be promoted. In the future, the ability to meet most new demands for water will come from a combination of increased conservation and water use efficiency, improved coordination of management of surface and groundwater, recycled water, new technologies in drinking water treatment, groundwater remediation, and brackish and seawater desalination.[3] Renewable energy sources, such as wind, solar, waste biomass and small hydropower, can help meet the energy demands for new and future water demands.

Objective 7b: Improve forest management through fuel reduction treatments and meadow restoration. "Recent research has reaffirmed that 'an ounce of prevention is worth a pound of cure' when it comes to managing wildfire risks. The Sierra Nevada Conservancy, The Nature Conservancy, and the U.S. Forest Service studied the economic benefit in taking proactive forest management activities, using the Mokelumne River watershed in the Sierra Nevada as a representative case. They found that fuel treatments such as forest thinning and controled burning can save up to three times the cost of future fires, reduce high-severity fire by up to 75%, and bring added benefits for people, water, and wildlife. They also found that by reducing the size and severity of fires, the carbon emissionsfrom the fires were decreased by 38-77% suggesting that these activities could protect the carbon stocks sequestered in our forests." [4]

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[1] The initial Climate Change Scoping Plan was adopted pursuant to AB 32 (2006) Global Warming Sollutions Act, re-approved by the California Air Resources Board in 2011, and updated again in 2014. Documents accessible at https://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

[2] The 2017 Climate Change Scoping Plan Update-The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target.

[3] The 2017 Climate Change Scoping Plan Update-The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target. https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf Embedded reference 186: California Natural Resources Agency, California Department of Food and Agriculture, and California Environmental Protection Agency. California Water Action Plan. resources.ca.gov/docs/californiawateractionDraft Plan/2014CaliforniaWaterActionDraft Plan.pdf

[4] American Forest Foundation, "Wildfires and Cilmate Change", website accessed at https://www.forestfoundation.orf/wildfires-and-climage-change

Fire prevention practices and vegetation health actions can reduce wildfires and release of CO2 and all GHGs. Meadows can also serve as a natural fire break. Many meadows in the Southern Sierra Region have been damaged by overgrazing and other causes, and can benefit from restoration. The restoration can help control wildfires, while also providing water supply and ecolocial benefits.

Objective 7c: Support innovation in biomass and compost utilization pathways. Consistent with AB 32 Scoping Plan composting of biomass instead of burning it or disposing of it in landfills should be encouragaged. Consideration should be given to innovative pathways that can convert greenwaste into other products, fuels and electricity, even on a small scale. As the energy sector is decarbonized through measures such as increased renewable energy and improved efficiency, energy intensities will also be reduced.[1]

Objective 7d: Incentivize composting and other practices that are known to sequester carbon in agricultural soils and plants. The degradation of soils from unsustainable agriculture and other development has released billions of tons of carbon into the atmosphere. New research shows how effective land restoration can play a major role in sequestering CO_2 and slowing climate change, making soil an important consideration for more than just a medium for plant growth. Soil can be a beneficial place for carbon to go. Minimizing ground disturbance, developement and earthwork of the mountainous and foothill regions can reduce soil exposure to air that results in CO_2. For agriculture in foothill regions, encouraging use of conservation or no-till practices can benefit the "demand" side of the CO/CO_2 reduction equation.[2]

The Healthy Soils Program, an outgrowth of the AB 32 Scoping Plan Update is offering grants to develop and administer a new incentive and demonstration programs to build soil carbon and reduce agricultural greenhouse gas (GHG) emissions.[3]

Objective 7e: Promote all waste as a resource for reuse and recycling. Recycling and resuse of recovered waste, including green- (bio-) waste generally results in less energy consumption and GHG generation compared to mining/harvesting and processing of virgin materials for production of new products. Promote projects that utilize recycled-content procurement markets or that add reduction, reuse, recycling or remanufactureing of recovered material opportunities to the market place.

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[1] The 2017 Climate Change Scoping Plan Update-The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target. https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf

[2] Schwartz, Judith D., "Sustainable Agriculture, Soil as Carbon Storehouse: New Weapon in Climate Fight?", Yale Environment 360 (E360) Newsletter published at Yale School of Forestry & Environmental Studies,. Accessbile at https://e360.yale.edu/features/soil_as_carbon_storehouse_new_weapon_in_climate_fight

[3] California Department of Food and Agriculture, Healthy Soils Program, website accessible at https://www.cdfa.ca.gov/oefi/healthysoils/

4.3 - Process to Develop Goals and Objectives

Water is used by a diverse group of stakeholders in the Southern Sierra Region for a variety of needs including domestic use, agriculture, hydropower, and environmental flows. Water management issues for the Region are also broad and include water supply, water quality, recreation, flood management, environmental stewardship, regional self-sufficiency, and infrastructure development. This variety of water users and issues challenges water managers in the Region. The goals were created to address the variety of water management needs, issues and conflicts in the Region.

The goals and objectives were established through a collaborative process that included meetings, stakeholder surveys, public workshops, and open discussions. This process included several iterations from 2009 through 2014. The groups involved included the Coordinating Committee, Regional Water Management Group and the general public. The process produced several lists of issues, conflicts, goals and objectives in the Region. The information in **Chapter 3 - Region Description** and **Chapter 5 – Resource Management Strategies**, and the local knowledge of numerous water and natural resources managers, were used extensively in developing the goals and objectives. These were combined into the final list of goals and objectives found in this plan. The final list was reviewed and approved by the Coordinating Committee in the form of a Draft Goals and Objectives Chapter and then subsequently with approval of the IRWMP.

4.4 - Methods for Measuring Objectives

The guidelines set forth by DWR require that each objective include metrics for measuring success. These metrics may either be qualitative or quantitative depending upon the nature of the goal. The metrics are used to determine if objectives are achieved. **Table 3.2** summarizes how the objectives can be measured. These are suggested metrics and the actual metrics used on projects may vary based on project and site specific features.

The metrics will be used for the following purposes:

1. Document successes in the RWMG annual report
2. Document progress on specific projects as required for grant funded projects
3. Document overall success of the RWMG to assist in securing additional grant funds
4. Provide information to RWMG members for evaluating progress and priorities

Table 4-2 Measurement Criteria for the Objectives of the SSIRWM Plan

No.	Objective	Methods for Measurement
1a, 4d	Promote natural storage through meadow, stream and forest restoration	• Number of meadows and acres restored • Number of forest acres restored • Changes in annual evapotranspiration and demands by vegetation on subsurface storage during dry periods • Number of acres/miles of streams restored • Water temperatures pre-and post restoration • Groundwater level change • Wetland vegetation restoration, increases in native cover and diversity • Number of special status species' habitat improved in restored areas • Number of acre-feet stored or delayed in runoff
1b	Increase understanding of the water balance and groundwater resources	• Number of groundwater studies completed • Number of monitoring wells • Coverage of groundwater supply information • Increased knowledge of local geology and aquifer • More accurate predictive model(s) of water balance • Number of studies improving water balance data • Estimates of subsurface water storage in soil and weathered bedrock across the landscape
1c, 3d	Increase capacity of water storage facilities, including targeted groundwater recharge	• Increase in volume of water stored • Number of days of delayed runoff • Increased duration of irrigation deliveries • Acres of new recharge facilities
1d	Efficiently use, conserve and recycle water resources	• Number of sites employing native, near-native, or xeric landscaping • Amount of water conserved • Number of hours spent on public awareness education • Number of households contacted on public awareness education

No.	Objective	Methods for Measurement
1e	Manage/adapt to climate change impacts on water supplies	• Reductions in greenhouse gas emissions in local project area • Number of Projects Completed • Number of studies on climate change and greenhouse gas emissions • Number of adaptation strategies employed by managers • Success in implementing adaptation strategies
1f	Promote sustainable water supplies for human developments	• Number of land-use plans utilizing BMPs for sustainable management that have been adopted • Amount of policies emplaced by local jurisdictions increasing sustainability of water supply
2a	Protect natural streams, lakes and other water bodies from contamination	• Number of studies identifying sources and types of contamination • Number of identified contamination sources mitigated • Hours of public education on contamination • Number of people/households contacted for public education efforts
2b, 4a, 4f	Promote best land conservation and management practices to protect water quality or reduce water contamination, including from polluted runoff	• Number of water quality violations • Number of riparian management projects completed • Beneficial changes in the miles of impaired streams in the Region • Beneficial changes in the number of impaired water bodies in the Region • Beneficial changes in the number of miles of riparian/wetland fencing • Number and type of BMPs employed in projects that disturb soils • Hours of public awareness education • New or long-term efforts to monitor general water quality such as nutrients, pH, turbidity, electrical conductivity, etc.

No.	Objective	Methods for Measurement
2c, 4c	Reduce erosion and sedimentation	• Amount of development that is relocated away from sensitive areas • Acreage of protected lands • Number of properly employed sediment/erosion BMPs • Number of studies evaluating land use and erosion/sedimentation
2d	Promote storm water management planning and implementation	• Number of stormwater management plans created and adopted • Improvement in runoff water quality after baseline is established • Number of beneficial uses of storm water
2e	Assess water quality problems of small water systems	• Number of assessments performed • Number of violations mitigated • Number of water quality improvement / treatment projects implemented
2f	Study impacts of septic systems on water quality	• Number of studies identifying areas of concentrated septic systems • Number of water quality samples taken in areas with high concentrations of septic systems • Number of projects implemented to reduce water quality impacts
3a	Identify and implement projects to accommodate flood related impacts from climate change	• Number of studies identifying flood prone areas • Number of projects implemented that reduce flood risk to property • Amount of flood reduction/mitigation infrastructure installed
3b	Integrate flood management with other land management activities	• Number of acres of farmland or urban parks irrigated with floodwater • Number of stream and meadow restoration projects that mitigate downstream flooding • Acres of reforested land-both logged and burned areas
3c, 4f	Protect and restore connectivity of floodplains with other water bodies	• Number of critical areas identified • Number of projects to establish floodplain connectivity • Number of key areas protected, acres of floodplain restored/protected

No.	Objective	Methods for Measurement
4b	Manage vegetation to reduce catastrophic fire risk / keep fires within natural range of variability	• Number of projects completed • Area of land managed to reduce unnaturally large fires • Number of acres of fuel breaks
5a	Promote community education about water issues	• Number of new programs • Number of days of educational activity provided • New materials and dissemination • Number of people/households contacted
5b	Increase outreach to Native American Tribes	• Number of outreach meetings and MOUs signed by tribal entities • Number of water resources related projects completed on tribal lands
5c	Increase outreach to disadvantaged communities	• Number of outreach meetings and MOUs signed by DACs • Number of water resources related projects completed in DACs • Demand by DACs for additional water and climate information and capacity to use that information for water-resources management
5d	Develop/maintain comprehensive website for Regional Water Management Group	• Successful website • Number of users of the website • Hours of public awareness education supplied
6a	Protect unique areas with high value to water storage and groundwater recharge	• Number of new areas identified for protection • Number of acres protected
6b	Protect unique areas with high value to water quality protection and remediation	• Number of new areas identified for protection • Number of acres protected
6c	Protect unique areas with high value to other water resources issues	• Number of new areas identified for protection • Number of acres protected
6d	Enhance water management in already protected areas	• Number of projects completed • Number of acres enhanced
7a	Promote renewable energy in water sectors	• Number of projects completed • Total capacity (KW) of renewable energy capacity installed

No.	Objective	Methods for Measurement
7b	Improve forest fuel reduction treatments and meadow restoration	• Acres thinned • Number of restoration projects funded/implemented
7c	Support biomass and compost utilization pathways	• Hours of Public Awareness Education • Number of projects completed • Tons of biomass or componst utilized
7d	Incentivize carbon sequestration in soils	• Hours of Public Awareness Education • Acres of fallowed land converted to vegetative cover
7e	Promote reuse/recycling of all waste	• Hours of Public Awareness Education • Tons of reduced landfill disposal

4.5 - Goal and Objective Ranking

The IRWMP guidelines require that the goals and objectives be prioritized, or that reasons be given on why they are not prioritized. All of the goals and objectives are considered important to the Region, but the RWMG chose to rank them for the following reasons:

- Give focus and direction to the RWMG
- Identify high priority issues
- Help to identify strategies, projects and funding availability
- Helps to capture a cross section of the group's input

The six goals are considered very important and all are considered coequal. However, the RWMG chose to rank the objectives under each goal as part of a public survey. The ranking exercise was announced by email and at several RWMG and Coordinating Committee meetings. The RWMG decided that the ranking was useful and should be included in the IRWMP.

Each objective was ranked as low, medium or high importance. Most of the objectives fell in between medium and high importance, illustrating that most of the objectives have high value in the Region. ***These rankings are not intended or expected to exclude certain projects from being pursued or considered for funding or inclusion in grant applications.***

The ranking results are illustrated in several graphs in **Appendix F**. **Table 4.3** shows each objective in decreasing order, according to the survey. In a few cases an objective was included under more than one goal. In these cases the relevant goal is shown in parentheses after the objective.

Table 4-3 Results of Survey - Ranking of Regional Objectives

Rank	Objective	Low	Medium	High	Average
1	Promote natural water storage (Improve Watershed Management)	0	0	12	3.00
2	Improve forest management through fuel reduction and meadow restoration	0	0	12	3.00
3	Protect natural water bodies	0	1	11	2.92
4	Protect areas with high value to water storage and groundwater recharge	0	2	10	2.83
5	Protect areas with high value to water quality protection and remediation	0	2	10	2.83
6	Promote natural water storage (Improve water supply management)	0	2	10	2.83
7	Manage vegetation to reduce fire risk	0	2	10	2.83
8	Mitigate and adapt to climate change impacts on water resources	0	2	10	2.83
9	Promote community education on water issues	0	3	9	2.75
10	Promote best land management and conservation practices to protect water quality or reduce water contamination, including polluted runoff. (Improve Watershed Mang.)	0	4	8	2.67
11	Reduce erosion and sedimentation (Protect and improve water quality)	0	4	8	2.67
12	Integrate flood management with other activities	0	4	8	2.67
13	Promote best land conservation and management practices to protect water quality or reduce water contamination, including polluted runoff. (Protect & Improve Water Quality)	0	5	7	2.58
14	Protect areas with high value to other water resources issues	0	5	7	2.58
15	Reduce erosion and sedimentation (Improve Watershed Management)	0	5	7	2.58
16	Protect/restore floodplain connectivity	1	4	7	2.50
17	Protect and restore floodplain connectivity	1	4	7	2.50
18	Create/maintain RWMG website	1	4	7	2.50
19	Enhance water management in already protected areas	1	5	6	2.42
20	Increase outreach to Native American Tribes	2	3	7	2.42
21	Increase outreach to disadvantaged communities	2	3	7	2.42
22	Incentivize practices that sequester carbon in agricultural soils and plants	2	3	7	2.42
23	Increase understanding of water balance	2	4	6	2.33
24	Promote sustainable water supplies for new human developments	1	6	5	2.33
25	Support innovation in biomass and compost utilization and conservation	3	2	7	2.33
26	Improve water use efficiency	1	7	4	2.25
27	Promote storm water management planning and implementation	3	3	6	2.25
28	Address climate change impacts from flooding	2	5	5	2.25
29	Assess water quality of small water systems	3	4	5	2.17
30	Promote all waste as a resource for reuse and recycling	3	4	5	2.17

Rank	Objective	Low	Medium	High	Average
31	Increase capacity of water storage facilities, including recharge (Perform Integrated Flood Management)	4	3	5	2.08
32	Study septic system impacts	2	7	3	2.08
33	Increase capacity of water storage facilities, including recharge (Improve water supply management)	5	2	5	2.00
34	Promote renewable energy facilities in water sector	5	4	3	1.83
	Total	**44**	**118**	**246**	
	Percent	**11%**	**29%**	**60%**	

Twelve organizations responded to the survey. A greater response was hoped for, but numerous requests were sent out to complete the survey and the response is considered the best achievable. Only one person from each organization was allowed to complete the survey to prevent any organizations from being over-represented. The participants included representatives from federal agencies, special districts, Native American Tribes, non-governmental organizations and landowners.

4.6 - Previous Goal and Objective Ranking

In 2009 the RWMG developed and ranked preliminary goals. These goals were considered in the development of the more comprehensive goals presented in **Table 4.1**. However, their ranking is provided below to document historical efforts, and for comparison to the recent ranking efforts, especially to show how goals have changed from being more planning-focused in 2009 to more implementation-focused in 2014. The results in **Table 4.3** are not intended to guide decision making or setting priorities.

In 2009, fifteen goals were identified and stakeholders ranked according to the following criteria

- Urgent – 3 points
- Important (but not as important as urgent item) – 2 points
- Would be Nice (but not particularly important or urgent) – 1 point

The survey results are summarized in **Table 4.3**. The score is the sum of points from voting by several stakeholders. The average score for the goals is 29.

Table 4-4 Initial Ranking of Regional Goals (2009)

Rank		Description	Related Goal or Objective
1	44	Find ways to bring the resource management agencies and organizations together to share data and information and to work collaboratively on policies, plans and projects.	Vision statement for RWMG
2	43	Assess hydrologic capacity of Region - amount of water available in fractured rock system.	1b – Increase understanding of water balance
3	37	Provide examples of best practices, technical assistance and training that furthers the implementation of multi-benefit/integrated management strategies	2b – Promote water quality best management practices
4	36	Assist stakeholder agencies in improved outreach, public education and stakeholder involvement by providing forums for public discussion, e-mail notice lists, etc.	5a – Promote community education on water issues
5	33	Put together baseline watershed conditions for purposes of climate change, etc.	1e – Mitigation and adaptation to climate change impacts on water resources
6	32	Help frame a cumulative effects analyses for the Region that can streamline the process and enhance the value of the analysis for everyone. (Cumulative Watershed effects model analysis for the Region)	1b – Increase understanding of water balance
7	32	Create a web portal with links to all planning documents and studies for the Region.	5d – Create/maintain RWMG website
8	31	Assess small system water quality problems and provide feasibility analysis for corrective actions.	2e – Assess water quality of small water systems
9	30	Study the impact of septic systems on water quality	2f – Study septic system impacts
10	29	Assess options for water storage infrastructure where needed.	1c – Increase capacity of water storage facilities
11	27	Synthesize interagency databases from existing agency sets (e.g., South Sierra Geographic Information Coop)	5d – Create/maintain RWMG website
12	21	Construct data base showing all CEQA/NEPA documents in process, (example: USFS Schedule of Proposed Actions (SOPA)). Create notification system that will filter project by type, region, etc. that automatically will send out notices to interested stakeholders.	5d – Create/maintain RWMG website
13	19	Identify beneficiaries of Region's ecosystem services/benefits. Engage in outreach and education to the beneficiaries to increase the likelihood that they will contribute to watershed health.	5a – Community education on water issue 5b – Increase outreach to Native American Tribes 5c – Increase outreach to disadvantaged communities
14	10	Education on legal issues	5a – Promote community education on water issues
15	9	Develop curriculum/training program	5a - Promote community education on water issues

Chapter 5 - Resource Management Strategies

5.1 - Introduction

A resource management strategy (strategy) is defined as a project, program, or policy that helps local agencies and governments manage their water and related resources (DWR, 2013 California Water Plan Update). Resource management strategies (RMS) include structural development of capital facilities such as conveyance structures (pipelines or canals), recharge ponds, and water treatment plants, and non-structural solutions including programmatic or policy solutions, such as drought response plans or water conservation ordinances. The 2013 California Water Plan Update describes 37 separate resource management strategies. (Although a new 2018 California Water Plan Update Draft is in progress, no new Resource Management Strategies are currently being proposed.) The State does not expect that each of the 37 strategies be implemented in every region but does require that each are addressed and encourages as many strategies be implemented as practical to diversify their water management program. This IRWMP evaluates each of the strategies listed in the 2013 California Water Plan Update, including an additional strategy on 'Drought Planning', which was added by the Southern Sierra Regional Water Management Group (RWMG). The evaluations include the following:

- Description of the strategy
- Discussion of current use in the Southern Sierra RWMG area
- Evaluation of applicability in the area
- Constraints to implementation
- Impacts of climate change on the efficacy of the strategy
- Ability of strategy to help adapt to climate change impacts

The 2013 California Water Plan groups the RMS into 8 topical categories. Each category contains specific strategies outlined in the 2013 update. These categories include:

- Reduce Water Demand
- Improve Operational Efficiency & Transfers
- Increase Water Supply
- Improve Flood Management
- Improve Water Quality
- Practice Resources Stewardship
- People & Water
- Other Strategies

Each strategy was evaluated through an open and transparent process by the Coordinating Committee and the RWMG including its members and interested stakeholders. Each strategy was individually evaluated, and the RWMG identified which were applicable to the Region.

The Southern Sierra IRWMP encompasses the upper watersheds for eight major rivers and streams. In addition, six different IRWMP groups are located downstream of the Southern Sierra IRWMP Area. Many of the resources management strategies will have a significant impact on water supply and water quality in these downstream areas.

Table 5-1 shows the categories and related strategies that were evaluated, and which are applicable to the Southern Sierra RWMG. Those that are not currently applicable will be periodically reviewed as part of the IRWMP's annual review report and its adaptive management strategy. More than 30 of the strategies are currently being implemented within the Southern Sierra Region, and, as a result, the Region maintains a reasonably diverse water management portfolio. All of the relevant strategies will be used to meet the Goals and Objectives (Chapter 4) of this plan. Some of the strategies, while applicable, have limited potential since they only apply to a small area. These strategies would, however, have a significant benefit to localized areas. Some other strategies have limited potential due to possible constraints in getting regulatory approval or funding.

Table 5-1 Resource Management Strategies

Potential Benefits *

Resource Management Strategies **	Reduce Drought Impacts	Improve Water Quality	Higher Operational Flexibility & Efficiency	Reduce Flood Impacts	Environmental Benefits	Energy Benefits	More Recreational Opportunities	Reduce Groundwater Overdraft	Improve Food Security	Public Safety & Emergency Response
Reduce Water Demand										
Agricultural Water Use Efficiency	○	○	○		○	○		○	○	
Urban Water Use Efficiency	●	○	○		○	○		●		
Improve Operational Efficiency & Transfers										
Conveyance — Delta	Not Applicable									
Conveyance — Regional / Local	○		○	○				○	○	
System Reoperation	○									
Water Transfers	○		○					○		
Increase Water Supply										
Conjunctive Management & Groundwater Storage	○	○	○	○	○			○	○	
Desalination - Brackish Water & Seawater	Not Applicable									
Precipitation Enhancement	●						●	●	●	
Recycled Municipal Water	○		○			○		○		
Surface Storage – CALFED	○		○	○			○	○	○	
Surface Storage – Regional / Local	○		○	○			○	○	○	
Improve Flood Management										
Flood Management		○	○	○	○					○
Improve Water Quality										
Drinking Water Treatment & Distribution	○	○								
Groundwater / Aquifer Remediation		○								
Matching Quality to Use	○	○	○		○				○	
Pollution Prevention	●	●			●	●	●		●	●
Salt & Salinity Management		○			○				○	
Urban Stormwater Runoff Management	○	○	○	○	○			○		○
Practice Resource Stewardship										
Agricultural Land Stewardship	●	●		●	●		●	●	●	
Ecosystem Restoration	●	●	●	●	●		●	●	●	
Forest Management	●	●		●	●		●	●		●
Land Use Planning & Management	●	●		●	●		●	●	●	●
Recharge Area Protection	○	○	○	○				○	○	
Sediment Management		●		●	●		●	●		●
Watershed Management	●	●	●	●	●	●	●	●	●	●
People & Water										
Economic Incentives (Grants, Water Pricing, etc.)	●		●		●	●				

Resource Management Strategies **	Potential Benefits *: Reduce Drought Impacts	Improve Water Quality	Higher Operational Flexibility & Efficiency	Reduce Flood Impacts	Environmental Benefits	Energy Benefits	More Recreational Opportunities	Reduce Groundwater Overdraft	Improve Food Security	Public Safety & Emergency Response
Outreach and Education	●	●			●		●			●
Water & Culture					●		●			●
Water-Dependent Recreation				●	●		●	●		
Other Strategies										
Crop Idling for Water Transfers	○		○		○	○		○		
Dewvaporation/Atmospheric Pressure Desalination	Not Applicable									
Fog Collection	Not Applicable									
Irrigation Land Retirement	○	○			○	○		○		
Rainfed Agriculture		○			○	○		○	○	
Waterbag Transport / Storage Technology	Not Applicable									
Drought Planning**	●	●	●		●		●	●	●	●
Climate Change Mitigation **	●	●	●	●	●	●	●	●	●	●

● Applicable to Region
○ Applicable, but limited in area or in the potential for project approval
* List of Potential Benefits based on those provided in the 2013 California Water Plan
** Drought Planning was added as a strategy by the Southern Sierra RWMG

Following is a general description of each strategy and its use in the Region. Refer to the 2013 California Water Plan Update for further detail on each strategy.

5.2 - Reduce Water Demand

5.2.1 Agricultural Water Use Efficiency

Agricultural water use efficiency can be improved through a variety of measures by the governing irrigation or water district, and by local growers. The Southern Sierra has a limited area of irrigated agricultural land at 15,500 acres **(Figure 3-11** in Region Description Chapter), which equates to less than one percent of the total IRWMP area. However, where it is practiced, agriculture is a significant part of the cultural heritage, produces significant income, and locally agricultural water use efficiency can be very important. In addition, vast areas (millions of acres) of agricultural land are irrigated in the San Joaquin Valley, which stresses the importance of proper watershed management to ensure sufficient water quantity and quality (see **Section 5.7.7**).

The 2013 California Water Plan Update lists 16 Efficient Water Management Practices (EWMPs) for agricultural water management, including:

- Water management plans
- Water conservation coordinator
- Water management services to water users
- Improve communication and cooperation
- Policy changes
- Facilitate alternative land use (drainage)
- Facilitate use of recycled water
- On-farm irrigation systems improvements
- Water transfers
- Canal lining and piping to reduce seepage
- Flexible water ordering
- Spill and tail-water recovery systems
- Conjunctive use of surface and groundwater
- Automate canal-control structures/telemetry
- Water measurement and water use reports
- Pricing or other incentives

Several of these EWMPs are used throughout the irrigated agricultural areas of the Southern Sierra and are included in the regional water management strategy. Their use varies, in some areas certain EWMPs are not used because they are not economical or practical. For instance, some ditch managers do not line their canals because canal seepage is an important part of their conjunctive use program.

Regulated deficit irrigation can also help to reduce water demands, especially in years when water supply is limited. Regulated deficit irrigation requires intensive monitoring. More information is provided in the 2005 California Water Plan Update (pages 4-207 to 4-210).

Anti-transpirants (chemicals applied to foliage that reduce plan transpiration) may hold promise for conserving water in the future, if they do not cause human health problems (some are considered safe for use on edible crops and others are not). Currently they are commercially available and used in gardens, nurseries, on cut flowers and on Christmas trees. Use on large-scale agriculture is still experimental and has several obstacles to overcome, including potential reduction in crop yields, high cost, and difficulty applying to large leaf/foliage areas of some crops.

Some obstacles to implementing EWMPs include: lack of grower interest, funding and cost-effectiveness, high water use efficiencies in some areas that reduce feasibility of further water conservation, and local conditions such as topography, micro-climates, etc., that make certain EWMPs impractical.

Climate change is not expected to impact the efficacy of agricultural conservation measures per se, although climate change may reduce water supplies or alter the timing of water supplies and improving agricultural water use efficiency can be an effective method to adapt to climate change.

5.2.2 Urban Water Use Efficiency

Improvements in urban water use efficiency can result in reduced water demand and improvements to quality through technological and behavioral improvements (behavioral modification) that decrease indoor and outdoor residential, commercial, industrial, and institutional water use. Methods to improve urban water use efficiency are typically called best management practices (BMP) or demand management measures (DMM). Some of the common BMPs and DMMs are listed below:

- Water survey programs
- Residential plumbing retrofits
- Water system audits
- Metering or improved metering
- Large landscape conservation programs and watering schedules
- Improved efficiency washing machine rebates
- Public information programs
- School education programs
- Conservation programs for commercial, industrial and institutional accounts
- Wholesale agency assistance programs
- Retail conservation pricing
- Conservation coordinator
- Water waste prohibition
- Low flow toilet replacement

Many of these are practiced to some degree in the Southern Sierra Region, but the level of practice varies. With few medium-sized districts (i.e. Springville and Three Rivers), and a majority of small to single connection systems in the Region, extensive urban water conservation programs are limited in scope and provide difficult public awareness challenges. In addition, these programs can be difficult to fund and administer in smaller communities (typical to the Southern Sierra). However, new conservation measures are constantly being developed. Continued efforts will become more critical to local success as high quality water supply becomes more difficult to secure.

The SBx7-7, also known as the Water Conservation Act of 2009, set a goal of reducing per capita water use by 20% by 2020. To meet these goals, some agencies will need to increase their urban water conservation efforts. Urban Water Management Plans are the primary document for recording urban water conservation measures. However, none of the water agencies in the RWMG area are required to prepare Urban Water Management Plans because their population and water deliveries fall below the threshold (greater than 3,000 connections or 3,000 AF delivered per year). Obstacles to implementing urban water use efficiency measures include sparse population, few water agencies, funding, public acceptance, reduced revenue from lower water sales, and poor economics. Other alternatives such as developing new water supplies are viewed by some as less expensive and more beneficial (even if not practicable).

Climate change is not expected to impact the efficacy of urban conservation measures. Climate change may reduce water supplies or alter the timing of water supplies, and improving urban water use efficiency can be an effective method to adapt to climate change. However, the Governor has recently declared a state of emergency and enacted several program modifications intended to improve local drought response. Many local communities have also imposed water use restrictions while looking to improve delivery reliability.

5.3 - Improve Operational Efficiency and Transfers

5.3.1 Conveyance – Delta

Delta conveyance includes managing, conveying and diverting water from the Sacramento-San Joaquin River Delta. The County of Fresno does depend on Delta conveyance with their Cross Valley Canal contract. They have a contract for 3,000 AF from the Shasta unit of the CVP. The water is delivered to Fresno County through a water exchange and used in the valley. There is little or no direct impact on the Southern Sierra IRWMP area or its stakeholder operations within the Region. However, this does provide an important water supply in this area where all other supplies are appropriated.

5.3.2 Conveyance – Regional/Local

Conveyance provides for the movement of water from the source to areas of need and includes natural channels and constructed facilities, such as canals, pipelines, pumping plants, and diversion structures. Conveyance facilities in the Southern Sierra are generally limited to small, local end-user distribution systems. Specific objectives for natural and managed water conveyance activities include urban and agricultural water deliveries, flood management, consumptive and non-consumptive environmental uses, and recreation.

Demand for higher conveyance capacity may increase if climate change continues to modify the timing and volume of river and stream flows. Increased capacity may be needed to deliver water during different times of the year, or to deliver high volumes during shorter durations.

5.3.3 System Reoperation

System reoperation involves changing existing operational procedures for existing reservoirs and conveyance facilities to increase water related benefits. System reoperation may improve the efficiency of existing water uses or it may increase the emphasis of one use over another. For instance, system reoperation could involve changing reservoir release schedules to improve fisheries or provide flood control. Reoperation may require new facilities or permits, and is sometimes legally challenged.

There are several reservoirs with the Southern Sierra IRWM Region which could in theory be affected by reoperation. Reservoir operations are largely controlled by existing demands and regulations concerning water rights, flood control, hydropower generation, and environmental flows. The existing reservoirs are considered to be operating as efficiently as possible under these current constraints. Improving operational conditions for one purpose (such as fish) would likely be at the expense of another purpose (such as water supply). As a result, wholesale reoperation is not considered feasible, unless highly creative operational scenarios are developed. Changes in water demands and climate change could provide the need for re-operation, and consequently re-operation options will be periodically evaluated.

5.3.4 Water Transfers

Water transfers are defined in the California Water Code (CWC) as a temporary or long-term change in the point of diversion, place of use, or purpose of use as a result of a transfer or exchange of water or water rights. Water transfers can help areas obtain new water supplies, increase supply reliability, reduce or eliminate overdraft, or generate revenue if water is transferred out of the jurisdiction. Water transfers have become a common part of the water management landscape throughout California. Water transfers may have a limited affect in the Southern Sierra Region due the small areas using surface water. Further constraints to water transfers in the Southern Sierra area include: 1) challenges with moving water upstream (if necessary); 2) consistency with local policies; 3) local and state political acceptability; 4) regulatory issues; 5) cost; and 6) availability of facilities. However, water transfers are a fundamental strategy for managing water in California and may be beneficial in certain areas of the Southern Sierra. Contracts that maintain water rights for holders, but temporarily provide relief or additional supplies to downstream or instream users, are an important strategy to address flexibility in water management.

Climate change may impact the volume of water available to transfer, but could also increase the demand and need to transfer water throughout the Southern Sierra and State of California.

5.4 - Increase Water Supply

5.4.1 Conjunctive Management and Groundwater Storage

Conjunctive management, also referred to as conjunctive use, is the coordinated and planned management of both surface and groundwater resources in order to maximize their efficient use, typically in areas with lower water table and poor aquifer conditions. Conjunctive management is often used to improve water supply reliability and environmental conditions, reduce groundwater overdraft, reduce land subsidence, and protect water quality. Conjunctive use can be performed in many fashions, but often includes recharging groundwater in wet years, and extracting that groundwater in dry years.

The Southern Sierra IRWMP area's geophysical region is typified by hard rock geology with little areas conducive to typical aquifer recharge. Groundwater flow is generally fracture flow and controlled by the direction and dip (angle) of the fractures. Often the larger fractures are preferentially eroded away from drainage paths and even valleys. Recharge basins and stormwater basins can be used to recharge the groundwater, but it is difficult to determine where the recharged water will flow and how much it will benefit the local area. DWR performed a preliminary water supply study on the Three Rivers area that starts to answer some of these questions (see **Appendix D**)

Improvement of natural areas that reduce surface water losses and that promote recharge to these fractures will be encouraged by the Southern Sierra RWMG. For example, projects and policies that reduce the forest understory to natural conditions would reduce water losses to evapotranspiration and increase recharge, and restoration of head water meadows would improve water supply by transferring surface water and snow melt to stored groundwater in the meadow complex.

Constraints to developing conjunctive use facilities include:

- Topographic and physiographic nature of the Southern Sierra Region
- Identification and access to prime recharge lands
- High cost of purchasing land and developing recharge basins and recovery wells
- Limitations in conveyance capacity to deliver water to basins
- High operational costs, especially if recharged water is not later recovered and sold
- Risk that water stored cannot be extracted when needed because of infrastructure, litigation, water quality or water level, politics, and institutional or contractual provision

The Southern Sierra RWMG could also seek opportunities for inter-regional conjunctive use programs (i.e. groundwater storage outside of the Region) that could benefit the area.

Climate change will impact the timing (more rain instead of snow and faster snowmelt) and quantity of precipitation and alter the amount of water available for conjunctive management. However, as climate change is projected to make precipitation more variable, and potentially reduce water supplies, conjunctive management would be a viable strategy to help adapt to climate change.

5.4.2 Desalination – Brackish and Seawater

Desalination is a water treatment process for the removal of salts from water for beneficial use. Desalination is not only used on seawater, but also on low-salinity (brackish) water from groundwater or other sources. In California, reverse osmosis is the principal method for desalination. This process can also be used to remove other natural contaminants in water such as arsenic, chromium, and man-made (anthropogenic) compounds such as trihalomethane precursors, volatile organic compounds, nitrates, and pathogens. The benefits of desalination may include:

- Increased water supply;
- Reclamation and beneficial use of impaired waters;
- Increased water supply reliability during drought periods;
- Diversified water supply sources;
- Improved water quality; and
- Public health protection.

Generally speaking there is little need or opportunity for desalination in the area. High chloride groundwater occurs in limited areas in some wells drilled into specific and limited geologic formations. Treatment of non-potable, high chloride wells would likely be too expensive to be practicable for single connections or small community systems.

The constraints for desalination in the Southern Sierra include lack of saline water sources, excessive cost for plant construction and operation, lack of economies of scale, and brine disposal. These constraints limit the applicability of desalination for the Region. There are no current opportunities for desalination and it is not currently a viable strategy for the Region on a large scale.

5.4.3 Precipitation Enhancement

Precipitation enhancement, commonly called 'cloud seeding', artificially stimulates clouds to produce more rainfall or snowfall than would naturally occur. This is performed by depositing or injecting seeding agents into the clouds that enable snowflakes and raindrops to form more easily. Precipitation enhancement is not a remedy for drought, since opportunities are generally fewer in dry years. In regions with large ability to store surface or groundwater seeding can result in increasing 'average' supplies. Most projects suspend operations during very wet years once enough snow has accumulated to meet their water needs. Recent reports, summarized in Chapter 11 of the The 2013 California Water Plan Update, indicate that in the Sierra Nevada cloud seeding can result in a 2 to15 % increase in precipitation.

Cloud Seeding By RHS Consulting Ltd

Cloud seeding has been conducted in the San Joaquin, Kings, Kaweah and Kern River watersheds for many years. The San Joaquin River Weather Modification Program has performed cloud seeding since the 1950's. The program is one of the longest running cloud seeding operations in California. The core operational project period is December through March, with the possibility of extending the period due to water supply conditions. The program utilizes the following methods: 1) aircraft seeding of storms as they approach the Sierra foothills upwind of the target area, and 2) seeding using an array of ground-based seeding generators in the foothills. Both seed modes are targeting the pool of low-altitude supercooled liquid water that develops in-cloud over the windward slopes of mountain barriers.

For comparison, analyses of the seeding effectiveness in the Kings River Weather Modification Program have been made at intervals throughout the project's history. A recent published estimation indicates a long-term average increase in Pine Flat Reservoir inflow of about "*5.1%, with 90% confidence that the true effect of seeding is somewhere between +1.5% and +8.8%*" (Silverman, 2007). Recent estimations using April 1 snowpack data indicate that, over the full seeded history of the project, an average increase of approximately 4% to 6% has occurred. These numbers fall within the range of 2 to 15 percent cited by the 2009 and 2103 California Water Plan Updates for other successful cloud seeding programs.

RHS Consulting Ltd., has been conducting cloud seeding in the Southern Sierra since 2011, and has evaluated their data since the project's inception. Their presentation can be found at: http://cdec.water.ca.gov/snow/meeting/2013/11-Cloud-Seeding-Activities-in-the-Southern%20Sierra.pdf

Silverman also indicates that in the San Joaquin River program:

> "*cost-effective increases in streamflow after 56 years of seeding was found for Mono Creek and Pitman Creek, but the results for Bear Creek were not statistically significant. Physical studies that help explain the statistical results and that could lead to more cost-effective seeding operations are suggested*". (Journal of Weather Modification Volume 41, No 1 2009)

Silver iodide is the most-commonly-used agent for cloud seeding. Currently, there is no clear consensus on the environmental impacts of silver iodide, in the concentrations introduced during cloud seeding, on aquatic habitat and wildlife – some studies suggest impacts and other do not. It continues to be used as a cloud seeding agent, however, research into new and alternative cloud seeding agents is on-going.

Climate change will impact the timing and nature of precipitation events, making it difficult to operate cloud seeding operations since past weather may not be good indicators of future conditions. However, in the snow zone, cloud seeding might offset some of the loss in snowpack expected from climate change. According to the 2013 California Water Plan Update, the State should support research on potential new seeding agents, particularly those that work at higher temperatures. Climate change in the Southern Sierra may limit the effectiveness of silver iodide, the most commonly used agent, which requires cloud temperatures well below freezing, around -5°C, to be effective.

5.4.4 Recycled Municipal Water

Recycled water can be used for a variety of purposes depending on its level of treatment. Some common uses include non-edible crop irrigation, freeway landscaping, groundwater recharge, and industrial processes. The State is supporting the use of reclaimed wastewater as documented in the State Water Plan and the recommendations of California's Recycled Water Task Force. The DDW has produced "The Purple Book," which contains health laws related to reuse of recycled water (CDPH, 2001). The DDW defines the appropriate legal uses based on the level of treatment (primary, secondary, or tertiary). One of the most common uses for recycled water is groundwater recharge. However, groundwater recharge projects that use reclaimed wastewater require DDW and Regional Water Quality Control Board (RWQCB) approvals based on effluent quality and quantity, spreading area operations, soil characteristics, hydrogeology, residence time, and distance to withdrawal.

Within the Southern Sierra there is limited potential for recycled municipal water, since most wastewater is disposed in septic systems. The largest wastewater treatment plant is found in the community of Springville (2010 population of 934).

Obstacles to using recycled water include the high cost, lack of water supply benefits when recycled water is already being recharged, regulatory issues, public acceptance, and marketability of recycled water. However, the Region recognizes that some recycled water supplies are an untapped source, and they will gradually be developed as demands and funding increase. Climate change is not anticipated to impact the effectiveness of using recycled municipal water. If climate change adversely impacts water supplies, recycling municipal water could be a useful tool to help augment water supplies.

5.4.5 Surface Storage – CALFED

The CALFED Bay-Delta Program, also known as CALFED, was a department within the government of California that focused on interrelated water problems in the state's Sacramento-San Joaquin River Delta. In 2009, CALFED was replaced by the Delta Stewardship Council. 'CALFED Surface Storage' is the legacy name for a resource management strategy to improve surface storage while simultaneously improving conditions in the Delta. The CALFED Surface Storage strategy includes five potential surface storage reservoirs in California, including one in the upper watershed of the San Joaquin River. A surface water storage project in the upper reaches of the San Joaquin River could provide significant water supply benefits, although much of the water would likely be reserved for agricultural, urban and environmental demands outside of the RWMG area in the San Joaquin Valley.

Surface Storage – Regional/local

Surface storage is the use of on- or off-stream reservoirs to collect water for later release and use. There are a number of storage dams and reservoirs in the Southern Sierra. For example, Lake Kaweah has played an important role in the Region where the pattern and timing of water use does not match the natural runoff pattern. The reservoir has provided historical benefits in the areas of conjunctive management and flood control. Friant Dam provides storage and regulation of San Joaquin River water. Other reservoirs are summarized in **Appendix C**.

Pine Flat Dam on the Kings River

Building large-scale surface storage in California and the nation as a whole is difficult because most of the prime sites have already been dammed, and regulatory, political, and economic constraints make planning for and construction of dams extremely slow and difficult. Small-scale reservoir projects may hold more promise due to the significant expense of developing large-scale surface storage. In addition, dam raising project, such as the raising of Terminus Dam on Lake Kaweah, may be more practical projects. However, they could still face significant environmental/permitting hurdles and public opposition. Off-channel reservoirs have been successfully developed by irrigation and water districts in the San Joaquin Valley, and offer potential to some local agencies. In the future, if climate patterns change results in longer and deeper drought conditions, including reduced snow pack and increased winter runoff, the priority for surface storage for water supply and flood control purposes could change.

Averaged over wet and dry years, the Sierra snowpack has historically provided natural water storage equal to about half the capacity of the Sierra's major human-made reservoirs (Cayan et al., 2006). Targeted forest thinning and restoration projects have a high potential to extend snow storage and increase water availability for ecosystem and downstream uses. Historical studies of forest harvesting in the Sierra Nevada have projected increases of 14-34% in snow accumulation (Bales et al., 2011). Treatments that increase snow accumulation and reduce evapotranspiration help enhance streamflow during low flows, when water resources' economic and ecosystem values are highest.

5.5 - Improve Flood Management

5.5.1 Flood Risk Management

Flood risk management is a strategy that assists individuals and communities in managing flood flows to prepare for, respond to, and recover from a flood or high flow events. Some examples of flood risk management include levees, floodwalls, floodplain zoning, floodplain function restoration, disaster preparedness, and flood emergency response. FEMA does not maintain flood risk maps for most of the Southern Sierra due to the lack of flood potential, which is a result of the topographic relief and absence of large, relatively flat floodplains. However, flash floods and high flow events in rivers and creeks (at their respective 100 year channels) are highly likely with warming climate (Das et al., 2013). In addition, bridges and other "choke points" across many streams and rivers has created the potential for high flow short-circuiting and erosion problems that damage built infrastructure and natural features. Landslides pose a particular flood risk where incised river channels may be dammed from debris flow from upstream or upslope. Mapping the risk areas is an important aspect of flood risk management in the Southern Sierra.

Local attention should be given to alleviating potential damage from high flow events. The intensity and duration of precipitation events, associated with possible weather pattern changes due to climate change (Dettinger, 2011), can have significant local affects. High flow events are projected to increase in number and/or volume as precipitation phase shifts (more rain instead of snow) and earlier and faster snow melt (Bales et al., 2006; Safeeq et al., 2015). By end of century, discharges from the Southern Sierra Nevada with 50-year return periods may increase by 50–100% (Das et al., 2013). Often older structures associated with rural areas have not been reevaluated under new climate change scenarios and could thus present higher risks. Hence, these effects should be evaluated in light of the prediction of changing patterns described in Chapter 16 (Climate Change).

5.6 - Improve Water Quality

5.6.1 Drinking Water Treatment and Distribution

A reliable supply of safe drinking water is the primary goal of municipal water systems and paramount to small and single well domestic systems. To achieve this goal adequate water treatment and distribution facilities are needed. Water treatment must meet State and Federal drinking water standards. Opportunities for distribution systems in the Southern Sierra are limited due to the sparse population. Additional constraints to developing water treatment and distribution systems include high capital cost, high O&M cost, and opposition to higher water rates.

Most developed areas the Southern Sierra rely on fracture-controlled groundwater to meet all water needs. These aquifers have limited ability to store and transmit groundwater, and well yields are typically low. Aging infrastructure, rural growth, more strict water quality standards and rising treatment costs pose significant challenges, especially to disadvantaged communities (DACs) and Native American tribal lands. Greater use of surface water in-lieu of groundwater could help reduce groundwater dependence in some areas.

Climate change could impact water quality and impact the need for or type of water treatment that could become necessary for existing and future systems. Lower precipitation could result in changing water chemistry in fracture flows resulting in increasing concentrations of gross alpha, arsenic and other naturally occurring compounds detrimental to human health.

5.6.2 Groundwater Remediation/Aquifer Remediation

Groundwater remediation involves either: 1) in-situ treatment or 2) extracting contaminated groundwater from the aquifer, treating it, and discharging it to a water course, using it for some other purpose, or injecting it back into the aquifer. Contaminated groundwater can result from a multitude of both naturally occurring and anthropogenic sources (e.g. underground storage tank leaks, dry cleaner releases). Remediation results in an additional water source that would not be available without remediation, but groundwater treatments are expensive and years or decades may be required to remediate contaminated groundwater sites. There are several known contaminated groundwater cases open in the IRWMP Area under the Regional Water Control Board, Fresno County, and Tulare County. These projects typically address specific plumes and are the responsibility of the owner and/or operator of the site. Under certain situations municipalities can take over the remediation on behalf of absent or financially deficient responsible parties (RPs). Lists and maps of contaminated sites can be viewed at http://geotracker.waterboards.ca.gov/.

Applicability to the Region is limited to areas in close proximity to contaminated sites or releases. Typical groundwater impacts from contaminated leaks are less than 2,000 feet in length, and, in hard rock, fracture controlled flows do not impact large quantities of useable groundwater. Though every contaminated leak should be assessed and attempts to remediate made to the extent possible, most situations affect a very limited number of groundwater users.

Climate change effect on groundwater remediation is expected to be very low and limited to indirect affects if groundwater itself becomes less available.

5.6.3 Matching Quality to Use

Matching water quality to use is a strategy that attempts to match water uses with the appropriate water quality. This strategy tries to avoid using high quality water for certain uses that do not require it. For example, groundwater of diminished quality can sometimes be applied to other uses, such as irrigation, industrial use, or groundwater recharge. In the Southern Sierra Region the obstacles to matching quality to use include: 1) little low quality water, 2) the general lack of abundant water supply, 3) public acceptance of using lower quality water (even if it acceptable for the intended use), 4) geographical distribution of the water supplies with different qualities, which may not be in or near places they can be beneficially used; and 5) limited conveyance systems to allow for the re-distribution of water supplies. There is some, but limited potential for this strategy due to the low level of agricultural and industrial water demands, which can often use lower quality or non-potable water.

Climate change may adversely impact the quality of some water supplies and require a re-evaluation of matching water quality to use.

5.6.4 Pollution Prevention

For the vast majority of manmade contaminants, it is generally accepted that a pollution prevention approach is more cost-effective than “end-of-the-pipe” treatment of wastes or advanced water treatment for drinking water. However, because of the nature and sources of some contaminants, a pollution prevention approach may not be possible, cost-effective, or desirable in some instances. In the Southern Sierra pollution prevention is practiced primarily through regulatory programs in lower elevations for irrigation and confined animal facilities. Some urban activities such as wastewater disposal and stormwater runoff are managed by existing Water Board Policy, and there are some rangeland management policies directed at erosion and sediment management. The National Park Service (NPS) and the US Forest Service (USFS) and their partners have developed in-house pollution prevention strategies. Some water facilities are also fenced, or access is limited, partly to help preserve good water quality. Pollution prevention also overlaps with the forest management and watershed management strategies that aim to reduce eroded sediment and pollution from entering water sources.

Climate change could impact pollution through new erosion patterns, concentration of contaminants in overdrafted groundwater, and less dilution capacity in water bodies for wastewater effluents. This may increase the need to implement stricter pollution prevention measures.

5.6.5 Salt and Salinity Management

Salt and salinity management includes efforts to limit buildup of salts in the soil and water, and mitigate lands currently impacted by salts. Salinity problems in the groundwater and soil are not prevalent in the Southern Sierra, therefore this strategy is limited to applicable irrigated farm land in the Region.

5.6.6 Urban Stormwater Runoff Management

The Southern Sierra contains little urbanized area and thereby few opportunities to develop urban runoff. Therefore, the management opportunities are also limited. Run-off management is generally considered a broad series of activities to manage both storm water and dry weather runoff. Dry weather runoff occurs when, for example, excess landscape irrigation water flows to the storm drain. In the Southern Sierra, dry weather runoff is limited to areas with landscape irrigation in the few larger urban centers. Urban runoff management has the primary goal of preventing damage from stormwater or urban water used, but should also consider multiple purposes such as water supply and habitat enhancement. Increased urbanization also may result in increased paved areas and runoff. This serves to change the local conditions and amounts of water available, and may affect groundwater recharge of natural precipitation. Maintaining the quantity and quality of groundwater recharge as part of stormwater management is considered very important in specific areas of the Region.

The intensity and duration of precipitation events may change due to climate change. These effects should be evaluated in light of the prediction of changing patterns described in **Chapter 16** (Climate Change).

5.7 - Practice Resource Stewardship

Following are discussions on seven different management strategies related to resource stewardship. Many of these management strategies are overlapping in their scope.

5.7.1 Agricultural Lands Stewardship

Agricultural lands stewardship broadly means the conservation of natural resources and protection of the environment on agricultural land. Land managers practice stewardship by conserving and protecting existing landscapes of high social values (NPS and USFS) and by improving land for food, fiber, bio-fuel, and solar energy production. Land

stewardship is also practiced through protection and conservation of soil, air, energy, plant and animal resources. As more land becomes developed in the San Joaquin Valley the lands of the Southern Sierra area will be increasingly relied on for such ecosystem services as watershed management, water conservation, habitat preservation, carbon sequestration, and resource management.

Agricultural land stewardship also protects open space and the traditional characteristics of rural communities. A significant percentage of the Southern Sierra area (over 79% or 3,000,000 acres) is managed by public agencies (**Figures 3.7** and **3.8**). In the limited areas of irrigated agriculture, agricultural land stewardship practices currently include wind breaks, noxious weed control, riparian buffers, cover crops, composting, and creation of wetland reserves.

Constraints to developing these types of projects include funding, financial incentives for landowners, landowner interest and recognition of benefits, and regulatory barriers. Climate change may negatively impact native habitats and require the preservation of more lands to help preserve aquatic species.

5.7.2 Ecosystem Restoration

Although ecosystem restoration can include a wide range of actions, we define it as restoration of meadow, forest, aquatic, riparian and floodplain ecosystems because they are the natural systems at the heart of the water supplied by the 3 million acres of upper watershed in the Region. They constitute the “green or natural infrastructure’ of the Region (Gartner et al., 2013). Forest ecosystem restoration activities range from reintroduction of low-intensity fires to major mechanical earth moving activities, and include managed wildfire. These ecosystems are also most directly affected by

water and flood management actions, are likely to be affected by climate change and can improve up stream water quality and run-off patterns. Abandoned mine restoration can also have a significant impact on water quality. Examples of ecosystem restoration include, curtailing waste flows into natural water bodies, reducing barriers to fish migration, meadow restoration, native plant preservation and restoration, road decommissioning, and restoring wetlands and riparian areas. Ecosystem restoration can also be directly incorporated into engineered projects, such as groundwater recharge basins. These types of projects are often done in collaboration with government agencies or non-governmental organizations.

The RWMG recognizes the importance of ecosystem restoration to improve water quality, provide flood protection, and increase public support for water projects. Examples of ecosystem restoration in the Southern Sierra IRWMP area include the Big Meadow, Long Meadow and Halstead Meadow restoration projects. Constraints to developing ecosystem restoration projects include funding, high land costs in some areas, feasibility of integrating restoration elements into proposed projects, regulatory constraints, lack of cost-benefit or effectiveness studies, and political acceptance.

Climate change may impact ecology and require a re-evaluation of ecosystem restoration efforts or strategies. Restoration efforts may be needed to help ecosystems adapt to climate change.

5.7.3 Forest Management

Forests occupy 44% of the Southern Sierra Region that cover substantial portions of all the four major watersheds, i.e. Kings, Kaweah, Tule, and Kern. Parts of the Sierra, specifically southern Sierra, are at a tipping point, as evidenced by the frequency and extent of stand replacing wildfires, and by the widespread forest mortality. Historically, tall trees, relatively low forest density, and mild climate defined the unique characteristics of our forests. However, decades of fire suppression have allowed forests to become unnaturally dense and unsustainable. The result is very high fuel loads, which when combined with a warmer and drier climate, give dry period responses that are different from those of past centuries. The Southern Sierra Region was at the hotspot of the recent forest die-offs during the 2012-2016 California drought that documented over 102 million dead trees. Most of the forest land is managed by the US Forest Service and the National Park Service and may require partnering with state and local government in order to develop and implement a successful forest management plan. Many of the Southern Sierra RWMG's members and stakeholders are directly involved in forest management and forest management planning.

Forests in California are used for sustainable production of resources such as water, timber, native vegetation, fish, wildlife, and livestock, as well as outdoor recreation. The economic value of water produced by forests equals or exceeds that of any other forest resource (CWP 2013 update). Almost all forest management activities can affect water quantity and quality. This strategy focuses on those forest management activities that are designed to improve forest health and the availability and quality of water for downstream users. Some forest management strategies include meadow restoration to regulate stream flows, abandoned mine reclamation, forest fuels reduction, forest fire management, and ecosystem restoration. Examples of forest management in the Southern Sierra Region include: 1) Big Meadows Improvement Project completed in 2007 in Sequoia National Forest; 2) the Dinkey Landscape Restoration Project for fuels reduction and habitat improvement in the Sierra National Forest; 3) Teakettle Ecosystem Experiment; and 4) the Kings River Experimental Watersheds for fuels reduction and riparian restoration in the Sierra National Forest is ongoing.

Forest-thinning prescriptions for fuels reduction and decreasing the risk of high-intensity, catastrophic wildfire are similar to those for enhancing water yield. Hunsaker, et al. (2014) reviewed studies on vegetation management and water yield and report that annual runoff increased about 0.1 inch for each 1 percent of watershed area harvested, and that approximately 20 percent of the basal area of the vegetation must be removed to detect a significant change in annual runoff. It is hypothesized that across the Sierra Nevada, average runoff yield could increase by approximately 9% with a 40% reduction in forest density (Bales et al., 2011). During the recent drought event, Bales et al. (2018) estimated that forest mortality and recent wildfire-associated thinning combined to reduce evapotranspiration in the first post-drought year (2016) by 20%, potentially increasing streamflow in that year by 15% compared to projections without forest disturbance. This is equivalent to about 217,000 acre-ft. Over the period 1990-2008, it is estimated that the net reduction in evapotranspiration due to wildfire across the Kings R. basin was about 10,000 acre-ft per year. There is evidence that forested areas in many mortality areas may not regenerate due to higher temperatures associated with climate change. This adds a further uncertainty to the regions water supply. Bart et al. (2016) reported that forest-to-shrubland type conversion in the Southern Sierra might increase or decrease streamflow depending on the water use of the replacement shrubs. A well-integrated approach to forest management considers many values such as water quality and aquatic habitat in an area rather than focusing on opportunities to maximize any one value such as water yield.

Much of the forested watershed within the Region could benefit from forest thinning to reduce the risk of catastrophic forest fires, reduce drought mortality risk of remaining trees, and to increase water yield. Expenses associated with forest thinning can vary from low hundreds of dollars to a thousand or more dollars per acre for “first entry” (to achieve sustainability). “Second entry” costs would be those related to long-term maintenance. Forest thinning can be done with fire or by mechanical activities, and expenses are dependent on a variety of site-specific conditions, including: how much thinning is needed, the appropriate method of thinning and maintenance to be used, whether follow-up work is needed, access conditions, topography of the area being cleared, equipment/worker mobilization, what types of trees and undergrowth are in the grove already, and current health and size of the trees being removed. Frequency would be on a case-by-case basis depending on the growth characteristics of the grove.

Expenses could conceivably be offset by revenues potentially derived as a result of the thinning project; that is, considerations for values of usable timber and lumber, biomass energy generated, contributions from headwater protection agencies, or others

Illegal marijuana cultivation is a significant problem in the forested areas. The forests provide cover and concealment for illegal operations, which are often found on public or tribal lands. Marijuana is typically cultivated without regard for impacts to the land or water quality. Specific impacts come from heavy application of fertilizers, pesticides, herbicides, and other toxic chemicals, removal of understory vegetation, and damming of small streams.

Constraints to forest management include the high cost of managing the vast forest lands in the Region, declining Congressional appropriations for forest management, and disagreements on forest management practices (such as the best method to reduce fire risks). Climate change will alter the forest landscape and could shift forested lands to higher elevations, and increase evapotranspiration. These shifts will impact both water quantity and quality for downstream areas. Forest management is important to help understand and adapt to climate change impacts on forest health and water resources.

5.7.4 Land Use Planning and Management

Integrating land use and water management is discussed in **Chapter 12 - Relation to Local Land Use & Water Planning**. The way we use land – the pattern and types of land use, transportation and level of intensity – has a direct relationship to water supply and quality, flood management, and other water issues. For example, local governments could require native landscape, near-native landscape, xeriscape or xeroscape to reduce water demands, or permeable pavement to improve run-off quality and reduce flood risks.

Planning for land use and water supplies is conducted by different agencies, at different times, for different planning horizons, often using different methodologies, assumptions, and data. As a result there are inconsistencies in the plans, poor coordination of public investments, and agencies subjected to legal challenges. Some local land use plans do not address, or only acknowledge, regional water issues, such as declining water supply. Consequently, developing an integrated land and water use planning effort could become an important goal in the Southern Sierra. California Senate Bill 375, The Sustainable Communities and Climate Protection Act of 2008, is an important bill related to land use planning. The bill encourages more-dense developments to reduce transportation, air pollution and water consumption.

Challenges to developing and implementing an integrated land and water use planning effort include low levels of public awareness, few governing agencies, and limited funding. An integrated effort would require the participation of city, county, state, and federal organizations and to date nothing has brought this together although the IRWMP process has this potential. Planning policies also need to address climate change, its impact on water supplies, and the need for adaptive management.

Finally, it is projected that responsibility for management of public lands that serve as source-water regions may no longer be the responsibility of just the federal government. As wildfire suppression costs consume an ever-increasing fraction of the budget of the U.S. Forest Service, state and local partnerships to finance forest restoration and source-water watershed management, as has been done in other parts of the U.S., provide a potential path forward in the Sierra Nevada.

5.7.5 Recharge Area Protection

Protection of recharge areas is based on two primary goals: 1) ensure that areas suitable for recharge are protected; and 2) preventing pollutants from entering groundwater to avoid expensive treatment that may be needed prior to potable, agricultural, or industrial uses. Recharge area protection has high importance since groundwater is the primary sources for potable water for most residences, the USFS and the NPS. There are few identified manageable recharge areas in the Region but additional work is needed to characterize lithology and map coarse-grained incised valley fill deposits (e.g. Kings River alluvial fan) that are not only most suited for groundwater recharge but also pose risk of pollutants entering into aquifer.

Federal, local, and county land use agencies can apply their land use authorities and develop policies to protect recharge areas, or require mitigation for groundwater impacts associated with new development. Agencies can also develop financial resources and acquire prime lands quickly from willing sellers when they are available on the market. High land and restoration costs, difficult access, lack of readily available capital, and inability to rapidly purchase lands are constraints to protecting prime recharge areas.

5.7.6 Sediment Management

Sedimentation is the process by which organic and inorganic materials are carried in surface water by sheet flow, in streams, rivers and eventually deposited in low velocity environments (e.g. sand bars of the Kaweah River and lakes). Sediment and sediment transport are critical to healthy aquatic ecosystems. In the wrong quantity, type and time of season sediments can cause significant damage to those systems. In addition, sediments carrying contaminants not indigenous to an area or in extreme concentrations can have long lasting effects that may require costly and long-term human intervention (e.g. oil spills, heavy metals from mining operations). Some harvesting of commercial timber occurs in the RWMG area, but recreation is considered the largest source of sediments. Dams also impound a large amount of sediment.

According to the 2013 California Water Plan Update, the key to effective water-sediment management is to address excessive sediment. Several impacts associated to excessive sediment loading can include the reduction of water clarity, reduction of available oxygen, excessive stream and lake-bottom loading and altering of the physical aquatic habitat. Each of these impacts have many resulting implications for aquatic habitats and the flora and fauna that occupy them, human use of the water way for recreation, and long-term alteration of landscapes.

Many state and federal agencies are involved in the management of sediment loading including the RWQCB for course-grained sediment to the coast (i.e. San Joaquin River), the USEPA, and State Land Commission, the NRCS, and others. Each agency has authority for aspects of sediment management respective to its own jurisdiction. Sediment management can be divided into several keys areas: Source Management, Transport Management and Deposition Management. Each of these areas has unique aspects and management strategies and BMPs.

Proper sediment management has important connections to other RMS in the Southern Sierra IRWMP including:

- Ecosystems Restoration
- Flood Management
- Forest Management
- Urban Storm-water Management

- Water Dependent Recreation
- Watershed Management

In the end, the benefits of well developed sediment management planning are a reduction in the negative impacts to the regions ecosystems. Too much or too little sediment can have dramatic impacts in the resource value and use, increase the potential for natural disasters and negative consequences for both the natural and built environment.

The effects of climate change on sediment management could be very significant. If certain predictions concerning the increase in warm weather and higher intensity and duration rain events are realized, then it can be expected that short duration sediment loading will increase. The physical and some chemical (Dissolved Oxygen, carbon loading) effects of these types of changes can be estimated in some systems but long-term proactive planning and implementation of remedial measures need to occur prior to the critical or emergency events. The effects on natural systems can be more subtle and will require research and educated planning efforts to reduce the impacts not yet understood.

5.7.7 Watershed Management

Watershed management is the process of evaluating, planning, managing, restoring, and improving land and other resource uses within an area of land that has a single common drainage point. This strategy is important for maintaining good water quality and healthy ecosystems. The entire Region is composed of several watersheds which feed rivers into the San Joaquin Valley and delta systems where the water ultimately is used by numerous cities and vast irrigated lands.

Dry Creek Watershed

Within the Southern Sierra Region there are a number of watershed planning efforts in progress. A watershed management plan has been prepared for the Upper San Joaquin River watershed. On the Kings River above Pine Flat Reservoir, a number of watershed planning efforts are occurring through the Resource Conservation Districts and National Forest Service. Other watershed management programs are implemented by non-governmental organizations. One example is the El Rio Reyes Conservation Trust, a regional California land trust whose mission is to safeguard the Kings River and its lands for future generations. The Trust believes the best way to accomplish this task is to conserve open space and riparian habitat and provide means to ensure the viability of the farms surrounding the river. The Region acknowledges these existing programs, seeks opportunities to coordinate efforts, and when appropriate, writes letters of support for funding projects. However, most areas in the Southern Sierra are not covered by a comprehensive watershed management plan, and significant work still needs to be performed.

Constraints to watershed planning include the size of the watersheds, multiple agencies with various responsibilities, and funding. Because 76% of the Region is in land managed by federal agencies (**Figure 3-7**) and most of these lands are required to have land management plans, the headwaters of the Region's watersheds are already protected or are open to public input on management. However, available funds for effective and sustainable stewardship are currently insufficient to implement plans. Therefore, IRWMP initiated watershed management activities could focus primarily on the remaining 24% of the land in the Region.

Climate change is projected to impact numerous aspects of watersheds such as vegetation, hydrology, water quality and wildlife. Watershed management plans should evaluate potential impacts from climate change and identify adaptation and mitigation measures.

5.8 - People and Water

5.8.1 Economic Incentives (Loans, Grants and Water Pricing)

Economic incentives include financial assistance, water pricing, and water market policies intended to influence water management. Examples of economic incentives include low interest loans, grants, free services, rebates, and water rate structures. Economic incentives can influence the amount of use, time of use, wastewater volume, and source of supply. Economic incentives can also produce environmental and social benefits, and avoid or delay construction of new facilities.

Economic incentives are not yet widespread throughout the Southern Sierra Region. Some specific incentives that have merit for the area include: tiered pricing, metering, rebate programs for installing conservation devices, and discounted prices for recycled water.

5.8.2 Outreach and Education

Outreach has been a hallmark of the Southern Sierra RWMG planning process, starting in the Spring of 2008. Accordingly, the Southern Sierra RWMG and its stakeholders already perform a wide range of public outreach and engagement. These include: special events, field trips, workshops, flyers, websites, educational materials, RWMG meetings, and email lists.

Constraints to outreach and engagement include the vast area in the Southern Sierra, low population density, and difficulty reaching large population groups. In addition, many of the land users are tourists and outreach and engagement must be performed while they are in the area and/or to the wider general public to reach these people.

Outreach and engagement is considered an important component of climate change mitigation and adaptations. Most of the general public lack the scientific background to fully understand the causes and impacts of climate change. Many people also undervalue the need for scientific rigor in climate change analysis and often form opinions based on single observations or limited data.

5.8.3 Water and Culture

Water is life in the Southern Sierra and culture shapes that life. As the National Park Service defines culture:

> *"Culture [is] a system of behaviors, values, ideologies, and social arrangements. These features, in addition to tools and expressive elements such as graphic arts, help humans interpret their universe as well as deal with features of their environments, natural and social. Culture is learned, transmitted in a social context, and modifiable. Synonyms for culture include lifeways, customs, traditions, social practices, and folkways. The terms folk culture and folk life might be used to describe aspects of the system that are unwritten, learned without formal instruction, and deal with expressive elements such as dance, song, music and graphic arts as well as storytelling*."

In the Southern Sierra Region water is the cornerstone of the culture. Whether Native American or fourth generation farmer or elementary school teacher, water influences every aspect of life and provides the ability to sustain human society on the land. Cultural connections to the land and water can involve a wide range of places, activities and norms. Maintaining natural water flows and qualities are critical to allow human social groups to experience these water dependent cultural connections.

Understanding the cultural histories, perspectives and activities is important for proper decision making by water managers. The Southern Sierra RWMG has several Tribal representatives as members and interested stakeholders. These representatives add significant value to the discussion and decision making of the RWMG including input on recreation, land use, historic use, and how current water policy may affect aspects of current life. For Native Tribal peoples, cultural prosperity is dependent on caring for the natural world.

Native American Tribes can contribute to the Region with their tribal ecological knowledge. Considering and using traditional knowledge and practices can inform decision makers to better sustain and integrate water management.

Climate change is and will continue to play an important role in the ability to manage water for many historic and cultural activities and needs. Native plants and animals may become scarce or migrate to higher elevation levels. Water itself may be less available in certain areas. Attention to these issues will be critical for continued connections to cultural practices, documenting histories and protecting future uses.

5.8.4 Water-Dependent Recreation

Water related recreational opportunities are provided throughout the Southern Sierra including camping, backpacking, fishing, boating and wildlife viewing along hundreds of mile of rivers and streams, and fishing and boating at reservoirs. These opportunities bring millions of visitors to the Region each year and form the tourist-spending backbone of the regional economy. The Southern Sierra offers many recreational opportunities in diverse, scenic settings as well as such unique, world class opportunities as visiting giant sequoia groves in both the National Forests and National Parks.

State and Federal land managers are charged with providing appropriate recreational opportunities on public land both for intrinsic value of recreation and as joint benefits for water supply projects. Poorly planned use, misuse, or overuse of any recreation resource can degrade natural resource values and recreational experiences. As a result, public agency managers go to great lengths to ensure that natural resources are not degraded in the course of providing recreational opportunities. This ethic applies both to provision of intrinsic recreational opportunities/experiences and of recreational opportunities funded as a joint benefit of a water project. Joint recreational benefits have the added aspect of helping to develop public support for the water project itself. In other words, if a project provides recreational opportunities, the public may be more supportive of the project overall thus helping to protect its water supply as well as its recreational benefits. That said, cost, timing, liability, and other issues may constrain the manager's ability to increase and integrate recreational benefits into new water projects.

Climate change could modify hydrologic patterns and will impact existing recreational opportunities. Recreational facility managers need an adaptive management strategy so that recreational opportunities remain available.

Forest disturbance also affects recreational use, particularly on public lands. Absent effective forest restoration, this disturbance by wildfire and mortality of trees is projected to increase in a warming climate.

5.9 - Other Strategies

5.9.1 Crop Idling for Water Transfers

Local Crops

Crop idling for water transfers is removal of lands from irrigation so the water supply can be transferred to other lands. The strategy is a temporary measure and the idled land would be returned to irrigation at a later time. (Permanent agricultural land retirement is discussed in a following section.) Also, crop idling is not the same as idling lands with the intent to improve soil and crop sustainability and productivity (i.e. crop rotation).

Benefits from crop idling include payment to farmers who sell their water supply, and redistribution of water to another area that needs it. The payments could be used for on farm-related investments, or to develop water conservation measures. Costs include loss of crop production and annual costs to manage the land to avoid negative impacts, such as weed spreading. Loss of crop production can have numerous socio-economic impacts on local communities. Crop idling is not feasible with permanent crops.

This strategy would involve idling crops in the Southern Sierra Region to transfer the water to other lands within the Region. Transferring the water outside of the Region would worsen the local water conditions. This strategy could also include implementing crop idling in parts of the state with surplus water, and transfer of that water to the Region.

Crop idling is sometimes practiced within irrigation and water districts and by landowners during droughts. Some districts allow growers to fallow their land for a season and sell the water to another grower in the same district.

5.9.2 Dewvaporation or Atmospheric Pressure Desalination

Dewvaporation is a specific process of humidification-dehumidification desalination. Brackish water is evaporated by heated air, which deposits fresh water as dew on the opposite side of a heat transfer wall. Since there are limited saline and brackish water supplies in the Southern Sierra this strategy may have limited applicability.

5.9.3 Fog Collection

Fog collection involves collecting fog on a fine mesh or array of parallel wires that drips into collection containers. There has been some interest in fog collection for domestic water supply in dry coastal areas that have frequent fog. Because of its relatively small production, fog collection is limited to producing domestic water where little other viable water sources are available. Fog collection has not yet been used as a water source in California. Some areas in the Southern Sierra receive dense fog. However, the fog is sporadic and typically occurs in winter months when water demands are low. Therefore, this strategy has limited applicability to the Southern Sierra.

5.9.4 Irrigated Land Retirement

Irrigated land retirement is the removal of farmland from irrigated agriculture to provide water supplies elsewhere and/or take unproductive land out of production. Land retirement can enhance water reliability by making water available for redistribution. Land use changes from land retirement can impact neighboring lands, such as through the spread of weeds or wildlife. In addition, retiring land can have large socioeconomic impacts on local communities including loss of jobs and income. However, retired land can be converted to other uses with low water demands such as dryland grazing, solar farms, wildlife habitat, etc., which could offset some of the socioeconomic impacts. Costs for retiring land include the price of land and the annual cost of managing the land to avoid environmental impacts. Land retirement should only be performed on a voluntary basis. When retiring lands the highest priority should be given to lands with poor quality, low productivity, and land management problems, such as poor drainage of irrigation waters.

The following policies are recommended regarding irrigated land retirement:

- As long as the demand for farm commodities remains relatively high, the retirement of irrigated lands in one location may naturally lead to the conversion of other native or non-irrigated agricultural lands in another location. For this reason, a program focusing on irrigated land retirement may be less effective at achieving conservation goals within the Region without a limitation on the conversion of other lands to uses that require an increase in water consumption.
- Should the Region look to a land retirement as a tool to reduce overall consumption or to facilitate water balance on a project or sub-regional level, a program should

be developed to encourage consistency regarding key elements such as mechanisms that that can be used to enforce land retirement; methodology for calculating net reductions in water usage; and subsequent uses of the properties after they have been retired.

Climate change may reduce water supplies or increase water demands, resulting in a greater need to retire lands. Although, large scale modeling results on field crops under increased atmospheric CO_2 concentration suggest a reduction in consumptive water use between 4-17% (Deryng et al., 2016). This reduction in water use is comparable to predicted increase in agricultural water demand due to project land use conversion, increased urbanization and shifts to more water intensive crops, by 2060 (Wilson et al., 2016). Climate change could also impact water quality leading to increased salinity buildup in certain lands, providing a higher incentive to retire the lands. Land retirement would still be a suitable alternative for climate change adaptation, but some impacts, such as wildlife or weed spreading may differ from historical retirement programs.

No permanent land retirement has been performed in the Region. Only about 15,500 acres in the Region is developed for agriculture. This area is small compared to the total area of the Region, but locally land retirement, and use for other beneficial uses such as developing and using as groundwater recharge basins, can have significant benefits to water supply and the ecosystem.

5.9.5 Rainfed Agriculture

Rainfed agriculture is the practice of providing all crop consumptive use directly by rainfall. Due to the unpredictability of rainfall frequency, duration, and amount, there is significant uncertainty and risk in relying solely on rainfed agriculture. However, rainfed agriculture has been practiced in the Southern Sierra. Some growers plant crops such as winter wheat and safflower that can be watered entirely by rainfall during the rainy season. However, some winter crops have been planted and subsequently lost during dry years. Rainfed agriculture is less risky if the growers have the option to apply irrigation water as an emergency measure. Due to the inherent risks with rainfed agriculture, it probably has little potential for increased use.

Climate change has the potential to change precipitation patterns which may benefit or adversely impact rainfed agriculture. According to the 2013 California Water Plan update, water supply improvements using rainfed agriculture will require development of new varieties of plants, and new and innovative soil and water management.

5.9.6 Waterbag Transport/Storage Technology

Waterbag transport/technology involves diverting water in areas that have unallocated freshwater supplies, storing the water in large inflatable bladders, and towing them to an alternate coastal region. This strategy is not currently being used in California and would likely have high costs and extensive permitting requirements. The Southern Sierra is over 100 miles to the coast and water delivered by waterbags would need to be conveyed directly to the Region or through complex exchanges. Transporting the bladders by rail has also been proposed, but this would also be costly and only limited quantities could be transported on a bladder that fits on rail cars. Due to its high cost, difficulty in permitting, and difficulty conveying the water to the Region, this alternative is not considered feasible.

5.9.7 Drought Planning

The Department of Water Resources (DWR) resource management strategies did not include drought planning. In recognition that drought is a frequent occurrence in the Southern Sierra, the RWMG decided to include drought planning as a resource management strategy.

The Southern Sierra is almost completely reliant upon a productive groundwater supply. The impacts of long-term drought can be seen in reduced snowpacks and low river flows. These conditions drastically reduce the available water for percolation and groundwater recharge.

Many local agencies have drought response plans. However, the Southern Sierra does not have a regional drought response plan. Such a plan would need to identify participants and their responsibilities, develop a drought monitoring plan, and develop drought response measures. A regional drought response plan would help to better characterize drought conditions, and allow water users to pool and share their water resources and help to minimize regional impacts. To date the hydrologic demand of the area is poorly understood and the DWR is in the process of conducting a conceptual model of the Three Rivers area in an attempt to identify data gaps, estimate demand and resource availability. It is hoped that the format and methodology for this study can be used in other areas of the Southern Sierra.

Effective, proactive drought planning is central to maintaining and realizing improvements in most benefits.

5.9.8 Climate Change Mitigation

Carbon Sequestration

It is widely understood that soil has the ability to hold carbon. Carbon content contributes to a soil's ability to retain water and provide improved food production. Fields in year-round crops or other cover, and agroforestry that increases diversity through combining crops, trees, and animal husbandry, serve to *hold* CO_2 in the soil. A soil's ability to sequester CO_2 however dissipates over time if the soil is left exposed and devoid of vegetation. The CO escapes from bare ground, and when combined with oxygen in the air, creates more CO_2. Therefore, instead of fallowing lands, regions should consider regenerative agricultural practices and techniques including planting fields in year-round crops or other cover, allowing soil to work as a carbon sink. These otherwise bare areas when vegetated create "demand" for the carbon side of the equation to offset "supply-side" approaches dealing with CO_2[1]; the secondary generation of CO_2 from the bare soil is also reduced—a win-win result.

According to Schwartz (2014) and other sources, an imbalanced approach focused only on supply-side will not reduce CO_2 to safe levels in time to avoid serious long-term impacts. Other techniques of soil sequestration of CO_2 are restoring degraded and eroded lands, mulching with rather than burning biomass, avoiding deforestation and the farming of peatlands, and bolstering soil microbiology by adding beneficial microbes to stimulate the soil cycles. Degraded soil cannot be food-productive soil. The broad concept is to treat soil carbon as a renewable resource, because carbon helps give soil water-retention capacity, structure and fertility.

Another technology is a 2,000 year-old practice of converting agricultural waste into a soil enhancer than can hold carbon and thereby boost food security, increase soil biodiversity and discourage deforestation.[2] One can also increase biochar – produced when plant matter, manure, or other organic material is heated in a zero- or low-oxygen environment – for its ability to turn problem areas into productive sites while building soil carbon. Vast deforested areas are excellent candidates for reforestation using biochar from the weeds now growing there. Biochar also improves water quality by increasing soil retention of nutrients and agrochemicals for plant and crop utilization, while also helping soil resist degradation.[3]

In addition to creating a soil enhancer, sustainable biochar practices can produce oil and gas byproducts that can be used as fuel, thus providing clean, renewable energy. When the biochar is buried in the ground as a soil enhancer, the system can become "carbon negative." While there is some disagreement that biochar use is not practical on a large scale, it could have some effectiveness on a regional level as part of an "all of the above" approach to CO_2/GHG reduction.

In foothill areas, use of conservation or no-till practices should be encouraged. Thinning forests and reducing wildland fires will reduce potential CO_2 emissions as vegetation mortality and decomposition releases CO_2--although some sequestration can occur as portions of vegetation mortality gets converted to soil organic matter which may eventually sequester carbon in the soil.

One goal of forest restoration is to restore the ability of forests to sequester carbon, both in above- and below-ground biomass. Long-term managed removal of biomass, versus wildfire, can provide carbon-sequestration benefits that are synergistic with water-resources management.

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[1] Schwartz, Judith D., "Sustainable Agriculture, Soil as Carbon Storehouse: New Weapon in Climate Fight?", Yale Environment 360 (E360) Newsletter published at Yale School of Forestry & Environmental Studies, 2014. Accessible at https://e360.yale.edu/features/soil_as_carbon_storehouse_new_weapon_in_climate_fight

[2] International Biochar Initiative, website accessed at http://www.biochar-international.org/biochar

[3] International Biochar Initiative, website accessed at http://www.biochar-international.org/biochar

Alternative Fuels & Renewable Energy Sources

Individuals, and water agencies, in particular, should consider all direct and indirect emissions that could occur from combusting fuel or using electricity such as from both stationary and mobile sources like engines, pumps, and generators or worker or agency transportation vehicles. Shifting to alternative fuels types and renewable energy sources such as solar or wind whenever possible can result in reduced emissions generally, and specifically reduced greenhouse gases. Combining efforts in this category with increasing opportunities for GHG sinks will reduce GHG emissions on both sides of the equation.

Energy Conservation

The water sector plays a significant role in California's energy consumption. In 2005, California Energy Commission studies showed that 19% of the state's electricity was spent on water-related activities. Because the water sector is such a large user of electricity, it plays an important role in reducing energy demand and related greenhouse gas emissions.[1] Pathways to energy neutrality resulting in both economic and environmental benefits are desirable.

Energy related to pumping can be conserved through increased recharge of groundwater aquifers. Aquifer pumping constitutes about 3% of California water-related energy use[2]. This energy use is expected to increase as aquifer depletion lowers water tables and more energy is needed to pump water from lower depths. Increasing managed aquifer recharge during wet periods when high-magnitude flows exceed both environmental flow requirements and California surface water allocations can help to replenish aquifer storages and raise aquifer levels[3][4]. Higher aquifer levels have the benefit of increasing California drought resiliency and also decreasing energy consumption associated with aquifer pumping, lowering California's carbon footprint. Managed aquifer recharge has been implemented at small scales (less than 1,000 acres) and is a potentially suitable carbon mitigation strategy for the limited groundwater basins within the RWMG.

Opportunities to retrofit water and related energy-use equipment that result in energy and water conservation and efficiency for both users and providers have synergistic benefits toward achieving statewide GHG reduction goals.

[1] Climate Change Handbook for Regional Water Planning. Environmental Protection Agency, California Department of Water Resources and US Army Corps of Engineers, South Pacific Division. November 2011. Accessible at http://www.water.ca.gov/climatechange/CCHandbook.cfm
[2] Public Policy Institute of California – Water Policy Center. California's Water. October 2016. Accessible at http://www.ppic.org/publication/californias-water/
[3] Kocis TN, Dahlke HE. 2017. Availability of high-magnitude streamflow for groundwater banking in the Central Valley, California. Environmental Research Letters, 12(8) 084009.
[4] Beganskas S, Fisher AT. 2017. Coupling distributed stormwater collection and managed aquifer recharge: Field application and implications. Journal of Environmental Management, 200, 366-379.

Chapter 6 - PROJECT REVIEW PROCESS

This chapter provides guidance to the RWMG on processes and procedures for identifying projects to be included in the IRWMP that are suitable for funding by either the DWR's Implementation Grant program or other funding opportunities. This process is intended to be transparent and understandable, and be readily available for regional stakeholders and public review. The result of the project review process is the production of a list of prioritized (tiered) implementation projects. The tiers are based on the project's readiness to proceed and described later in this chapter. **Figure 6-1** illustrates the overall project review process that will be discussed in this chapter.

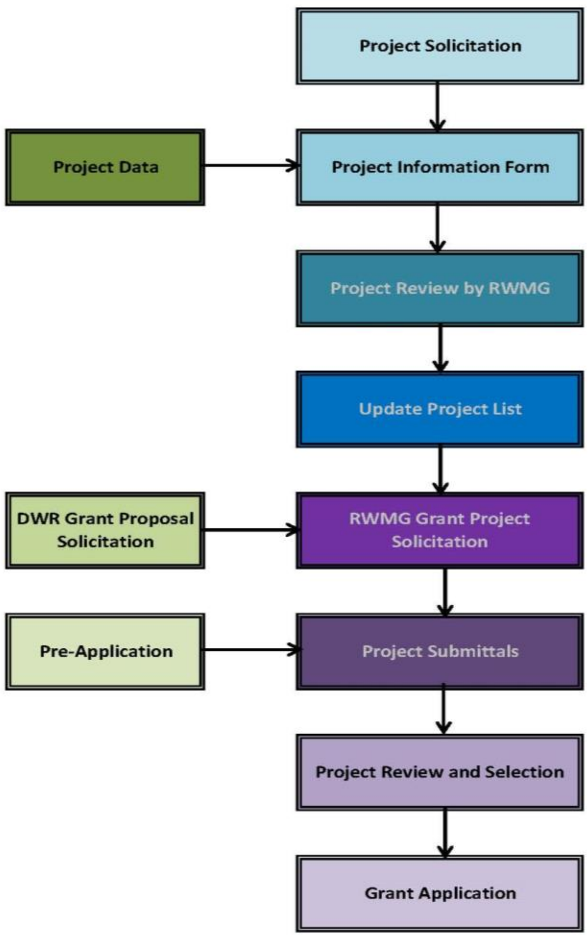


Figure 6-1 Project Review Process

The project review process satisfies four key functions:

- Develop a process for project proponents to submit potential projects for inclusion in the IRWMP (project identification and solicitation)
- Identify procedures to review and select projects that can implement the IRWMP (project selection)
- Develop a process to inform or communicate the list of selected projects to stakeholders and the public (publishing the project list)
- Provide a process to rank and select the most promising projects to include in grant applications that are scored and funded as a group (rather than individually).

As there are continual efforts by RWMG members and interested stakeholders to develop new projects and improve existing projects, the list of projects included in this chapter is not intended to be the final list. An updated list will be available on the RWMG's website (http://www.southernsierrarwmg.org/) as adopted by the RWMG annually, or more frequent if deemed necessary.

It is also noted that the 2016 IRWM Plan Guidelines and Standards have added more detail to the requirements for evaluating a project's contribution to climate-change adaptation.

- *Include potential effects of Climate Change on the region and consider if adaptations to the water management system are necessary*.

  This is central to IRWM planning in the southern Sierra, given the steep elevation and temperature gradients in the Sierra, and changes in water balances that will ensue as the region's climate continues to warm.

- *Consider the contribution of the project to adapting to identified system vulnerabilities to climate change effects on the region*.

  Adaptation and resiliency to projected changes in weather, flooding and drought are central to water security in the region.

- *Consider changes in the amount, intensity, timing, quality and variability of runoff and recharge*.

  This is one of the key changes that will result as warming temperatues affect precipitation from snowpacks, growing seasons, soil drying, wildfire, and water demand by communities.

- *Consider the effects of sea level rise on water supply conditions and identify suitable adaptation measures*.

This is of lesser concern as a direct impact, given that the minimum elevation in the Southern Sierra IRWM is about 600 ft. The lower part of the San Joaquin R. watershed, which lies outside the IRWM planning area, is 340 ft near Millerton Lake; however, sea level is currently not projected to rise that high this century. Pine Flat Lake, Lake Kaweah, and Lake Success are formed by dams above 600 ft elevation.

Further, new criteria address how proposed projects reduce greenhouse gases, relative to alternatives. These analyses can be done in parallel with, or part of, economic analyses.

6.1 - Identification and Solicitation of Projects

The RWMG has been identifying potential projects since 2008. Several requests for project ideas were made during the development of this IRWMP. The current project list is found in **Appendix G**. The RWMG has and will encourage all types of projects and programs provided they address at least one of the IRWMP's Regional Goals and at least one the Measurable Objectives methods for that goal. (**Chapter 4**). As indicated in Chapter 4, the Regional Goals are broad statements indicating the purpose of the IRWMP, and the Measureable Objectives are more specific actions to help achieve the goals. These goals and objectives are intended to address water management and ecosystem problems and conflicts in the Region. The goals are considered coequal and therefore projects will be accepted that address any one of the goals.

The RWMG policies require that projects be submitted and approved for the project list before they can be considered for an IRWMP grant application. This is intended to require stakeholders to carefully plan and document their projects in advance, and prevent stakeholders from conceiving projects on short notice only because funding becomes available.

The following three-step process has been developed for identification and solicitation of projects. These steps are intended to standardize the procedures and allow for an efficient review process. These steps include:

1) Call for Projects
2) Review by Projects Workgroup or the Coordinating Committee and approval by the RWMG
3) Project(s) added to the Project List

The project list is typically updated annually, although projects can be submitted at any time.

6.1.1 Step 1 - Call for Projects

The RWMG will, from time to time, release a 'Call for Projects'. A call for projects could be made when specific grant programs are announced, when revised goals or objectives are published, or simply on a periodic basis, such as every year, to keep the list current. This call will be made through several communication tools including:

- Announcements at regularly scheduled RWMG and Coordinating Committee meetings
- Announcements at members and stakeholders agency board and management meetings
- E-mails to stakeholders and interested stakeholders
- Posting the Call for Projects on the RWMG website

This process is open to any project satisfying the criteria previously discussed, regardless of the current status of the project. Projects at the conceptual level are encouraged and will be added to the list to help prevent duplication of effort and to foster project integration and development, especially if the project encompasses more than one watershed and/or user stakeholder group. Projects must be submitted by either a member or interested stakeholder.

Project proponents are asked to complete a Project Information Form. The form requires proponents to include basic information generally associated with State grant applications criteria. This information requires at a minimum the following:

- Project name
- Project proponent(s)
- Project location
- Project size
- Project development status (conceptual, planning, feasibility study, preliminary design)
- Background description
- Project workplan
- What is the Primary IRWMP goal that applies to the project?
- What are the performance measures and monitoring methods to verify that it meets objectives?
- Identify secondary IRWMP goals or measurable objectives met by the project
- Which Resources Management Strategies is the project related to?
- How does the project provide specific benefits to disadvantaged community (DAC) water issues? If so are there any Environmental Justice concerns?

This is not intended to be an exhaustive list of criteria to be addressed, but a representative list that may apply to a specific project. The RWMG may add or modify the form and the information requested in the future. For instance, developing reliliency to severe drought or long-term climate change is reflected in some new Federal, State or local grant funding programs and may bring additional criteria to the planning process.

The current version of the Project Description Form is included in **Appendix H**. The form can be obtained on the RWMG website (http://www.southernsierrarwmg.org/). The form can either be hand delivered at a RWMG meeting, or mailed/emailed to the contact listed on the RWMG website.

6.1.2 Step 2 - Review of Project Information Form

The Projects Workgroup or the Coordinating Committee will review each project information form for content and consistency. The Projects Workgroup will confirm the accuracy and reasonableness of the submitted information. If necessary, the Projects Workgroup will request clarifying information from the project proponents. Also, during this step the Workgroup will consider if the project is suitable for possible project integration, regional application, multiple benefits, and other strategic project efforts that could address IRWMP objectives. The review process will include evaluation of several criteria to meet current state funding requirements, such as:

- The technical feasibility of the project
- Specific benefits to critical water issues for Native American Tribal communities
- Project cost and financing
- Economical feasibility (long-term)
- Contribution to regional sustainability
- Project status
- Climate change impacts and contributions to mitigation or resiliency

These criteria and other are included on the SSRWMG scoring criteria, included in **Appendix I**. The projects will not be ranked numerically, but will be identified as suitable for the Project List (yes or no), and placed into one of three tiers, as defined below:

Tier 1: Project is ready for implementation, has a project proponent, and a completed Project Information Form

Tier 2: Project is not ready for implementation, but has a full or partially completed Project Information Form

Tier 3: Project is conceptual without a proponent and no Project Information Form. Tier 3 Projects are simply listed by name. They are listed to reduce the potential for duplication, and to provide information concerning potential project integration opportunities for regional projects.

6.1.3 Step 3 - Publishing the Project List

Updated project lists will be posted on the RWMG website and emailed to members and interested stakeholders. The current tiered list of implementation projects is provided in **Appendix G.**

6.2 - Project Prioritization for Specific Funding Opportunities

While the project list is continually being updated, there is need for project prioritization when specific grant opportunities arise. (Reference Appendix L for a list of potential grants programs and funding opportunities.) This is necessary for certain DWR grants that score applications based on the collective merit of all proposed projects. These applications are funded as a whole, and not individually by project. Currently, the IRWMP Implementation Grants are reviewed and funded this way. This necessitates a process to identify projects that are not ready for a grant application or have marginal benefits, and that could prevent an application package from being scored well. The RWMG has developed the following eight step process for project prioritization based on funding opportunities.

6.2.1 Presentation of Funding Opportunity Information

In addition to IRWMP funding opportunities, the RWMG considers many other funding options. Funding opportunity information is brought to the RWMG by members, interested stakeholders, consultants and other stakeholders. It is important that a basic understanding of the opportunity, project eligibility and selection criteria is disseminated within the Region. These opportunities come from a variety of sources for a wide range of projects and programs. The RWMG, through its regular meetings, and communication by e-mail and website, provides a clearinghouse for disseminating information on these opportunities. At its regular Coordinating Committee and RWMG meetings, funding opportunities from various sources can/will be presented to all participants, and are communicated to the Region through meeting minutes available on the RWMG website as well as by direct email.

6.2.2 Establish Projects Workgroup (Workgroup)

Upon the decision to consider pursuing a funding opportunity that requires project prioritization, a ProjectsWorkgroup is selected by the RWMG. The Workgroup shall have at least three and no more than seven individuals (members or interested stakeholders). The Workgroup works with the RWMG to develop Scoring Criteria that is tailored to the specific funding opportunity and a template form is developed. The template form also includes a scoring matrix based on the information required. The scoring matrix typically matches that of the funding opportunity, with the addition of other categories that specifically address the regional goals and objectives. The scoring matrix will be similar to the one included in **Appendix I**. At a minimum, the scoring matrix will address the following topics:

- Grant specific requirements
- Project Sponsor
- Applicants' status in adopting IRWMP
- List of each applicable IRWMP Measurable Objective (Table 4.2), how the project applies, and a description or estimate of the benefit
- Relation to relevant resource management strategies
- Benefits to DACs
- Environmental justice concerns
- Current project status and detailed schedule for completion
- Workplan
- Technical feasibility
- Economic feasibility
- Funding of local cost share (if required)
- Strategic implementation of plan and project merit
- Climate change and greenhouse gas (GHG) reduction and adaptative management considerations to reduce vulnerabilities, particularly in the water sector.

The Region does not receive water from the Delta, so reducing dependence on Delta supplies is not a relevant issue. The Region is also not susceptible to or a major contributor to sea level rise, so projects' ability to minimize effects of SLR is also not a relevant issue, except insofar as generally reducing GHG.
Stakeholders submitting proposed projects must also have adopted the IRWMP prior to being considered for inclusion in IRWM grant applications. Adoption should occur before the pre-application process. Stakeholders are discouraged from adopting the IRWMP only when an attractive grant application surfaces, and should consider adoption when they initially become involved with the group.

6.2.3 Project Information Request

The Workgroup provides information regarding the grant to members and interested stakeholders. An email announcement will be made, and typically a portion of a RWMG meeting, or if needed a separate workshop, will be held to educate project proponents on the funding requirements. Stakeholders interested in submitting a grant application are asked to submit a Pre-Application (see **Appendix J** for an outline of the Pre-application). As a general guideline, stakeholders should make efforts to keep the Pre-application between 5 and 10 pages, excluding attachments and appendices. The Pre-Applications can be submitted by email, mail, hand delivered, or through the RWMG web site. The purpose of the Pre-application is to:

1) Provide the group sufficient information to rank the project and see if it is suitable for a grant application;
2) Shows commitment on part of the applicant;
3) Helps the applicant further evaluate their project and determine if they are ready for a grant application; and
4) Provides the applications a head start on developing full application materials.

6.2.4 Project Prioritization by Workgroup

Applicants submit Pre-applications to the Workgroup before a strict deadline. The Workgroup members then individually score each project. Workgroup l members will be excluded from reviewing Pre-applications if they represent or are employed by the agency submitting the application. After scoring each project, the Workgroup meets to review the scores and provide a prioritized project list based on the scoring. The Workgroup then presents the prioritized list to the Coordinating Committee and RWMG. This can be done by email notification or through the RWMG website, and may also be presented at a separate meeting.

Each project will be given due consideration through a collaborative process. Important consideration points will include feasibility, economics, benefits to the Region and project readiness. Project readiness is very important because an applicant must prove they have sufficient information to prepare a competitive grant application.

6.2.5 Recommendation of Projects to be Included in Funding Application

The prioritized project list may include more projects or funding requested than is eligible or reasonable to submit for the specific funding opportunity. The Workgroup will consider and develop a recommended list of projects based on the prioritized scoring that should be included in the funding application request. It is possible that a highly prioritized project may not be able to proceed with the application or be initiated within the required timeframe. As part of this step, the Workgroup will then solicit confirmation from each of the recommended project proponents, ensure they can proceed with the effort required to prepare the application, and discuss possible mechanisms to assist with the application. An agreement for funding of the application process, and legal review of funding contracts (master agreement and sub-agreements), will be developed amongst the applicants and included in the Workgroup's final recommendation.

6.2.6 Coordinating Committee Recommendation

The Workgroup's recommended project list for a grant application will be presented to the Coordinating Committee for discussion, consideration, and a recommendation to the RWMG.

6.2.7 Workgroup Approval

The Coordinating Committee's recommendation will be presented to the RWMG, and the RWMG will make the final decision for approval of the projects to be included in the funding application.

6.2.8 Funding Application Development and Submission

Following approval by the RWMG, the project proponents will complete and submit grant applications to the funding agency.

6.3 - Conceptual Grant Application Schedule

The DWR typically provides estimated deadlines and draft Proposal Solicitation Packages (PSP) six months before a final grant deadline. The RWMG should start the process as soon as preliminary information is available. **Table 6-1** shows a conceptual schedule for responding to a grant solicitation. This schedule is just a guide, but following it will provide sufficient time to select the best projects and prepare a competitive grant application. An important step in preparing a successful IRWMP grant application is starting early, and the time to combine multiple applications into a single document is often underestimated.

Table 6-1 Conceptual Schedule for Submitting IRWMP Grant Applications

Task	Days prior to Final Deadline
Review Draft PSP and identify potential projects	Before 90
Prepare and submit Project Description Forms	Before 90
RWMG reviews Project Descriptions and selects likely projects for Pre-Applications	90
Prepare Pre-Applications	90-60
RWMG reviews Pre-Applications and selects best projects	60
Complete individual grant applications	60-21
Combine individual grant applications into single application	21-0

Chapter 7 - Impacts and Benefits of Plan Implementation

This chapter describes the general benefits and impacts from implementing the Southern Sierra Integrated Regional Water Management Plan (IRWMP). These Impacts were identified for both the local RWMG and surrounding IRWMP regions. Specific topics addressed include general benefits of regional water management, impacts/benefits of relevant resource management strategies, impacts/benefits to interested stakeholders, Native American Tribes and disadvantaged communities (DACs), evaluation of impacts/benefits in project evaluation, and a plan for updating the impact/benefit analysis.

Identifying the general impacts and benefits of implementing the IRWMP is important for the following reasons:

1. The impact/benefit analysis can be used to identify goals and resource management strategies
2. Assessing adverse impacts from resource management strategies is important, since they are often overlooked or overshadowed by the more obvious benefits of the strategies
3. The impact/benefit analysis can be used as a benchmark for evaluating IRWMP performance

7.1 - General Benefits of Regional Water Management

Historically, local management of the water resources, especially groundwater, was limited to independent operations by each overlying water agency and individual water users. If individual agencies and landowners continue to act individually, it is likely that competition and conflict will increase, groundwater overdraft will continue, and there will be increased risk for water quality impairment, litigation, higher groundwater pumping costs and short-or long-term loss of the resource. Regional water management replaces the local, fragmented approach with a more comprehensive and cooperative methodology. The key benefits of regional water management include:

- Development of a long-term vision for regional water management for water supply and water quality issues;
- Management of water resources within a recognized hydrologic boundary rather than many isolated political boundaries;
- Establishment of goals and policies for the most economical and efficient use of available water resources;

- Reduced potential for conflicting goals/projects among those who share the same river and groundwater basin;
- Forum for all parties to share ideas and information;
- Effective management of groundwater depletion;
- Improvement in local and regional water supply reliability;
- Improved protection from drought;
- Reduced costs of developing one regional plan versus individual agency plans;
- In certain cases reduced costs of developing regional projects rather than several smaller local projects;
- Increased operational flexibility of the water infrastructures in the Region for common benefit;
- Reduced potential for conflicts and litigation;
- Protection and improvement of groundwater quality and implementation of regional water management strategies to address drinking water issues;
- Shared development and use of the same hydrologic model and analytical tools for project evaluation;
- Reduced cost of data collection, data sharing, and data management;
- Increased political influence needed to protect and preserve water resources; and
- Increased chances for obtaining state/federal grant funds as a Region rather than as a local agency.

These benefits would be lost if the IRWMP document is not maintained, the RWMG does not remain active, or the members do not implement regional projects and programs.

The effects from not implementing the IRWMP would be continued issues and problems associated with regional water supply, water quality and sensitive ecosystems. Some specific impacts could include:

- Declining groundwater levels;
- Degraded ecosystems;
- Loss of habitats;
- Increased pumping costs;
- Increased costs to lower pumps, deepen wells or construct new wells;
- Potential conflicts between water users for available groundwater supplies;
- Loss of regional economic activity;
- Inability to respond to dry year or extended drought conditions;
- Reduced supply reliability;
- Limitations on planned development and inability to comply with revised state laws requiring proof of adequate and sustainable water supplies; and
- Inability to address regional water quality issues such as drinking water solutions for DACs.

7.2 - Impacts and Benefits of Resource Management Strategies

A screening level analysis of impacts and benefits from implementing over 30 different resource management strategies is included in **Table 7-1**. These strategies come from a list of resource management strategies listed in the California Water Plan Update (DWR, 2009) and draft 2013 update. Thirty two of those strategies were deemed applicable to the Region and are discussed in detail in **Chapter 5** (Resource Management Strategies).

The impacts and benefits of implementing the strategies broadly represent the potential benefits and impacts of implementing the IRWMP. **Table 7-1** was developed through interactive discussions by the RWMG. **Table 7-1** presents many of the potential benefits and impacts on the Southern Sierra IRWM area and adjoining IRWMPs from implementing a given management strategy.

Table 7-1 Benefits and Impacts of Resource Management Strategies

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
Reduce Water Demand	Agricultural Water Efficiency	• Extend supply (limited areas) • Reduced cost • More efficient use of chemicals • Reduced subsurface drainage • Protection of water quality	• Reduced groundwater recharge (limited areas) • Causes operational changes • Irrigation hardware needed • Hardware maintenance • Irrigator training requirements	• More interregional basin exchanges possible • Reduced subsurface drainage	• Reduced supply to neighbors from spills and drainage
	Urban Water Efficiency	• Extend supply • Reduced cost • Reduced home chemical use • Delayed capital costs • Protection of water quality • Reduced energy use • Reduced groundwater (fracture controlled) overdraft	• Causes operational changes • Lost revenue if usage based • Inconvenient watering times • Creates hard demand that reduces opportunities for drought response	• Possible increase in supply (if fractures traverse regions) • Reduced wastewater treatment • Stretch existing water supplies	• Reduced supply to neighbors from wastewater effluent or runoff
Improve Operational Efficiency and Transfers	Conveyance - Regional/local	• Maintain water rights • Revenue generation • Conjunctive use • Improved water quality • Increased flood control capabilities • Could deliver surface water to areas that use only groundwater	• Increased use of facilities • Shortened maintenance periods • Greater costs for larger facilities		
	System Reoperation	• Water quality improvements • Flood protection • Recreation benefits • Power generation • Ecosystem restoration	• Loss of historical supplies to other uses	• Temperature control for local fisheries • Flood protection • Ecosystem restoration • Litigation reduction	• Greater management requirements
	Water Transfers	Not Applicable in the IRWM Region	Not Applicable in the IRWM Region	Not Applicable in the IRWM Region	Not Applicable in the IRWM Region
	Conveyance - Delta	Not applicable in the IRWM Region	Not Applicable in the IRWM Region	Not Applicable in the IRWM Region	Not Applicable in the IRWM Region

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
Increase Water Supply	Conjunctive Management & Groundwater Storage	• Dry year supply • Extends use of existing basin • Overdraft reduction • Improved water supply reliability • Fracture controlled groundwater recharge • Better groundwater management	• Increased pumping costs compared to surface water • Litigation challenges • Increased data collection needs & costs • Uncertainty of impacts to facility neighbors • Facility capital costs • Land use changes for facilities	• Water quality improvement • Improved water supply reliability • Drought relief • Reduction in flood flows below reservoirs	• Water supply uncertainty if surplus flows diverted more frequently
	Precipitation Enhancement	• Quick project development • Increase in water supply	• Accuracy of location & timing	• Additional water supplies	• Increase in supply in one area at the expense of downwind area • Added snow removal burden in some areas • Public concern over accumulation of seeding agent
	Recycled Municipal Water (Limited Capacity)	• Reliable supply • Improved water quality • Allows for development • Drought resistant supply	• Increased operations & maintenance cost • Public acceptance • Water quality concerns with microbial contaminants, salinity, heavy metals, and pharmaceuticals	• Interregional exchange	
	Surface Storage - Regional/local	• Water supply reliability & augmentation • Flood control • Hydroelectric power generation • Recreation • Sediment transport management	• Permitting requirements • Environmental mitigation • Cost • Limited sites available • Failure impacts • Beneficiary determination • Property tax losses • Habitat losses • Operational control	• Water transfers • Ecosystem management	• Reduction in downstream flows • Habitat migration

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
	Surface Water Storage - CalFed	• Water supply reliability & augmentation • Flood control • Hydroelectric power generation • Recreation • Sediment transport management	• Permitting requirements • Environmental mitigation • Cost • Limited sites available • Failure impacts • Beneficiary determination • Property tax losses • Habitat losses • Operational control	• Most likely water would be supplied to Valley Floor outside of Southern Sierra Region	• Reduction in downstream flows • Habitat migration
Improve Water Quality	Drinking Water Treatment & Distribution (very few multi- user systems in Region)	• Protect public health • Maintain regulatory compliance	• Increased O&M costs • Increasingly stringent regulations • Trained operators needed • Facility security • Treatment residual disposal • Deteriorating infrastructure		
	Groundwater Remediation/ Aquifer Remediation	• Protect public health • Maintain regulatory compliance • Avoided costs of purchasing additional supply	• Costly • Highly trained operations staff • Public perception/acceptance of treated water	• Contaminant plumes kept from spreading	• Possible loss of water if re-injection not used for water disposal
	Matching Quality to Use	• Best use of available local water supplies • Most economical choice • Treatment avoided or limited	• Possible environmental impacts • Infrastructure costs • Conveyance costs	• Upstream and downstream partnerships	• Water quality degradation • Effluent dominated streams • Salinity increases
	Pollution Prevention	• Improved water quality • Consistent with anti-degradation policies • More cost effective than remediation or "end of the pipe" treatment	• Increased regulations • Increased costs • Increased management needs • Increased monitoring costs	• Protect water at source • Agriculture irrigation	• Difficult to distinguish between level of impacts of natural and introduced contaminants at times • Lack of access to some recreational areas
	Salt and Salinity Management	Not Applicable in the Region	Not Applicable in the Region	Not Applicable in the Region	Not Applicable in the Region

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
	Urban Runoff Management	• Water source for local recharge • Improve flood protection • Reduce surface water pollution • Minimize soil erosion & sedimentation problems • Local resource from waters historically lost to an area • Mimic natural hydrologic cycles	• Cost to treat and manage runoff • Increased cost to urban developments • Disease from standing water in basins	• Regional collaboration and coordination	• Possible groundwater contamination from recharged water
Improve Flood Management	Flood Risk Management	• Enhanced flood protection • Reduce risk to lives & property • Recharge possible if captured • Riparian habitat improvements • Possible floodplain function restoration	• Structural approaches are costly • Permitting requirements involved • Long-term ongoing maintenance of facilities • Emergency response planning required • Planning may limit development in some areas	• Reduce downstream flood risk • Reduce flood recovery costs • Manage upstream water • Regional planning required	• Planning may limit development in some areas • Revisions to flood insurance mapping • Multiple County communications system
Practice Resources Stewardship	Agricultural Lands Stewardship	• Reduces pressure to agricultural lands from urban development • Increased economic viability for agricultural lands • Habitat improvement • Encourages agricultural practices which also benefit environmental and restoration concerns	• Conservation easement costs • Cost to implement BMPs	• Preservation of open spaces & agricultural land • Regional planning urban growth strategy • Flood impact reduction • Food security • Recreational opportunities	• Reduced tax base for county and state governments
	Ecosystem Restoration	• General quality of life increase • Protection and enhancement of meadows, fish & wildlife and water resources • Enhance water quality • Changes in timing and amount of water yield	• Increased short term costs • Short-term impacts on sediment and water quality • Changes in timing and amount of water yield	• Increased recreational opportunities • Increased diversity of native species • Natural water quality improvements • Sustainability to water and flood management projects	• Conflicting objectives in flood management • Opposition to conversion of farmland to habitat

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
Practice Resources Stewardship	Forest Management	• Reduction in sedimentation in local rivers and streams • Water quality betterment, by protection of land surface from erosion • Reduced risk of fire • Reduction of carbon footprint • Increased water supply	• Economic impacts to timber industry and other forest users • Prescribed fires have a temporary impact on air quality • Possible short-term impacts to water bodies in local project area. • Conflicting resource priorities such as wildlife habitat vs. water yield	• Air quality protection via fuel reduction • Water quality improvement • Winter snowpack improved with vegetation management • Recreational opportunities • Increased water storage in the watershed • Protection of water supplies • Reduced risk of fire spreading into area • Reduction of carbon footprint	• Prescribed fires have a temporary impact on air quality
Practice Resources Stewardship	Land Use Planning and Management	• Improved communication among different agencies • Proper planning helps ensure new developments have reliable and sufficient water supplies • Potential for reduced water demands based on development designs	• Difficulty in getting some land and water use planners to cooperate • Increased costs to coordinate efforts	• Potential for reduced inter-regional conflicts	• Financial savings • Economy of scale by avoiding conflict • Overlaps of various interregional long-term plans • Opportunities to reduce flooding and increase recharge
Practice Resources Stewardship	Recharge Area Protection	• Provide sustainable and reliable water supply of good quality • Removal of some microbes and contaminants during recharge • Flood protection	• Vectors and odors	• Reduces pollutants entering groundwater	
Practice Resources Stewardship	Sediment Management	• Reduces sediment loading in aquatic environments • Improves aquatic health • Reduction in erosion	• Economic impacts to loggers and other forest users if roads closed	• Reduces sedimentation in lower reaches of rivers, lakes, and reservoirs • Reduces contamination transport downstream • Improvement in downstream water quality	
Practice Resources Stewardship	Water-Dependent Recreation	• Positive agency public relations • Revenue generation • Quality of life benefits to health	• Increased liabilities • Water quality degradation • Addition facility O&M costs • Lack of funding	• Recreational opportunities for travelers	

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
	Watershed Management	• Community level solutions • Water quality improvement • Protection of local water rights • Flow attenuation and augmentation	• Difficulty of diverse stakeholders working together	• Community collaboration • Flood mitigation • Quality of life • Habitat provision • Mineral/nutrient cycling • Recreation opportunities	
People and Water	Economic Incentives (Grant, Water Pricing)	• Decreased costs for grant recipients • Reduced wait for needed infrastructure • Reduction in water demand from water pricing structures • Reduces use through step charges • Extends supply • Provides capital funding	• Impacts poor communities disproportionately • May require matching funds • Burdensome application processes • Increased federal or state directives in local issues • Increased administrative costs • Funding is intermittent	• Local return from statewide obtained funds • Societal goals obtained	• Increase in State debt burden • Social inequities
People and Water	Outreach and Education	• More informed public are more engaged in decision making			
People and Water	Water and Culture	• Raises awareness of cultural impacts on resources and the lack of resource on culture			
People and Water	Water Dependant Recreation	• Positive agency public relations • Revenue generation • Quality of life benefits to health • Increased income and economic opportunities for local communities • Increases appreciation and support for protecting water bodies	• Increased liabilities • Addition facility O&M costs • Water quality impacts to aquatic species from motorized vehicles and boats	• Increases appreciation and support for protecting water bodies • Recreational opportunities for travelers	Water quality impacts
Other Strategies	Crop Idling for Water Transfers	• Drought water supply reliability • Stable farm income in water short years	• Introduction of wildlife, weeds, pests and trash dumping to the area • Changes to local community way of life		• Local tax base losses • Changes in school populations

Strategy		Southern Sierra Region		Interregional[1]	
		Benefits	Impacts	Benefits	Impacts
	Irrigated Land Retirement	• Generation of stable water supplies • Reduction in agricultural drainage to an area	• Taxpayer burden of land cost • Increased management costs of government owned retired lands • Lower income and higher unemployment		• Community and Region may lose way of life, jobs • Local tax base losses • Changes in school populations
	Rainfed Agriculture	• Reduction in runoff with no-till systems	• Increased uncertainty of crop production • Low value of viable crops in historical irrigated agricultural areas • Increased runoff and erosion potential		
	Drought Planning	• Improved water reliability	• Costs to develop and maintain drought response plan • Implementing plan may be unpopular • Lack of funds for additional storage	• Lower regional groundwater overdraft • Lower demand for dry year water supplies • Prevent loss of crops or crop idling	

1 - Interregional refers to adjacent IRWMP regions in lower watersheds. The adjacent IRWMP regions are shown on **Figure 7.1.**

7.3 - Regional Benefits and Impacts

Identifying regional benefits and impacts is important since they are often ignored because of a focus on local benefits and impacts. Project proponents often look only within their political boundary and areas that provide their revenue. Recognition that projects affect other regions is a crucial step in developing effective inter-regional water management. The Southern Sierra IRWMP may influence surrounding areas as described below. **Figure 7-1** below shows the surrounding IRWM organizations.

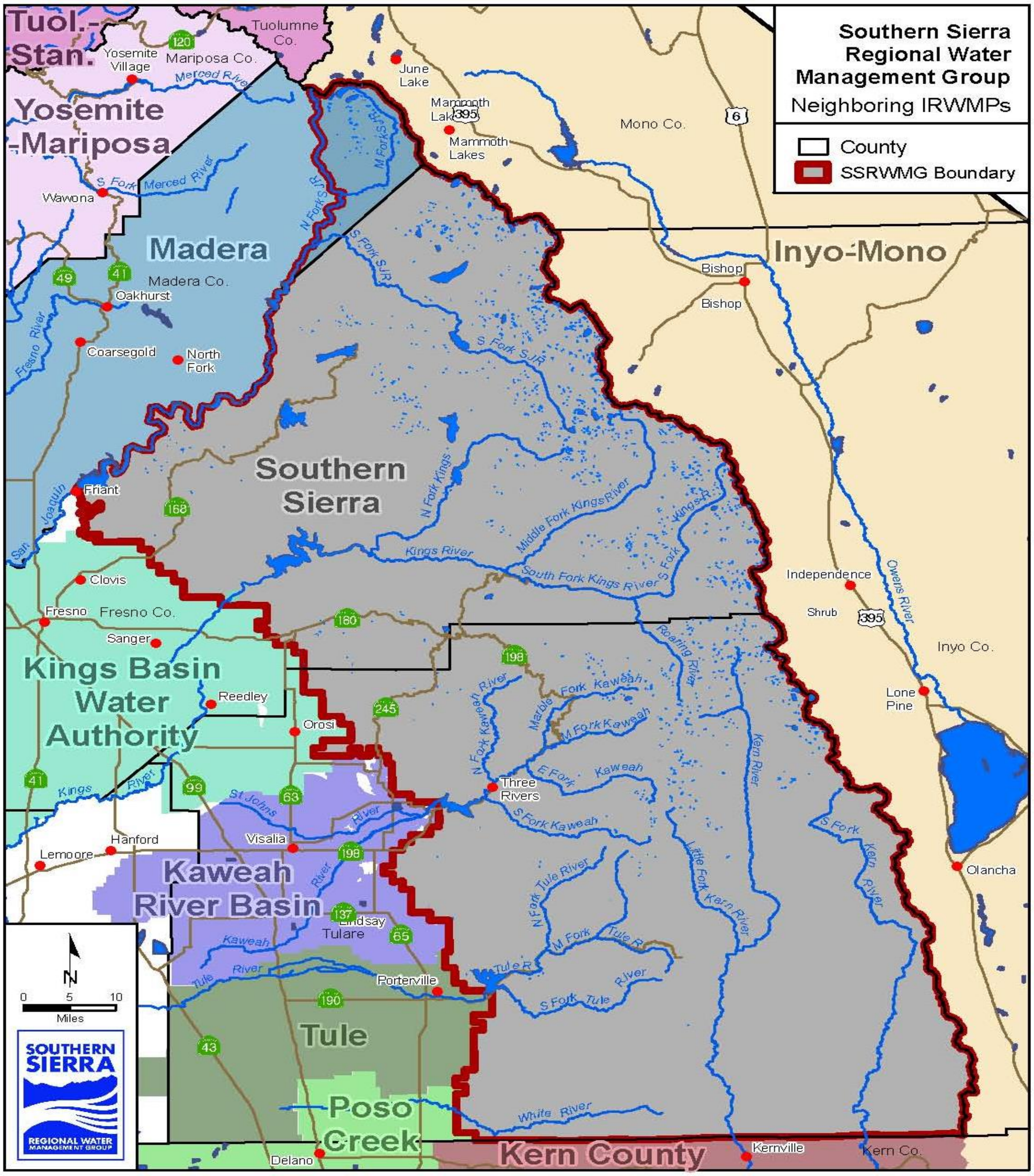


Figure 7-1 Neighboring IRWMPs

<u>North – Madera Region IRWM</u>

The Madera IRWM Region is located north of the Southern Sierra IRWM Region. The two regions are generally separated by the San Joaquin River, which creates a partial hydrological boundary, but the two regions are still hydrologically connected. Both regions share an area south of the San Joaquin River and east of the South Fork of the San Joaquin containing the watershed of the Middle Fork of the San Joaquin River. The Madera IRWM Region is experiencing groundwater overdraft, and water management strategies that address or exacerbate overdraft would affect the Madera Region. Both regions would also be affected by projects that impact the flow rate or water quality in the San Joaquin River.

East – Inyo-Mono IRWMP

The Inyo-Mono IRWM Region occupies lands to the east of the Southern Sierra IRWM Region and are hydrologically disconnected. The topographic boundary between the two regions is the crest of the Sierra Nevada Mountain range, which separates the surface flows west and east. Direct benefits or impacts on the Inyo-Mono IRWM Region are not anticipated from policies or actions in the Southern Sierra Region.

North West - Kings Basin Water Authority

The IRWM Region for the Kings Basin Water Authority (previously called the Upper Kings Basin Water Forum) lies to the north west of the Southern Sierra Region. This area receives most of their surface water from the Kings River and relies heavily on watershed management in the Southern Sierra to provide reliable and high quality surface waters. The largest concern in the Kings Basin Water Authority (KBWA) Region is groundwater overdraft. Pine Flat reservoir provides flood control and flow regulation downstream of the Southern Sierra Region and into the KBWA Region. Operational changes at the reservoir in response to water supply and quality will have a direct affect on the KBWA Region.

The Kings Basin Water Authority boundary covers a small portion of the Tulare Lake Subbasin in northern Kings County. A portion of the Tulare Lake Basin is not covered by any IRWMP. Historically, Kings River flows are known to have terminated in this area, and in very wet years flood waters would spill north to meet the San Joaquin River. Under its current operation, Kings River flood waters are preferentially sent north and only spill south to the historic Tulare Lake during very wet years. Consequently, flood control and diversion projects could negatively or positively impact the Tulare Lake Basin.

Central West – Kaweah River Basin IRWMP

The Kaweah Basin IRWM Region lies to the center west of the Southern Sierra IRWM Region and north of the Tule IRWM Region. The area relies partially on Kaweah River surface water supplies, which originate with flow through the Southern Sierra IRWM Region, with other demands met with other surface water supplies and groundwater. Kaweah River water supplies are impacted by watershed management in the Southern Sierra Region. Lake Kaweah provides flood control and flow regulation downstream of the Southern Sierra IRWM Region and into the Kaweah Basin IRWM Region. Operational changes at the reservoir in response to water supply and quality will have a direct affect on the Kaweah Basin Region.

Central South West – Tule IRWMP

The Tule IRWM Region is located central and southwest of the Southern Sierra IRWM Region just below existing rangeland. The area relies partially on Tule River surface water supplies, which originate and flow through the Southern Sierra IRWM Region, with other demands met from other surface water supplies and groundwater. Watershed management performed in the Southern Sierra Region can impact Tule River water quantity and quality as well as land retirement and irrigated land fallowing.

South – Kern IRWMP

The Kern County IRWM Region lies to the south and shares the entire southern boundary with the Southern Sierra IRWM Region. This boundary is not hydrologically based and, as a result, the Kern River, White River and Poso Creek watersheds fall into the Kern and Southern Sierra IRWM areas. Consequently, coordination is very important for comprehensive watershed management in these watersheds as the water quantity and quality of surface water entering the Kern IRWM Region is dependent on management practices within the South Sierra IRWMP.

7.4 - Impacts and Benefits to Interested Stakeholders and DACs

The Southern Sierra RWMG has taken several steps to engage interested stakeholders and DACs in the IRWMP development and implementation. Some local agencies, organizations and DACs are not full members of the RWMG, but can participate in a meaningful way as interested stakeholders. Implementation of the IRWMP is expected to have the following benefits to DACs and interested stakeholders:

- Discussion Forum. Provide a forum to discuss water management issues, concerns, and priorities, especially those important to DACs.
- Information Dissemination. Share information to which DACs or interested stakeholders may not normally have access. For instance, DACs and interested stakeholders may not have the staff to regularly track Department of Water Resources (DWR) grant projects or attend other regional or statewide meetings. This type of information it typically summarized for everyone's benefit at regular RWMG meetings.
- Funding Opportunities. RWMG members can apply for a variety of grant programs from DWR, including some that are specifically for RWMG members and stakeholders.
- Special DAC Efforts. DACs can get greater recognition, publicity and input on their water resources issues through special DAC projects.

DACs and interested stakeholders are not expected to bear significant fiscal impacts from the IRWMP implementation, except local impacts that may occur from new projects.

7.5 - Project Specific Impact/Benefit Analysis

The Southern Sierra IRWMP requires that impacts and benefits from specific projects be evaluated through the California Environmental Quality Act (CEQA) or National Environmental Policy Act (NEPA) process. Project impacts and benefits must be described when projects are submitted to the Southern Sierra RWMG in the Project Information Form (Project Review Process) and prior to funding consideration. Completion of the CEQA or NEPA process is not required during the project evaluation phase, but a thorough discussion of benefits and impacts is required. However, a complete and approved CEQA or NEPA analysis would be viewed more positively than a preliminary assessment since it provides greater assurance of project success.

As a minimum, the benefit/impact analysis should address the topics found in a CEQA analysis including: aesthetics, air quality, biological resources, climate change, cultural resources, geology and soils, hydrology and water quality, land use and planning, noise, population and housing, public services and utilities, recreation, and transportation and circulation.

In addition, as part of project evaluation and justification in grant applications, stakeholders will be required to document the benefits and impacts of their projects, using the format in **Table 7.1**.

7.6 - Revisions and Updates to Benefits and Impacts

The impacts and benefits of IRWMP implementation will be revised according to the following guidelines:

- Impacts and benefits will be reviewed and revised whenever the IRWMP is updated or DWR establishes new guidelines for this standard. It is expected that the IRWMP will be updated at least every 5 to 10 years.
- Impacts and benefits will be revised, as appropriate, to reflect anticipated or observed changes in the regional climate.
- Impacts and benefits will be revised to reflect lessons learned, or new impacts or benefits identified during implementation of local projects.

Chapter 8 - Plan Performance and Monitoring

This chapter describes several existing regional monitoring programs in the Southern Sierra Region, procedures for monitoring progress in meeting the Integrated Regional Water Management Plan (IRWMP) objectives and implementing projects, and guidelines for preparing project-specific monitoring plans. In addition, an annual report is described which will include annual monitoring data and evaluations.

8.1 - Monitoring IRWMP Objectives

Each year the RWMG will measure their success in meeting the IRWMP objectives. Each objective is listed in **Table 4.1** in **Chapter 4 – Goals and Objectives**, along with its metric and how it will be monitored. For example, for Objective No. 1a: Promote Natural Water Storage, the RWMG will describe studies and implementation projects to develop identify forest, meadow and stream restoration projects, the project goals, and their effectiveness at storing water.

8.2 - Monitoring Progress in Implementing Projects

The RWMG will monitor progress in implementing projects that are secured through the RWMG or with assistance from the RWMG. Each year the following will be documented:

- List of projects submitted and approved for funding.
- Description of new projects that are underway or completed and their anticipated benefits.

8.3 - Project-Specific Monitoring

Project monitoring is important to track the success and benefits of a project, ensure it is being operated properly, to comply with laws and regulations, and to monitor the IRWM process and benefits. Examples of project-specific monitoring can include monitoring water quality, groundwater levels, flood frequency, and the effects a project may have on a particular species or an assembedge of species. Project-specific monitoring is the responsibility of the agency or group that is implementing a project and expects to directly benefit from the project. The agency is also responsible for developing project monitoring plans.

The RWMG will require draft monitoring plans for projects that are considered for funding. Final monitoring plans are prepared after final designs are completed, and are typically approved by regulatory or funding agencies and should be copied to the RWMG. Draft monitoring plans must include the following information when applicable: General Information

- Project description
- Describe what is being monitored (water quality, water flows, etc.) and the applicable measurement metrics.
- Need for monitoring
- Staying consistent with the most current adopted California Water Plan

Monitoring Program

- Performance monitoring frequency and schedule including adapting monitoring program as effects of climate change manifest or warrant
- Overall monitoring time period (e.g. 5 years, life of project, etc.)
- Monitoring locations
- Monitoring protocols including considerations for adapting protocols as new information and data becomes available
- Monitoring tools and equipment, including considerations as new tools and equipment become available
- Laws and regulations pertinent to monitoring
- Quality control procedures

Data Management

- How monitoring data will be stored and tracked
- How monitoring data will be incorporated into Statewide databases
- Targets to be reached (if any)
- Measures to remedy or react and adapt to problems encountered during monitoring or new sources of reliable data
- Reporting procedures

Other Topics

- Funding source for on-going monitoring
- Responsibilities (who will perform the monitoring)

An important component of monitoring and data management is qualitative or quantitative trend analysis. When relevant, appropriate trend analysis should be a part of project monitoring plans.

A useful example of a detailed monitoring report was prepared by Stillwater Sciences (2012) for a meadow restoration project in the Southern Sierra.

8.4 - Regional Water Management Group Annual Report

The RWMG will prepare annual reports at the end of each calendar year and make them available upon request. The reports will document the aforementioned monitoring, an updated project list, proposed amendments to the IRWMP, and changes in governance, policies, and membership. An annual report is considered important for the RWMG and will offer the following benefits:

1. Help to validate the RWMG by documenting successes and achievements.
2. Increase awareness of RWMG efforts with the members, stakeholders and general public.
3. Serve as a reference document for RWMG administrators.
4. Document information that may be needed for future IRWMP updates.

The RWMG will assign a member of the Coordinating Committee to oversee preparation of the Annual Report. The RWMG may also use consultants to help prepare the report. Members and stakeholders will need to contribute information on completed or on-going projects. Timely cooperation from the stakeholders is crucial to prepare an accurate and complete annual report. Below is a proposed outline for the Annual Report with a brief description of each section.

<u>1 – Executive Summary</u>
The executive summary will summarize the main points in the report. The executive summary will be written so it can be used for public outreach efforts such as press releases, newsletter articles, newspaper articles, etc.

<u>2 - Success in Meeting Plan Objectives</u>
Identify progress made by the RWMG and local stakeholders in meeting each of the IRWMP's objectives. Describe progress in terms of the metric provided for each objective (see **Section 4.4**).

<u>3 - Implementation Projects</u>

3.1 - Regional Studies
Describe regional water related studies performed by the RWMG, members and stakeholders or other agencies such as DWR, Department of Public Health, United States Geological Survey, etc.

3.2 - Project List
Solicit updated project data from the members and interested stakeholders and store it in the Projects Database. Report on any updates or changes to Project prioritization.

3.3 - Completed or On-going Projects
Describe the progress made on on-going and completed implementation projects.

3.4 - Grant Funding
Discuss grant funding that was applied for or awarded to members and stakeholders.

3.5 - Lessons Learned

Document lessons learned from studies, project monitoring, grant applications or project implementation in the Region that could affect regional goals; regional priorities, resource and adaptive management strategies used, and project operations, monitoring, and monitoring methodologies.

4 - Proposed IRWMP Amendments

Document proposed amendments to the IRWMP. These differ from changes in governance or policy documented in Section 5 of the annual report. Any member or stakeholder can propose an amendment to the IRWMP. These proposed changes will be re-evaluated when the IRWMP is formally updated, which is expected to be about every five to ten years.

5 – Governance, Policies and Membership

5.1 - Changes in Governance and Policies

Document changes in governance and policies that have been formally adopted by the Coordinating Committee and the RWMG.

5.2 - Changes in Regulations

Provide updates on regulations that may impact the IRWM such as new requirements for IRWMPs, new monitoring requirements for groundwater quality, etc.

5.3 - Changes in Members and Stakeholders

Document changes in the members and interested stakeholders

5.4 - Coordination with Other RWMGs

Document important coordination efforts with other RWMGs.

The report will be based on the calendar year (January to December). Each year data collection will begin in November and the report completed by the end of February.

8.5 - Regional Monitoring Efforts

Following are descriptions of some of the major monitoring programs in the Southern Sierra Region. Each of these programs covers specific areas within the regions and is described below.

Kings River Fisheries Management Program (KRFMP) - The Kings River Fisheries Management Program (KRFMP) partners, which include the Kings River Water Association, Kings River Conservation District, and California Department of Fish and Wildlife have been collecting information for several years on the habitat conditions, stream flows, water quality, water temperature, hatchery planting programs and fisheries studies within the lower Kings River and the Pine Flat Reservoir (see http://www.krfmp.org/monitoring.html). Monitoring activities include: telemetry studies, water quality surveys, population surveys and macroinvertibrates. Two monitoring sites are located downstream of Pine Flat Dam within the Southern Sierra Region, one at the Army Corps of Engineer's bridge about ½ mile below the dam, and another on Mill Creek upstream of the confluence with the Kings River.
Kings River Water Association (KRWA) – KRWA reports daily water conditions on its

website. These daily reports consist of information regarding water storage, stream flows, water releases and precipitation (see http://www.kingsriverwater.org/water_conditions/hydro_data.php).

California Department of Water Resources Data Exchange Center (CDEC) – The California Data Exchange Center (CDEC) installs, maintains, and operates an extensive hydrologic data collection network including automatic snow reporting gages for the Cooperative Snow Surveys Program and precipitation and river stage sensors for flood forecasting, including various locations within the Southern Sierra Region. For more information see http://cdec.water.ca.gov. The mapper tool can be used to locate monitoring stations within a limited geographical area http://cdec.water.ca.gov/cgi-progs/mapper.

California Department of Water Resources, Coordinator for California Cooperative Snow Surveys – Information on the snow survey program can be found at http://cdec.water.ca.gov/snow/. Active snow courses with the San Joaquin, Kings, Kaweah, Tule and Kern River Basins are highlighted at http://cdec.water.ca.gov/misc/SnowCourses.html, and monitored by the Park Service, Forest Service, Department of Water Resources, utility companies and water associations.

US Army Corps of Engineers (USACE) – River and weather data on the Lake Isabella and Lake Kaweah Projects is maintained by the Army Corps of Engineers at http://rivergages.mvr.usace.army.mil/WaterControl/new/layout.cfm.

US Forest Service, Pacific Southwest Research Station - The Kings River Experimental Watershed (KREW) is a watershed-level, integrated ecosystem project for headwater streams in the Sierra Nevada. Eight sub-watersheds have been chosen and fully instrumented to monitor ecosystem changes: four on the Big Creek drainage, three on the Dinkey Creek drainage, and one that drains directly into the North Fork of the Kings River. Data collection has included stream discharge, water and soil chemistry, and meteorological data for the eight study watersheds. Findings from this research should be relevant for other headwater areas of the Region. See http://www.fs.fed.us/psw/topics/water/kingsriver/ for additional information. The Teakettle Experimental Forest is managed by the Pacific Southwest Research Station and abuts the Kings River Experimental Watershed. Present research in the experimental forests focuses on fire and forest management. Streamflow and sedimentation data exists from 1958 to 1979. See http://www.fs.fed.us/psw/ef/teakettle/ for additional information.

National Park Service, Sequoia & Kings Canyon National Parks (SEKI), Sierra Nevada Inventory & Monitoring Program - The Sierra Nevada Network Inventory & Monitoring Program (http://science.nature.nps.gov/im/units/sien/index.cfm) is one of 32 National Park Service Inventory & Monitoring (I&M) networks across the country established to facilitate collaboration, information sharing, and economies of scale in natural resource monitoring. The Sierra Nevada Network (SIEN) comprises four national park units located on the west slope of the Sierra Nevada mountain range in California, including SEKI. SIEN works closely with each park's natural resources program to develop and implement long-term monitoring and provide sound scientific information to park managers. The river monitoring efforts for 2011 are summarized in the linked document http://science.nature.nps.gov/im/units/sien/assets/docs/briefs/RiversBrief_sienv2_20121029.pdf and a 2005 water resources information and issues overview report (http://www.nature.nps.gov/water/planning/Info_Issuesoverview_reports/seki_wriio_final_High.pdf) indicates over 400 water quality sampling locations and 6 staff gauge locations within the park. The Parks also prepare annual reports that include information on surface water, snow, and fire management.

US Geological Survey (USGS) – The USGS monitors stream flow and surface water quality in multiple locations throughout California. California daily stream flow locations can be accessed from http://waterdata.usgs.gov/ca/nwis/rt and for a couple of water quality monitoring sites in Fresno and Tulare Counties access by county is at http://waterdata.usgs.gov/ca/nwis/current/?type=quality.

Tule River Native American Indian Tribe – The Tule River Indian Tribe conducts annual water quality sampling at 30 established locations within the South Fork Tule River Watershed. See the Water Settlement Technical Report at http://www.tulerivertribe-nsn.gov/index.php for information on monitoring conducted by the Tribe. In addition, the US Geological Survey maintains a stream gage on the Tule River South Fork just downstream of the Reservation boundary (see http://waterdata.usgs.gov/usa/nwis/uv?11204100).

Sierra Nevada Research Institute – The Sierra Nevada Research Institute (SNRI) is located at the University of California at Merced (UC Merced). Faculty, researchers, and students in the SNRI conduct basic and applied research, using the San Joaquin Valley and the Sierra Nevada as their "outdoor laboratory." Currently over 35 UC Merced faculty are members of SNRI. The Institute conducts research and collects data on ecology, hydrology, climatology, forest management, agriculture and various other topics. More information can be found on their website at: http://snri.ucmerced.edu/. Several research programs by SNRI researchers contribute to data and value-added products in the region. These include ground-based and remotely sensed data. Data from SNRI projects are served through a digital library (https://eng.ucmerced.edu/snsjho) and archived in the California Digital Library.

Southern Sierra Critical Zone Observatory – The Southern Sierra Critical Zone Observatory (CZO) a long-term project under SNRI, is a platform and program for investigating how the water cycle drives critical zone processes, focusing on water balance, nutrient cycling, and weathering across the rain-snow transition. The Southern Sierra CZO was established in 2007, under a grant from the National Science Foundation. The Southern Sierra CZO represents a longer-term measurement-based research program, which contributes management-relevant knowledge to the region. For example, it maintains four focal measurement sites along an elevation transect extending from 1350 to 9000 ft elevation, providing the only spatially distributed measurements of water and carbon balances in the region.More information on the observatory can be found at http://criticalzone.org/sierra/. A recent addition to the National Science Foundation research along the CZO transect is the addition of five focal measurement sites by the

National Ecological Observatory Network (NEON). These sites also measure water and carbon balances, plus aquatic and terrestrial biodiversity. NEON is part of a nationwide network, with 20 measurement domains around the United States; and more information on NEON is available at https://www.neonscience.org/, Both the CZO and NEON also develop LiDAR and other specialized, remotely sensed data on vegetation and other landscape attributes.

Shifts in Temperature and Why it Matters – On average, land-surface temperature in the southern Sierra decreases about 3.7oF per 1000 ft elevation, or 1oF per 270 ft elevation (about 2oC per 300 m elevation). These values can vary by +50% throughout the year, vary with topographic patterns that influence heating, cold-air drainage and other attributes, and thus also vary from day to night. Daily minimum and maximum temperature values are consistently reported for a few long-term operational stations in the region; plus dozens of shorter-term research stations typically report hourly or more-frequent temperatures. Real-time operational data are available for some sites through CDEC and other portals, with archived data that have undergone quality control available through the NOAA Western Regional Climate Center, and other portals. Various gridded minimum and maximum daily temperatue products are available, with a widely used product being that from the PRISM group at Oregon State University (Parameter-elevation Relationships on Independent Slopes Model). PRISM data are extrapolated to higher elevations, which typically lack measurements.

The Earth's warming temperature affects the regional water cycle in at least six ways, all of which require monitoring to assess impacts and upgrade water infrastructure (Figure 8.1). A key driver is the higher freezing elevation during storms at warmer temperatures, resulting in more rain and less snow. A second driver of change is the longer growing season for forest vegetation at warmer temperatues, resulting in more annual water use by forests. Together the longer growing season and a century of fire suppression by land managers, this has resulted in more biomass, i.e. forests that are overstocked with smaller trees. The increased forest biomass results in more canopy interception, with less rain and snow coming to the ground surface. A warmer climate drives earlier snowmelt, which is also exacerbated by a very dense forest. Earlier snowmelt leaves less water in the forest for vegetation to use during the summer dry season, and earlier drawdown of subsurface water that forests depend on during the annual dry summers that characterize the region's Mediterrenean climate. This effect is especially acute in the dense lower-elevation conifer forests where evapotranspiration is approximately equal to average annual precipitation; and the effect was quite striking during the 2011-15 drought when subsurface water was gradually depleted and some areas experienced near complete conifer mortality. The earlier runoff also results in less seasonal water storage behind dams, which must guard against downstream flooding by reserve storage for late-season rainstorms. The one feedback that reduces evapotranspiration and increases runoff is

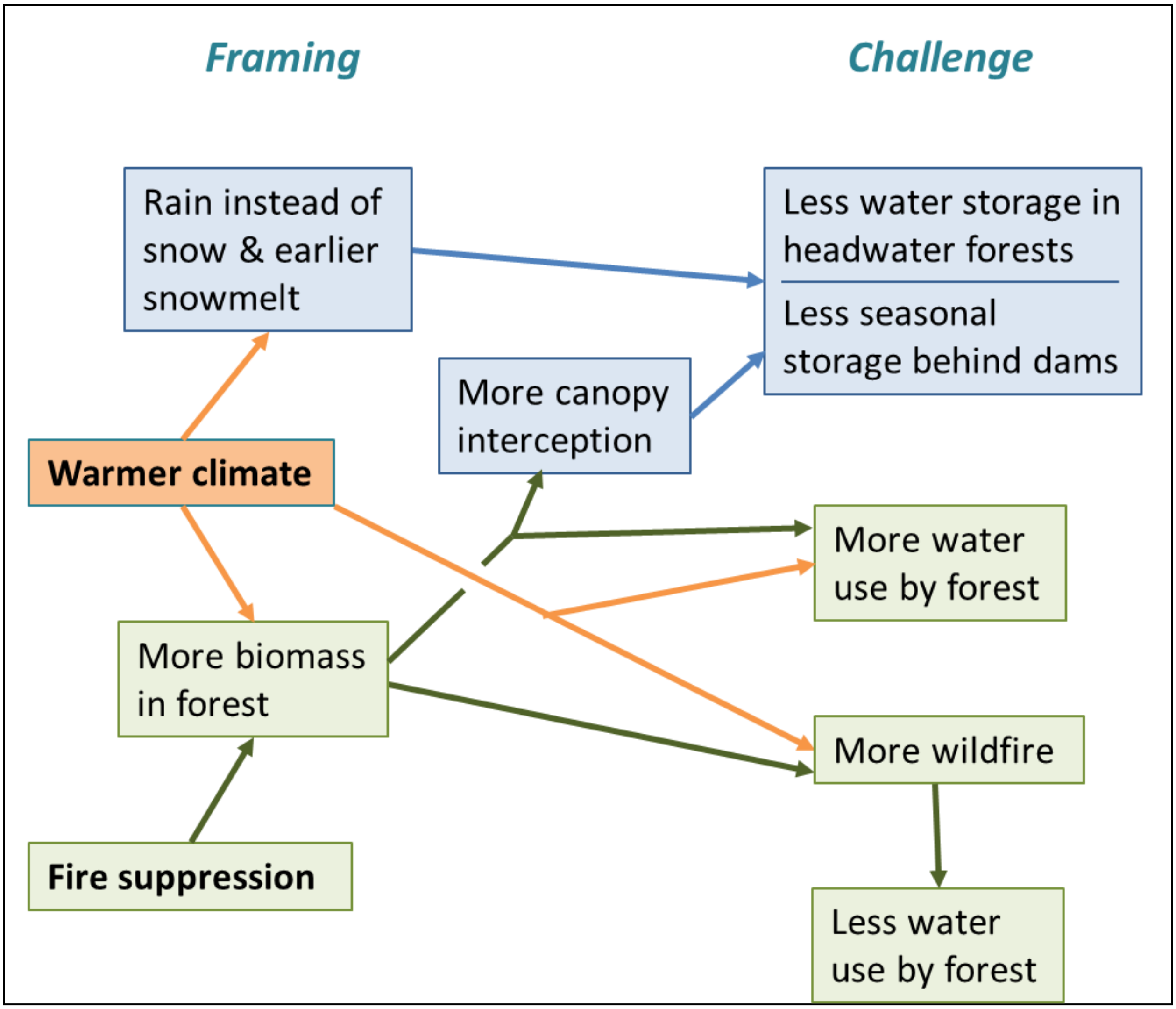


Figure 8-1. Some primary impacts of warming temperature on the water balance in Sierra Nevada headwater forests

high-intensity wildfire, the risk of which increases with a warmer climate and higher fuel loads. The balance of these feedbacks in the Kings River basin, plus wildfire effects, were

quantitatively assessed using a wide range of local measurements (Bales et al., 2018; Roche et al., 2018)[1]. These same approaches can be extended across the region, and projected forward to warmer climates and altered forest-management strategies. Quantitative measurements, scaled across the landscape, are central to planning, desigining, and financing water-system upgrades to adapt.

Hydroelectric Powerplant Monitoring – Several hydroelectric power plants in the Region are required to perform extensive monitoring to satisfy Federal Energy Regulatory Commission (FERC) licensing requirements. These typically cover hydrology, surface water, fluvial geomorphology, biology and numerous other topics.

[1] https://escholarship.org/uc/item/0sg4f8g3 and https://escholarship.org/uc/item/71f611j4

NASA Airborne Snow Observatory – The National Aeronautics and Space Administration (NASA) out of its Jet Propulsion Laboratory, operates the Aerial Snow Observatory (ASO) in the San Joaquin, and Kings river basins in the SSIRWM along with Merced and Tuolumne in the north. ASO uses aircraft-based LIDAR (light detection and ranging) technology to measure the depth of snow on the ground which are then combined with numerical models to produce evolution and ablation of snow water equivalent (SWE). Details on flight and data can be found: https://aso.jpl.nasa.gov/.

Sierra Nevada Aquatic Research Laboratory (SNARL),University of California Santa Barbara – In the years beginning, during and after the extended drought of 2012-2015 conditions in sentinel streams were monitored by David B. Herbst with SNARL to elucidate effects of hydroclimateic change and drought on headwater stream ecosystems. Using only undisturbed reference sites as monitoring stations, streams of high and low risk were selected to establish a network of sites to detect the varied levels of projected change. Three sentinel catchments with a nested tributary in each, in four combinations of risk and resistance have been established to represent high and low risk for climate-induced loss of snow cover and hydrologic stability, in combination with high and low resistance to climate change (Figure 2, Table 1). This monitoring design provides a range of conditions for observing responses within an environmental risk analysis framework.[1]

Surface Water Ambient Monitoring Program (SWAMP) – SWAMP is tasked with assessing water quality in all of California's surface waters. The program conducts monitoring directly and through collaborative partnerships, and provides numerous information products, all designed to support water resource management in California. Find out more on the overall program and statewide monitoring efforts at the State Water Board's SWAMP website. The Central Valley Regional Water Quality Control Board's SWAMP have established monitoring sites on the Kings, Kaweah, Tule, and Kern Rivers Watersheds that are monitored for water quality. Data information is located on the California Environmental Data Exchange Network (CEDEN) which integrates data from SWAMP and other programs.

Big Meadows Restoration and Post-Implementation Monitoring Report[2] – Stillwater Sciences prepared this study report for the Fresno Fly Fishers for Conservation in an effort to apply a relatively new technique, referred to as "pond and plug", to improve meadow condition and functionality. The report summarizes pre- and post-restoration monitoring at Big Meadows located in Sequoia National Forest, within the Giant Sequoia National Monument. The project was implemented with the following goals: (1) establish a primary-thread low flow channel with multiple ancillary channels, (2) reduce flow peaks and increase/extend summer base flows, (3) increase instream cover and shading, (4)

[1] Herbst, David B., Sierra Nevada Aquatic Research Laboratory, University of California, Santat Barbara. *A Monitoring Network for Detecting Climate Change Effexts on the Ecology of Sierra Nevada Streems* (unpublished). Date Unknown,. See also, website for additional related information: http://herbstlab.msi.ucsb.edu/

[2] Stillwater Sciences, *Big Meadows Resotration and Post-Implementation Monitoring Report, Final*, February 2012.

enhance aquatic and terrestrial habitat, (5) improve water quality, and (6) raise local groundwater level within the meadow (USDA Forest Service 2007).

Monitoring data were collected on the following meadow attributes: (1) meadow channel cross-sections, (2) channel surface water flow, (3) groundwater levels, (4) meadow channel bed material, (5) meadow vegetation, (6) aquatic macroinvertebrates, (7) stream and pond temperature, (8) and bird diversity and abundance and summarizes findings from the monitoring efforts in attempt to address whether progress towards the six project goals enumerated above was made during the study period (2005– 2011).

Although early monitoring results showed no indications of gross changes in the channel form due primarily to the paucity of pre-project measurements, the report recommends on-going monitoring and adaptive management to more completely undertand the long term natural range of potential variability in meadow conditions.

Sierra Meadows Partnership, Sierra Meadows Restoration Strategy – Prepared in November of 2016, this study emphasizes the importance of meadow restoration within Sierra Nevada as a key component of water quality within California. The Sierra Nevada occupies about 25% of the State's total land area, and is the source of 60% of California's developed water supply. Many state and federal agencies understand that the relatively small 191,000 acre area of meadows in the Sierra Nevada provide vital and unique hydrologic and ecological functions for watershed health for the State. Therefore, the Partnership through the Strategy sets forth the urgency to increase the pace, scale, and efficacy of meadow restoration and protection in recognition of the greater footprint for downstream water users. The Strategy aligns with many other state and federal water protection policies and long range planning documents and sets forth an "all-lands and all-hands" approach to an ambitious push to restore and/or protect 30,000 acres of meadows, in part, to protect the value of water flowing from federal, state, and private lands—an increasingly important effort, especially where severe drought conditions continue. The implementation of the Strategy is based upon pre- and post-restoration activity monitoring coupled with adaptive management in response to monitoring observations of numerous measurable objectives and changing conditions inlcuidng those related to greenhouse gas/climate and land use change effects and carbon sequestration. The Strategy establishes short- (<5 years), intermediate- (5-10 years) and long-term (in 15 years) timeframes to achieve identified desired outcomes.

Millerton Area Watershed Coalition Phase 3 Watershed Assessment and Protection Plan Recommendations Report-Upper San Joaquin River – The final study in a series funded by CalFed, assesses resource conditions in the Sierra National Forest, San Joaquin River Gorge Management Area, San Joaquin Experimental Range, and part of the Millerton Lake Area (primarily Finegold Creek and environs.) Specifically, the 3-phased study assessed surface water quality, groundwater quality and quantity, noxious weeds/invasive species, and fuels and fire. Assessment involved monitoring and field survey. The Phase 1 assessment concluded that the Millerton Area watershed is in relatively good condition, but future demands from the Fresno/Clovis metropolitan area will incread demand on the watershed's resources. In the phase 2 area, monitoring indicated that there may be potential impacts from septic systems. The overall condition of the watershed was deemed “repairable.” The phase 3 task was more involved than the previous two, attempting to collect more detailed data over far more land. The area suffered from the same septic problems as phase 2 and was also considered to be “repairable.” As an outcome of these assessments, the authors presented 68 recommendations for future management of the watershed, including on-going data collection and monitoring of changing conditions related to surface and groundwater; sediment, erosion, and soils; biodiversity and habitats; fuels and fire history; and invasive and noxious weeds.

Many communities monitor groundwater levels and groundwater quality related to their drinking water supply, wastewater treatment, and wastewater disposal. The data collected is generally localized around the community. Due to the numerous communities in the Region they are not all listed here.

In addition to these regional monitoring programs there are many State, Multi- Regional and Federal programs that have local implications. The following is a list of several of these programs. This list is not intended to be complete or comprehensive but represents examples of the types of monitoring being conducted:

- National Atmospheric Deposition Program (NADP). This program monitors precipitation chemistry including compounds of nitrogen; http://nadp.sws.uiuc.edu/. The two stations in the Region are CA28 located at KREW on the Sierra National Forest and Ca75 located in Sequoia National Park.
- Interagency Monitoring of Protected Visual Environments (IMPROVE). IMPROVE monitors several aspects of air quality linked to reductions in visibility in Parks and special places of visual importance; http://vista.cira.colostate.edu/improve/
- Conservation Biology Institute (CBI). The institute maintains several Sierra Nevada data sets found at http://consbio.org/general/search?q=sierra+Nevada and http://consbio.org/

California Climate Commons (CCC). The CCC maintains several data sets concerning climate change and holds workshops focusing on vulnerability assessments and adaptive management: http://climate.calcommons.org/.

Chapter 9 - DATA MANAGEMENT

9.1 - Introduction

This chapter discusses data collection, storage, management and availability to the stakeholders and public within the Southern Sierra Region. The goal of data management is to ensure efficient use of available data, stakeholder access to data, and to ensure the data generated by IRWM implementation activities can be integrated into existing State databases.

The Southern Sierra Region is a very large, remote area with no incorporated cities. There is no single agency or entity, such as a regional water management district, collecting, analyzing, storing or making data accessible to the entire Region. Instead data is collected and stored by various public and private organizations with limited coordination. The Southern Sierra RWMG is composed of multiple jurisdictions, agencies, non-profit groups, tribes and communities, and, as a result, data management is key in making data universally available to the stakeholders. Stakeholder surveys in 2009 and 2010 identified '*Data sharing for efficient and effective management*' as one of the priority strategies for the Region. This section generally concludes that greater efforts are needed to collect, store and distribute water resources data in the Southern Sierra.

Data collected for the development of this IRWMP is presented throughout this document, but is concentrated in **Chapter 2 – Region Description**. In addition, **Chapter 8 – Plan Performance and Monitoring**, includes a description of several (though not intended to be comprehensive) monitoring programs that collect and store data.

The RWMG has limited resources to build and maintain new databases. The RWMG therefore relies on existing databases managed by various public and private entities. The RWMG will also utilize their website (http://www.southernsierrarwmg.org) as the main portal for storing their data.

9.2 - Data Needs in the Southern Sierra Region

In general, water resources data is sparse in the Region and data availability differs sharply from other areas that practice intense water management, such as the San Joaquin Valley. Due to the low population density, rugged terrain, and poor accessibility, data is sparse in some areas. For instance, floodplain maps, soils data and groundwater levels are unavailable for large areas in the Region. Further data collection, storage and analysis will be needed to improve future policy and decision making, to enhance the water management portfolio, provide the data needed to develop projects, and make water management decisions. Following is a list of data needs in the Region that was developed by the RWMG stakeholders:

1. Groundwater Resources - Very little groundwater information is available in the Region. (A groundwater study was performed for eastern Fresno County, (Geomatrix Consultants and Boyle Engineering, 2006)). Most groundwater comes from fractured bedrock aquifers, and many of the wells serve remote, disadvantaged communities through individual wells or small community systems. There are no incorporated cities, only a few small water treatment plants, and the majority of the Region utilizes wells and individual septic systems. County general plans call for development in the foothill and mountain communities yet sustainable use rates have yet to be established for existing communities who rely almost exclusively on fractured-rock aquifers.
2. Resource Management Strategy Justification – Additional data is needed to justify some of the Resource Management Strategies described in **Chapter 5**. For example, more data is needed on the impacts of forest management strategies on water supplies. Forest thinning (whether mechanically, by prescribed burns or employing other management options) and forest restoration are broadly applicable in the Region to increase water supplies, however, completion of existing research such as KREW (see page 8-2) and possibly additional research/monitoring on different thinning approaches are needed.
3. Watershed Management Plans – Much of the RWMG area is not covered under a recent watershed management plan or watershed assessment. The U**pper Reac**hes of the San Joaquin River are covered under a plan, the National Forest Service has some plans, and the Sierra and Inyo National Forests have prioritized watersheds for restoration in their Forest Plan Revisions. However, large areas are still not covered. Watershed Management Plans are needed for the different sub-regions as well as the RWMG as a whole. Potential teaming partners include the National Forest Service, USGS and US Army Corps of Engineers.
4. Stream Monitoring – The Southern Sierra includes hundreds of small streams; most of the streams are not monitored for hydrologic, chemical or biological parameters. Many watersheds may be impacted by unknown contaminants, both natural or anthropogenic, and this data has not been collected and documented.
5. Flood Risk – Limited data is available on floodplains in the RWMG area. Most FEMA floodplain maps stop before reaching the foothill areas due the topographic constraints and lack of wide floodplains, but flooding does occur along streams and rivers and in certain local areas.
6. Groundwater Recharge Areas - Geographic and geologic data on areas potentially suitable for intentional groundwater recharge are generally not available.
7. Water Balance – Water balance data includes amount of incoming precipitation, distribution into ecosystem compartments by runoff and infiltration into soil, surface water, and groundwater; evaporation and vegetation transpiration into the atmosphere. This type of information is not available for most of the RWMG area.
8. Infrastructure Inventory – This goal includes developing an inventory of all major water infrastructure in the Region.

9.3 - Data Collection Techniques

Data integration is best achieved through the use of common and compatible methods for data gathering, analysis, monitoring, and reporting systems used by members of the RWMG. Much of the data collected will be compiled by the granting agency and integrated into existing state and federal databases (see **Section 9.8**).

9.4 - Stakeholder Contributions of Data

Stakeholders have, and will continue to contribute data to the RWMG through their input on the IRWMP, and by implementing projects that are funded through RWMG efforts. For several years the stakeholders have also identified potential projects and submitted project descriptions to the RWMG. This data is collected so that all stakeholders are aware of potential future projects, stakeholders can identify and cooperate on multi-agency projects, duplicative efforts can be avoided, and so projects can be put on a formal list to be eligible for future grant applications. This data will be stored on the RWMG website. See **Chapter 7 -Impacts and Benefits of Plan Implementation** for more detail on this process and a current list of potential projects.

9.5 - Data Management Responsibilities

The Regional Water Management Group will maintain a website to store data collected directly by the RWMG, or on projects funded through RWMG sponsored grant applications. The RWMG does not have the institutional capacity or funding to develop and maintain databases to improve more specific forms of data management (i.e. groundwater levels). Such databases could only be created with grant funding, and on-going maintenance would need to be performed by another organization with on-going funding sources. However, there is the need for greater data storage capacity so the RWMG can store information they have collected and reports they prepare. These will generally be placed on the RWMG website or links provided to other websites where they can be found. The RWMG will also continue to rely on State and Federal databases for storing much of the water resources data they collect.

9.6 - Regional Water Management Group Website

The RWMG website (www.SouthernSierraRWMG.org) will be the primary portal for storing data collected and generated by the RWMG. The website includes the following:

- Integrated Regional Water Management Plan
- Copies of studies, reports, designs and data for projects funded by RWMG applications
- Historical RWMG documents
- RWMG Annual reports
- Funding opportunities
- Regional maps
- Educational materials
- Information on proposed, current and completed projects

The website will provide a simple, easily accessible format for stakeholders to access this data. The website will be maintained by the Regional Water Management Group.

The RWMG has also setup a Facebook® page to promote the RWMG and post regular news, announcements and comments. The Facebook® pages can be accessed at: https://www.facebook.com/southernsierrarwmg

9.7 - Quality Control and Quality Assurance Measures

The RWMG includes a review process that solicits comments from members and stakeholders on all RWMG projects, or projects that are coordinated with the RWMG. For instance, the RWMG and Coordinating Committee reviewed and provided comments on each separate chapter for this IRWMP as they were written. In some cases, technical work groups can be formed to review data or oversee its use in specific areas.

When stakeholders implement projects funded with grants secured through the RWMG, they must adopt and implement Quality Control/Quality Assurance (QA/QC) measures. These measures need to be thoroughly documented in grant applications, and IRWMP Implementation Grant applications will not be submitted unless QA/QC measured are satisfactorily addressed.

9.8 - Data Sharing and Distribution

Data will be shared and distributed to local stakeholders, and government organizations that maintain databases.

Local stakeholders. Data will be shared with local stakeholders including RWMG members, interested stakeholders, local agencies and the general public through the following mechanisms:

1. Final reports for RWMG projects will be placed on the RWMG website
2. Annual reports will identify the type of data collected, and be posted in the website
3. Public outreach efforts, such as website postings, RWMG meetings, public workshops, and targeted outreach will inform stakeholders of data that is or has been collected
4. When appropriate, copies of reports and data will be sent to specific stakeholders that may have a high interest in the data.

State Databases. When appropriate, data collected for RWMG projects will be forwarded to the appropriate State agency for inclusion in their databases. In general, State databases have specific requirements for data submittal (format and procedural) that will need to be followed. Grant applicants need to consider what State databases they may be contributing data to, because the legislation supporting a given grant program may specify a State database for data submittal. Following is a list of some state databases that may be applicable to future projects:

- *California Environmental Data Exchange Network* – CEDEN is a system designed to facilitate integration and sharing of data collected by many different participants. The CEDEN data templates are available on the CEDEN website: http://www.ceden.org.
- *Water Data Library (WDL)* – DWR maintains the State's WDL which stores data from various monitoring stations, including groundwater level wells, water quality stations, surface water stage and flow sites, rainfall/climate observers, and well logs. Information regarding the WDL can be found at: http://wdl.water.ca.gov/.
- *California Statewide Groundwater Elevation Monitoring Program (CASGEM)* – CWC §10920 et seq. establishes a groundwater monitoring program designed to monitor and report groundwater elevations in all or part of a basin or subbasin. These requirements also limit counties and various entities (CWC §10927.(a)-(d), inclusive) ability to receive State grants or loans in the event that DWR is required to perform ground monitoring functions pursuant to CWC §10933.5. Requirements of the CASGEM Program can be found here: http://www.water.ca.gov/groundwater/casgem/.
- *Surface Water Ambient Monitoring Program (SWAMP)* – The SWRCB has developed required standards for SWAMP. Any group collecting or monitoring surface water quality data, using funds from Propositions 13, 40, 50, and 84 must provide such data to SWAMP. More information on SWAMP is available at: http://www.swrcb.ca.gov/water_issues/programs/swamp.
- *Groundwater Ambient Monitoring and Assessment Program (GAMA)* – GAMA provides a comprehensive assessment of water quality in water wells throughout the State. GAMA has two main components, the California Aquifer Susceptibility (CAS) assessment and the Voluntary Domestic Well Assessment Project. The CAS combines age dating of water and sampling for low-level volatile organic compounds to assess the relative susceptibility of public supply wells throughout the State. The Voluntary Domestic Well Assessment Project provides sampling of water quality in domestic wells, which will assist in assessing the relative susceptibility of California's groundwater to contaminants. Because water quality in individual domestic wells is unregulated, the program is voluntary and will focus, as resources permit, on specific areas of the State. Constituents to be analyzed include nitrate, total and fecal coliform bacteria, methyl tert-butyl ether, and minerals. Additional information on the GAMA program is available at: http://www.swrcb.ca.gov/gama.
- *California Environmental Information Clearinghouse (CEIC)* – The California Natural Resources Agency (CNRA) maintains the CEIC, which is a statewide metadata clearinghouse for geospatial data. The CEIC is accessible at: http://ceic.resources.ca.gov/. The online directory is used for reporting and discovery of information resources for California. Participants include cities, counties, utilities, State and federal agencies, private businesses, and academic institutions that have spatial and other types of data resources.
- *Integrated Water Resources Information System (IWRIS)* – DWR maintains IWRIS, which is a data management tool for water resources data and not a database. IWRIS is a web based GIS application that allows entities to access,

integrate, query, and visualize multiple sets of data simultaneously. Information on IWRIS is available at: http://www.water.ca.gov/iwris/

- *California Environmental Resources Evaluation System (CERES)* – CERES is an information system developed by CNRA to facilitate access to a variety of electronic data describing California's rich and diverse environments. The goal of CERES is to improve environmental analysis and planning by integrating natural and cultural resource information from multiple contributors and by making it available and useful to a wide variety of users. Information on CERES can be found at: http://ceres.ca.gov/.
- *California Integrated Water Quality System (CIWQS)* - CIWQS is a computer system used by the SWRCB and RWQCB to track information about places of environmental interest, manage permits and other orders, track inspections, and manage violations and enforcement activities. CIWQS also allows online submittal of information by permittees within certain programs and makes data available to the public through reports. The CIWQS database can be found at: http://www.waterboards.ca.gov/water_issues/programs/ciwqs/index.shtml
- For geospatial data collected by RWMG members, data maintained by the Region should be accompanied by applicable metadata that describes each data set (including projection and datum information, dataset description, data lineage, etc.).

9.9 - Data Sources

Following is a list of sources that contain important data on the Region and its water resources:

- Monitoring programs listed in **Section 8.1- Regional Monitoring Efforts**
- Resource Database of water resources studies, reports and datasets for the Southern Sierra and adjacent regions (database created by RWMG members and included in **Appendix K**)
- State databases listed above in **Section 9.8**.
- Geotracker database (environmental data for regulated facilities in California) - http://geotracker.waterboards.ca.gov/
- California Water Plan (http://www.waterplan.water.ca.gov/)
- Tulare Lake Basin Disadvantaged Community Water Study (http://www.tularecounty.ca.gov/cao/index.cfm/tulare-lake-basin-disadvantaged-community-water-study/)
- Three Rivers Water Supply Study (**Appendix D**)
- California Department of Fish and Wildlife – Numerous endangered species studies throughout the RWMG area
- US Fish and Wildlife Service - Landscape Conservation Cooperatives
- Sierra Nevada Conservancy - Geographic Information Systems data
- DWR Well completion reports for the Southern Sierra Region
- National Park Service, Sierra Nevada Network Inventory and Monitoring Program; http://science.nature.nps.gov/IM/units/sien/index.cfm
- Sequoia & Kings Canyon National Parks Natural Resource Condition Assessment

- National Park Service Searchable Report Database; https://irma.nps.gov/App/
- Precipitation and discharge data for headwater streams at the the Kings River Experimental Watershed (KREW), Forest Service, Pacific Southwest Research Station at www.fsl.orst.edu/climhy
- Recent Forest Plan Revisions for the Inyo, Sequoia and Sierra National Forests
- Sequoia National Forest Website: http://www.fs.usda.gov/sequoia
- Sierra National Forest website: http://www.fs.usda.gov/sierra
- Inyo National Forest website: http://www.fs.usda.gov/inyo
- Research efforts at local community colleges, University of California at Merced and California State University at Fresno
- Citizen science efforts to collect data
- USBR studies on the San Joaquin River, including studies on the proposed Temperance Flats Dam
- NRCS – soils and other GIS data

Chapter 10 - Financing

The Southern Sierra Regional Water Management Group (RWMG) needs funding for ongoing operations, updating the Integrated Regional Water Management Plan (IRWMP), preparing grant applications, project development (studies, design, and construction), project operation and maintenance, and local cost share for grant funded projects. This chapter provides a general overview of potential funding sources, programs, and project partnerships available from tribal, federal, state, local, and private sources. This chapter also explores long-term funding options such as annual membership dues and rate-based funds.

10.1 - Funding Sources

The primary sources of funding are illustrated in **Figure** 10-1 and discussed below.

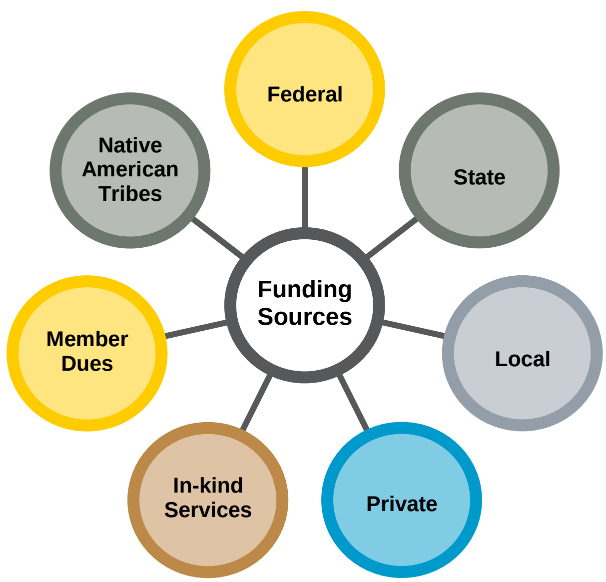


Figure 10-1 Funding Sources

10.1.1 In-kind Professional Services

In-kind professional services (in-kind services) include time donated by stakeholders to assist with RWMG efforts. In-kind services represent an important component of the RWMG's funding model. In-kind services have helped with institutional development, RWMG operations, grant applications, public outreach, and the IRWMP development. To date, the value of in-kind services by consultants, members and interested stakeholders has exceeded $400,000.

10.1.2 Member Dues

The current membership model for the Southern Sierra RWMG requires that members sign the MOU. The model does not require a minimum financial contribution to participate. The RWMG has decided not to collect annual dues at this time for the following reasons:

1. Some stakeholders may not see the benefits of paying dues until the RWMG has illustrated greater benefits and success with project funding and implementation.
2. Stakeholder recruitment is still a primary focus of the RWMG and membership dues may be a barrier to successful recruitment.
3. Some government agencies may be prohibited from contributing annual dues even though they are active participants or MOU signatories.
4. Some DACs may not have the funds to pay dues.

Presently the RWMG operates through grants and in-kind professional services. Collecting annual dues may be a viable option in the future, for selected member types, to help cover operational and administrative costs. As a result, the RWMG has discussed criteria for a potential financial agreement for RWMG members in case dues are collected in the future. The criteria are listed below:

1. The financial agreement will have a specific duration and will need to be periodically reviewed and renewed.
2. The cost-share schedule can take a variety of forms:
   a) May be based on services provided (exclusively manage water, manage or provide goods and/or services other than water management, no utility services);
   b) May be based on total estimated number of water/sewer connections, and proportional contributions;
   c) Minimum contribution, if desired; and
   d) May include waiver for member entities for whom a financial contribution constitutes a hardship.
3. If the RWMG begins a cost-share agreement, it will need to develop a process for reallocating costs if membership changes.
4. Cost-share contributions should not impact decision-making. In other words, all members would have equal voting power regardless of their contribution.

10.1.3 Native American Tribal Funding

Native American tribes provide funding for water resources projects on reservations as well as other projects throughout the Southern Sierra that enable tribes to perform traditional activities and customs such as indigenous food gathering. Some project examples include native habitat restoration, exotic species removal, and stream restoration.

10.1.4 Federal Funding

Federal funds are available through a variety of mechanisms, including legislative appropriations, federal agency interest, and federal assistance programs (grants and loans). Examples of these funding mechanisms are described below.

Legislative Approach

Federal funding may be secured through the legislative process to directly fund an approved project. A public agency working with a local congressional representative can initiate this process. The project may require the establishment of federal interest through an act of Congress (authorization) and then be funded in subsequent years (appropriation). An appropriation can be made the same year if the project is consistent with the goals and objectives of an existing federal program. Obtaining congressional funds is a highly competitive process and requires broad support of local, regional, and state interests for projects to be successful.

Federal Agency Interest

Funding can also be secured directly from federal agencies. Local projects may be eligible for funds and in-kind services through directed actions and partnerships. Federal agencies commit to projects during their respective internal budgeting processes and have the flexibility to disperse funding over several years.

Federal Assistance Programs

A third federal option is to apply for project funding under an existing federal agency grant, loan, or assistance program. Potential grant programs funded by federal agencies are listed in **Appendix L**. Eligibility, cost sharing, and application requirements vary among the programs.

10.1.5 State Funding

State funds are similar to the federal funding mechanisms and include legislation, state agency interest, and state assistance programs.

State Legislative Approach

Although funding opportunities available from the state (through the legislative approach) are usually less substantial than federal funding opportunities, the state legislative process can be more straightforward. Appropriating funds through the state legislature is extremely competitive and subject to the state budget conditions.

State Agency Interest

Discretionary funds may be available from the state in the form of directed action assistance or in-kind services. Partnerships with agencies such as the DWR Division of Integrated Water Management, Department of Fish and Wildlife (DFW), and Division of Drinking Water (DDW) may yield funds and services.

State Assistance Programs

A third option is to apply for project funding under an existing grant, low-interest loan, or assistance program administered by a variety of state agencies. In the past, Propositions

13, 204, and 50 provided substantial state-wide funds for water resources projects. Proposition 84 provided significant funds specifically for IRWMP updates and implementation projects and continues to be a source of funding through DWR. The last round of Proposition 84 funding is expected to provide implementation grants in 2015. Additional propositions will likely be needed to maintain the current level of state IRWMP funding, although many other State grants can fund projects that would help meet the goals and objectives of this IRWMP. **Appendix L** lists some of the major state grants that fund water resources projects.

10.1.6 Local Funding

Local funding will vary by source and agency authority. City and county government can generate local funding from a variety of sources including: general funds, water rates, development or impact fees, sales tax, water/sewer connection fees, capital improvement programs, revenue bonds, acreage or ad valorem assessments, user fees, violation fees, and sales taxes. Water and irrigation districts can generate local funds through benefits assessments, water standby and availability charges, sales taxes, water service fees, developer fees; or by generating revenue through water sales, groundwater banking, exchange, or transfer related contracts. Increasing benefits assessments or fees by the overlying district or the land use agency may require studies and a special election and/or protest hearing pursuant to state laws including Proposition 218. Local funding is often the funding source for grant cost sharing and project operation and maintenance.

10.1.7 Private Funding

Private funding can come from individuals, private foundations, corporations, or non-governmental organizations. Private funding is an important source that is often overlooked by Regional Water Management Groups. Some organizations do not solicit applications but choose projects themselves. In these cases it is worthwhile to introduce the RWMG to the organization for future consideration. Private organizations generally, but not always, provide smaller grants than state and federal programs. **Appendix L** lists some foundations, organizations, and corporations that fund water-related projects.

10.2 - Funding Needs

The Southern Sierra RWMG seeks funding for its operations, IRWMP updates, grant applications, planning and project development, project operation and maintenance, and local cost share for grant-funded projects. **Figure 10-2** depicts the RWMG's funding needs along with potential funding sources for each need. The funding needs are described below in more detail.

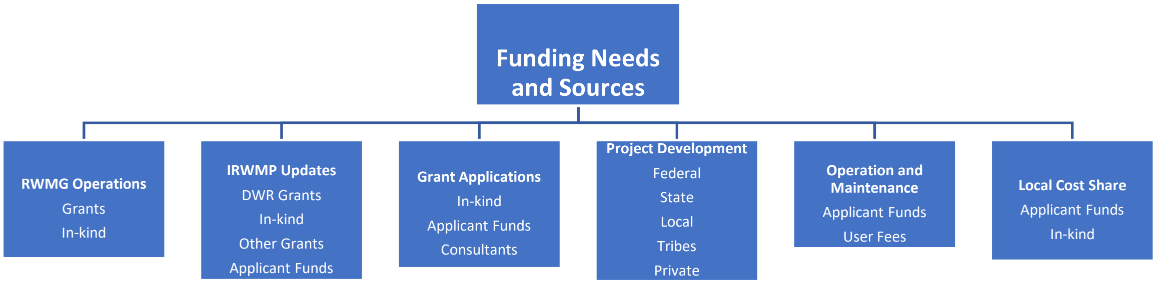


Figure 10-2 Funding Needs and Sources

10.2.1 Regional Water Management Group Operations

RWMG operations include administration, governance, public outreach, regular meetings, and special workshops. Funding for the RWMG operations has come from several sources including grants and in-kind services. The RWMG received a $50,000 grant from the Sierra Nevada Conservancy as seed money in 2008 to organize the RWMG, conduct outreach, assemble technical data sources, hold public meetings, and write the initial planning grant application to DWR. Since then, consultants and participants have provided valuable in-kind services to organize and operate the RWMG. The RWMG has also secured grants from the Sierra Nevada Conservancy ($13,000 facilitation, $50,000 for ITWMP launch) and DWR for professional facilitation of RWMG meetings. The RWMG is actively seeking more grants similar to the seed money provided by the Sierra Nevada Conservancy to continue member recruitment and institutional development. The RWMG will also be developing a long-term financial plan to fund RWMG operations during periods when there are no grant funds.

10.2.2 Funding for Updating IRWMP

A draft IRWMP was developed with in-kind professional services and work from two graduate students, consultants and RWMG stakeholders. The draft IRWMP was updated and expanded with a $520,000 grant from the California Department of Water Resources through a Proposition 84 Integrated Regional Water Management Planning Grant. The cost share for the IRWMP update was provided through professional in-kind salary costs for stakeholders. The RWMG will seek DWR funds for future IRWMP updates, but realizes that these funds may not be available, or that their timing may not coincide with the appropriate time for an update. If DWR funding is not available then updates could be funded through a combination of in-kind costs, fees collected from RWMG members, or other grant programs. **Appendix L** list numerous grant programs including some that fund water resources planning, and may fund updates to the Southern Sierra IRWMP. The RWMG also plans to prepare annual reports documenting progress, data collected, changes to policies, etc. These annual reports will be the basis for any plan update, and using them will reduce the cost of a full plan update.

10.2.3 Funding for Grant Applications

The RWMG has submitted grant applications that benefit the entire RWMG area and some that directly benefit one or more agency. Applications that benefit the entire RWMG, such as an IRWMP update or regional study, will be funded by the RWMG. To date this has been performed with in-kind services from the stakeholders. Applications that directly benefit one or more agency will be funded by those agencies receiving the benefits. Requiring members to fund their own applications helps to ensure that they are serious and committed to their projects. An IRWMP Implementation Grant application in 2013 was funded with applicant funds ($5,000) and in-kind services from other RWMG members to help launch the RWMG and secure their first implementation grant. Such in-kind services may not be available in the future and applicants need to be willing to commit sufficient funds to prepare competitive applications. Grant application funding could also be acquired by providing consultants a signed commitment for any related consulting work if they prepare a successful grant application at their own expense.

10.2.4 Funding for Project Development

Project development includes feasibility studies, design and construction. Federal, state, local, tribal and private funding are options for project development. **Appendix L** list potential funding programs from each of these sources. The list in **Appendix L** is not comprehensive, but includes well known and likely sources of funding. The national grant database eCivis, which is a subscription service, can provide a more comprehensive list of funding options.

The certainty and longevity of the funding sources is not well known. Grant programs are constantly evolving. Some are cancelled each year while new programs also emerge each year. Funding generally fluctuates with the economy and government focus. Stakeholders need to stay constantly apprised of current opportunities. A major source of funding for project development is IRWMP Implementation Grants. The last round of applications through Proposition 84 is expected to begin in mid 2015. Future funding is likely dependent on the passage of State Propositions. These Propositions can provide funding for long periods lasting five to ten years. Funding from state general funds is unlikely for the IRWMP Program, which will likely rely on State Propositions for the foreseeable future. However, many other local, state and federal funding programs can help develop projects that meet the goals and objectives of this IRWMP.

10.2.5 Operation and Maintenance Funding

Operation and maintenance (O&M) funding for infrastructure projects is generally required from those agencies directly benefitting from the project. The RWMG is not responsible for project O&M expenses and grant and loan programs typically do not cover these expenses. Before undertaking a new project, a grant applicant must estimate the O&M expenses and define a secure long-term funding source. These typically come from applicant reserves, on-going revenue, or new fees. Projects should not be pursued if long-term O&M funding is uncertain.

10.2.6 Local Cost Share Funding

Many grant programs require applicants to pay a portion of the project cost, which is called the local cost share. Local cost shares vary but are commonly 25% or 50% of the project cost. A small number of grant programs have no cost share requirement. It is also common for cost share to be waived for DACs. These are typically funded with applicant reserves, on-going revenue or new fees. They can also be funded with monies from another grant. The RWMG has established the following guidelines regarding local cost share funding:

1. Local funding sources must be firmly defined for all projects requiring local funds.
2. Local funding match requirements are to be provided by the project stakeholder or stakeholders (partners) that are the direct beneficiaries as defined by engineering and economic evaluations.
3. Specific agreements between project partners must clearly define the mechanism for cost sharing and on-going project O&M.
4. All new projects not already covered by an existing funding mechanism will need to expeditiously engage their communities and obtain approvals for any new project funding, whether for capital construction or O&M costs.
5. User fees are appropriate for cost share where the beneficiaries are clearly defined and increases in fees are approved according to appropriate rules and regulations.

10.3 - Funding Opportunity Awareness

The RWMG members will track tribal, federal, state, local and private funding sources and keep the group apprised of opportunities for grants, loans or other forms of assistance. A standing agenda item on funding sources will be included in Coordinating Committee and RWMG meetings to brief the community. Funding opportunities will also be listed on the RWMG website. The list of grant opportunities in **Appendix L** should be updated annually and a revised list distributed to RWMG members.

10.4 - Annual Budgets and Audits

During active planning and implementation, the grantee will prepare budgets for the Coordinating Committee and RWMG to review. This will occur as regular or quarterly updates and summarized in annual reporting.

Regular auditing may be needed during the planning and implementation projects. The costs for the auditing should be included in grant proposals so that auditing is covered under administrative expenses. Additional requests for details on budget or expenditures may be made during public comment periods, or requests may be made to members on the Coordinating Committee.

Chapter 11 - Technical Analyses

11.1 - Introduction

The intent of the Technical Analyses Chapter is to document technical efforts made by stakeholders that support the IRWMP process and that were used or can be used in the future to develop and inform the RWMG, stakeholders and the IRWMP. These efforts include, but are not limited to, a wide range of technical investigations, studies, reports and planning documents on regional water supplies, water demands, hydrogeologic conditions, land use and planning documentation, water quality studies, and regional groundwater evaluations and climate change models.

In general, many resources were reviewed for technical information and data to inform various chapters of this report. Due to the nature of the IRWMP process little original analysis was conducted in the process of preparing this IRWMP; rather, the report relies on other work accomplished in the Region which relates directly to the goals and objectives of this Plan.

Available analysis for some subjects is thorough and up to date. Data for other subjects is less complete, and this chapter discusses and identifies gaps (additional analyses needed) that can and should be filled through additional analysis and/or data monitoring. Some of this analysis/monitoring is on-going and some would need additional funding. For the time being, the information used in the preparation of this Plan is believed to be the best available.

Technical efforts discussed in this chapter fall into three areas: 1) Previous Technical Analyses efforts, 2) Current Efforts and 3) Needed Technical Analyses.

11.2 - Previously Conducted Technical Analyses

The stakeholders of the Southern Sierra IRWMP have recently conducted three technical analyses described in the following section. In addition, there are many studies and projects from the IRWMP's members and other organizations that make up a significant body of technical data for the Region. Some of the data is reviewed and/or referenced in this plan. The RWMG has compiled a more comprehensive list of resources which are available for use by stakeholders to develop strategies and projects. These resources are also discussed and listed in the Data Management chapter (**Chapter 10** and **Appendix K**). **Appendix K** – **Resource Database** includes a comprehensive list of reports, studies and datasets that were gathered and documented by the RWMG. This effort included numerous phone calls, meetings, and visits to local agencies to look through their files and libraries. Some of the resources in **Chapter 10 - Data Management** and **Appendix K** will be available or linked on the RWMG's website.

11.3 - Current Technical Analyses

11.3.1 Disadvantaged Community Water Study

The Tulare Lake Basin Disadvantaged Community Water Study (TLB Study) identified various disadvantaged communities generally within the Valley Floor portions of the Tulare Lake Basin study area, which encompasses limited areas of the lower elevation reaches of the Southern Sierra IRWMP area. The TLB Study also identified the water supply challenges faced by DACs in the study area and general solution sets that could be considered for communities facing the different challenges identified. These challenges and potential solutions are generally applicable to most of the DACs in the Southern Sierra Region. Communities can include cities, towns, and census designated places from the 2010 United States Census and more local areas that fall below the income criteria. Areas identified to be DACs, according to the TLB Study criteria, in the Region include Springville, California Hot Springs, Pine Flat, Doyal's Mobil Home Park, Sierra Glen Mobile Home Park and Hartland. There are likely other DACS in the Region, but they were not identified because the DAC study did not cover the entire IRWMP area.

The TLB Study focused on the drinking water and wastewater needs of rural and unincorporated communities that meet the Proposition 84 definition of "disadvantaged community", which is a community whose MHI is 80 percent or less of the statewide median household income. Communities in the TLB study area were initially classified based on U.S. Census data. However, there were communities that were reclassified based on separate income surveys that were completed, indicating that either 1) a community is disadvantaged even though the MHI for the Census tract that it falls within is greater than 80 percent of the statewide average, or 2) a community is not disadvantaged even though the MHI is indicated to be less than 80 percent of the statewide average. A copy of the study can be found at the following website: http://www.tularecounty.ca.gov/cao/index.cfm/tulare-lake-basin-disadvantaged-community-water-study/.

11.3.2 Three Rivers Water Supply Study

Based on efforts of the RWMG to promote the need for a local hydrologic study, secure funding, and get technical support from DWR staff, the DWR has conducted a preliminary Water Supply Study of the Three Rivers Area. The scope of the study is generally based on a Project Prospectus titled: Surface and Groundwater Resources in the Southern Sierra to Support Water Management and Water Management Planning (Kamansky's Ecological Consulting, September 2013) prepared by members of the RWMG. The DWR, with assistance from the RWMG, prepared a spreadsheet with well data based on a review of hundreds of well logs. The spreadsheet included lat/long, well depth, well yield, ownership and notes (Public Data Only). This date was then tied back to Arcmap to produce GIS map related data and summary tables showing the number of wells by section.

Preliminary review of the limited data contained on well reports indicate that the water chemistry appears to be from three or more water sources: surface water (very fresh, snow melt type water), groundwater occurring in the regional fractured rock system, and salt water. Once plotted on a Piper diagram (a graphical representation of the chemistry of a water sample), it becomes apparent that there is clear mixing of waters, with water in the wells containing some proportion of fresh, low TDS water and some proportion of high TDS saltier water (in some cases exceeding the secondary drinking water standard for TDS and some inorganic materials). In going through the information on the well logs, there are areas where schist and limestone were encountered. In at least some of these areas, salt water (in some cases also containing hydrogen sulfide) was noted and the well destroyed.

The final report will include precipitation banding, water demands, concentrations of groundwater wells (map), and water quality (general water chemistry).

A copy of the Three Rivers Water Supply Study is included in **Appendix D.**

11.3.3 Southern Sierra Climate Projections

The RWMG made a significant investment in developing a specific set of climate change projections for the Region, given its unique geomorphic variability and diverse ecosystems that will be greatly affected by the changing weather patterns. Water and fire management are directly tied to the type, duration and severity of changing weather conditions. Chapter 16 of this plan presents a detailed evaluation of climate change management and **Appendix M** includes projections from a climate change model presented by the GEOS Institute of Ashland, Oregon, in their climate change report.

11.4 - Technical Data Sources

The following is partial list of technical data resources that are publically available and were fully or partially reviewed for this IRWMP. Many of these publications or data resources are referenced in **Chapter 10 - Data Management**.

- National Park Service General Management plans – Sequoia and Kings Canyon National Parks lie within the SSIRWM Region. These parks contain the headwaters for all of the rivers in the Region except for the White River, Deer Creek and Poso Creek. The General Management Plan describes the conditions of the Parks and describes and prescribes management actions.
- National Forest Service Forest Management plans – parts of Sequoia, Sierra and Inyo national forests lie within the Southern Sierra Region
- Sierra RCD's Phase I study on groundwater – portions of the San Joaquin River Watershed are in the Southern Sierra Region.
- DWR Climate Change Handbook for Regional Water Planning
- The Southern Sierra Partnership, a partnership between The Nature Conservancy, Sequoia Riverlands Trust, Sierra Business Council and Audubon California seeks to plan and implement climate-adapted conservation strategies through its climate

adaptability analysis. Conservation planning yielded key linkages and corridors. Subsequent work will provide significant data in this realm.

- Forest Service and National Park Service hydrology, geomorphology, and water quality data
- USGS – hydrological and geological data for the Region
- DWR - hydrological and geological data for the Region
- Fresno and Tulare County General Plans
- Minutes from regional water management group meetings, coordinating and subcommittee meetings
- Stakeholder surveys
- Climate change model presented by the Geos Institute for the entire Sierra Nevada, and the special model prepared specifically for the Southern Sierra RWMG area. They also prepared reports for Fresno and surrounding counties, which provide details on local vulnerabilities and stakeholder views on solution-based adaptation strategies.

11.5 - Additional Information Needs

Although there is a significant amount of technical information produced by both the USFS, NPS and other federal agencies concerning land and water management, there is not yet a single resource which compiles the important data. This is and will likely be one the greatest data needs for the Region. Cooperation between agencies with staff devoted to this topic, and a sustainable funding source for this effort, will need to be addressed. Additional technical information is needed to fully support water management, mitigation strategies and the development of critical water projects.

Stakeholders have identified a critical need for a study to increase understanding of the groundwater hydrologic capacity of the Region. Appropriate water management strategies (and associated land and resource management policies) are challenging and prone to error if they are developed in the absence of this information. The California Water Plan has little useful data for the foothill/mountain portion of the Tulare Lake Region. No groundwater management plan has been done for the Region, mostly because the funding (AB3030) for accomplishing such plans was focused on groundwater basins and the Region's groundwater is almost entirely stored in hard rock fractures. Representatives from the Southern Sierra Regional Water Management Group met with DWR representatives to discuss the possibilities of working together to build more knowledge about this area. The DWR South Central Region staff stated that it was their intent to request funding to conduct special studies to address the local water management needs of the watersheds and communities in the Sierras. The DWR is currently providing technical assistance to the Southern Sierra group as it moves forward with its planning process and the preparation of the Three Rivers Water Supply Study. This study will provide a valuable template for other efforts in each of the watersheds in the Southern Sierra area. Further DWR assistance could come as technical advice concerning project scope and objectives, data gathering and evaluation, and participation in technical and public meetings.

Other technical data needs include (but are not limited too):

- Water supply demand and supply data for all communities
- Flows and quality data required to support ecosystems and fisheries

Chapter 12 - Relation to Local Land Use & Water Planning

12.1 - Introduction and Background

The IRWM process provides for many opportunities to collaborate and integrate with local land use and water planners at the county, city, community, special district and non-governmental organization (NGO) levels. Collaboration of community and county land use plans with water supply/demand plans and the water planning process is an important strategy for the Southern Sierra IRWMP. This chapter discusses the relationship between the DWR IRWMP process and current adopted local land use and water planning efforts for the Southern Sierra area as well as future plans to further a collaborative, proactive relationship between land use planners and water mangers. This purpose of this chapter is as follows:

1.) To provide an inventory of local City, County and other special district land use planning water planning documents integral to the Southern Sierra IRWMP;
2.) Describe the relationship between this IRWMP and local land use planning documents and programs, regional water issues and water management objectives;
3.) Describe the dynamics between the IRWMP and land use and water planning documents; and
4.) Identify opportunities to enhance proactive collaboration between local land use and water planning efforts in order to avoid duplication and working at cross-purposes, and better coordinate and maintain consistency between the local land use and water planning efforts with the Southern Sierra IRWMP

As suggested by the Ahwahnee Water Principles[1], water - how we capture it, treat it, use it, control it, manage it and release it – is vital to the 36 million people who live in California and has a tremendous impact on our quality of life, local budgets and day-to-day policy-making. As California adds another estimated 12 million residents by 2030, water-resource challenges will be increasingly serious.

Of importance to the Southern Sierra Region IRWMP, is that the natural functions of the mountain and foothill watersheds that collect and cleanse our water supplies be protected and not allowed to diminish. Water and land use policies are the most effective when they protect headwaters areas, natural watershed conveyances, address water-wise growth, water conservation, water friendly neighborhood/site scale planning and

[1] http://www.lgc.org/wordpress/docs/ahwahnee/ahwahnee_water_principles.pdf; as accessed 5/2/14.

designstrategies, and implementation strategies to make the physical changes necessary to ensure long-term water conservation and sustainability.

12.2 - Land Use and Water Plans/Policies Integral to Southern Sierra IRWM

The Southern Sierra Regional Water Management Group (RWMG) membership includes representatives of the Fresno and Tulare County Boards of Supervisors, and these agencies' respective Planning and Public Works Departments (directors), who oversee their long-range General Plan land use planning policies and implementation of county water capital improvements. Participation of land use planning and public works personnel in the IRWMP process is valued for more complete understanding of the regional County Goals, Policies, Objectives, and Implementation strategies to be integrated into IRWMP project development. As well, representatives of Federal National Parks and Forests, along with local public and private water districts, irrigation districts and public utility districts can share and collaborate amongst themselves and with counties and cities regarding their efforts on a different, but not less important scale and focus, of service.

The DWR IRWMP Plan Standards require the review and assessment of formally adopted local, state and federal land use and water planning policies. While it is acknowledged that there is a large body of studies prepared by water resources professionals and academicians that may contain recommended policies, the review and assessment of these types of studies are not required by the Guideline standards. Various public lands, county, public and private agencies and organizations wereconsulted to identify public lands plans, county general plans, community or area plans, specific plans, resource plans, municipal service reviews, agriculture, water and urban water management plans pertinent to the IRWMP process. These documents and plans are catalogued in Tables 12-1 through Table 12-5.

Table 12-1 below lists land planning and resource management documents adopted by federal, state and local agencies with jurisdiction in the Southern Sierra IRWMP area.

Table 12-1 Land Use Planning and Resource Management Documents

Agency or Entity	Land Use Planning and Resource Management Documents
USDA, Sierra National Forest	Forest Land & Resource Management Plan, Sierra National Forest (Jun-91), as amended
USDA, Sequoia National Forest	Forest Land & Resource Management Plan, Sequoia National Forest, (1988) as amended
USDA, Inyo National Forest	Forest Land & Resource Management Plan, Inyo National Forest, (Aug-88), as amended
USDA, Sequoia National Forest	Implementation Plan-Kings River Special Management Area; Kings South Fork Kings and Middle Fork Kings, Wild and Scenic Rivers (Apr-91)
USDI, Sequoia and Kings Canyon National Park	Middle and South Forks of the Kings River and North Fork of the Kern River- Final General Management Plan and comprehensive River Management Plan/EIS (Dec-04)
USDI, Sequoia and Kings Canyon National Parks	Sequoia and Kings Canyon National Park California Water Resource Information and Issues Overview Report (Jun-05)
USDI, Sequoia and Kings Canyon National Park	Sequoia and Kings Canyon General Management Plan Comprehensive Plan for Resource Education (Apr-06)
USDI, Sequoia and Kings Canyon National Park	A Climate-Smart Resource Stewardship Strategy for Sequoia and Kings Canyon Nation Parks (Sept-17)
USDI, Sequoia and Kings Canyon National Parks	Natural and Cultural Resource Management Plan (Dec-99)
Big Sandy Band of Western Mono Indian Tribe	Draft Environmental Impact Statement for the Big Sandy Rancheria Casino and Resort (Jan-11)
County of Fresno	Fresno County General Plan Policy Document 2000 (Oct-00)

Agency or Entity	Land Use Planning and Resource Management Documents
Fresno County Department of Public Works and Planning	**Regional Water Study of the Foothill and Mountian Areas of Eastern Fresno County (Mar 2006)**
Fresno Irrigation District	Municipal Service Review and SOI Update- Report to the Fresno LAFCo (Jul-07)
Big Creek Community Service District	Big Creek Community Service District- Municipal Service Review and SOI Update (Sep-11)
Fresno Area Irrigation Districts	Irrigation Districts- Municipal Service Review and SOI Update report to Fresno LAFCo (Jul-07)
Waterworks District #18	Waterworks District No.18 Municipal Service Review and Plan for Services (Mar-11)
Waterworks District #41	Waterworks District No.41 Municipal Service Review and SOI Update- Fresno LAFCo (Feb-11)
County of Tulare Local Agency Formation Commission	Group 4 Municipal Service Reviews Final Report (Oct-11)
Springville Public Utility District	Group 3 Municipal Service Review Final Report (Mar-07)
Fresno Irrigation District	Rules and Regulations - Control and Operation of the Water Distribution System (Dec-85)
Community of Shaver Lake	Shaver Lake Community Plan (Oct-78)
Kings River Conservation District and Kings River Water Association	The Kings River Handbook (Sep-09)
Kings River Conservation District and Kings River Water Association	The Kings River Handbook (Jun-03)
California Department of Forestry and Fire Protection- The Natural Resources Agency	Mountain Home Demonstration State Forest Management Plan (Mar-10)
County of Fresno	Fresno County General Plan Policy Document 2000 (Oct-00)
County of Fresno	Fresno County 2000 General Plan Review- Revised Public Review Draft (Mar-14)

Agency or Entity	Land Use Planning and Resource Management Documents
County of Fresno	Friant Ranch Community Plan (Feb-11)
County of Tulare	2030 Update Tulare County General Plan - Part I, Goals and Policies Report, 2012
County of Tulare	2030 Update Tulare County General Plan – Part II, Area Plan Policies (Foothill Growth Management Plan and Mountain Area Framework Plan for identified Service Centers of private inholdings within Federal lands), 2012
County of Tulare	Great Western Divide North-Half Area Plan, 1986
County of Tulare	Draft Three Rivers Community Plan, 2018
County of Tulare	Springville Community Plan, 1985
County of Tulare Local Agency Formation Comission Special Districts	Cities and Special Districts Inventory - Tulare LAFCo (Apr-13)

Table 12-2 below lists water, wastewater and stormwater master plans adopted by local agencies with various water management jurisdictions in the Southern Sierra IRWMP area.

Table 12-2 Water, Wastewater and Stormwater Master/Management Plans

Members & Interested Stakeholders	Water Management Documents
County of Fresno	Draft Water and Sewer System Master Plan Update- Fresno County Department of Public Works and Planning (Sep-06)
County of Fresno	Sewer System Management Plan- Fresno County Special Districts (Apr-10)
Millerton New Town	Millerton New Town Infrastructure Plan (Dec-00)
Sierra Cedars Community Service District	Sierra Cedars Community Service District Water Conservation Program (Jun-08)
County of Tulare	Storm Water Management Plan, NPDES Phase II (Dec-08)
Tulare County Flood Control District	Flood Control Master Plan For the County of Tulare California (1972) (Jun-71)

Members & Interested Stakeholders	Water Management Documents
County of Fresno	Draft Water and Sewer System Master Plan Update- Fresno County Department of (cont'd) Public Works and Planning (Sep-06)
County of Fresno	Sewer System Management Plan- Fresno County Special Districts (Apr-10)
County of Fresno	Friant Ranch Infrastructure Master Plan (Feb-11)

Table 12-3 below lists groundwater management documents adopted by and local agencies with jurisdiction in the Southern Sierra IRWMP area.

Table 12-3 Groundwater Management Plans

Members & Interested Stakeholders	Groundwater Management Documents
County of Fresno, Fresno Metropolitan Flood Control District and et al.	Fresno Area Regional Groundwater Management Plan (Dec-06)
Alta Irrigation District	Alta Irrigation District - Amended Groundwater Management Plan (Jun-10)
Consolidated Irrigation District	Groundwater Management Plan (Jul-95)
Kings River Water District	Groundwater Management in the Kings River Region- A comprehensive and coordinated effort (Mar-04)
Kaweah Delta Water Conservation District	Groundwater Management Plan (updated November 2006)

Table 12-4 below lists agricultural water management documents adopted by local agencies with jurisdiction in the Southern Sierra IRWMP area.

Table 12-4 Agricultural Water Management Plans

Members & Interested Stakeholders	Agricultural Water Management Plans
Terra Bella Irrigation District	Five year Update Agricultural Water Management Plan (Jun-13)
Alta Irrigation District	Five year Update Agricultural Water Management Plan (2012)
Fresno Irrigation District	Agricultural Water Management Plan (in progress)
Consolidated Irrigation District	Agricultural Water Management Plan (in progress)

Table 12-5below lists water management documents adopted by local agencies with jurisdiction in the Southern Sierra IRWMP area.

Table 12-5 Water Management Plans

Agency or Entity	Water Planning Document
County of Fresno	Draft Water Conservation Ordinance and Other Documents (Available)
Association of California Water Agencies	Statewide Water Action Plan For California (Oct-13)
Alta Irrigation District	Alta Irrigation District - Water Management Plan Update for Alta Irrigation District Volume 3 of 3 (Dec-12)
Orange Cove Irrigation Dist.	Water Management Plan - Five year Update (Jul-10)

12.3 - Relationship Between This IRWMP and Other Local Land Use/Water Management Policies

In his Forward to the *2014 California Water Action Plan* (CWAP), Governor Brown succinctly stated the state's challenge regarding maintaining water for all, as follows:

> *Among all our uncertainties, weather is one of the most basic. We can't control it. We can only live with it, and now we have to live with a very serious drought of uncertain duration.*
>
> *Right now, it is imperative that we do everything possible to mitigate the effects of the drought. I have convened an Interagency Drought Task Force and declared a State of Emergency. We need everyone in every part of the state to conserve water. We need regulators to rebalance water rules and enable voluntary transfers of water and we must prepare for forest fires. As the State Water Action Plan lays out, water recycling, expanded storage and serious groundwater management must all be part of the mix. So too must be investments in safe drinking water, particularly in disadvantaged communities. We also need wetlands and watershed restoration and further progress on the Bay Delta Conservation Plan. It is a tall order.*
>
> *But it is what we must do to get through this drought and prepare for the next.*
>
> *Edmund G. Brown Jr.*
> *State of the State Speech, January 22, 2014*

This statement captures the essence of the critical nature of integrating and coordinating land use planning not just for the transient term of our current drought but for the longer range growth and continuing economic vitality of the state with a careful understanding of how available water supplies can be enhanced, conserved, sustained and better managed to meet future demands

The California Water Plan, Update 2009 for Integrated Water Management[1] (CWP Update,) and accompanying *California Water Plan Highlights* brochure[2] describes the challenges for managing the state's water resources and identifies a diversified portfolio of six broad topical management objectives, summarized as follows *(Note to Reader: At the time of preparation of this Plan, the California Water Plan, Update 2013 was only available in draft and was not yet adopted. Consequently, this Plan only reflects the content of the most recently adopted Update 2009)*:

1. Reduce water demand
   - Maximizing both agricultural and urban water use efficiency
2. Improve Operational Efficiency and Transfers
   - Maximize utilization of statewide (Delta), regional and local conveyances, water transfers and system re-operations
3. Increase Water Supply
   - Maximize conjunctive management and water storage, desalinating brackish and sea water, recycling municipal water and pursuing CalFed and regional and local opportunities for surface water storage
4. Improve Water Quality
   - Improving drinking water treatment, distribution, salt, salinity and urban runoff management, maximize pollution prevention and groundwater/aquifer remediation, match water quality with appropriate use or re-use,
5. Practice Resources Stewardship
   - Maximize agricultural forest and land use planning stewardship and management, increase economic incentives for stewardship and recharge area protections, maximize watershed management, and pursue water-dependent recreation.
6. Improve Flood Management
   - Maximize pursuit of flood risk management.

To begin to meet the challenges associated with these six water management tools, the CWAP sets forth the following Actions that must be taken statewide by all water management and planning entities:

Actions

1. Make conservation a California way of life;
2. Increase regional self-reliance and integrated water management across all levels of government;
3. Achieve the co-equal goals for the Delta;
   a. Providing a more reliable water supply for California , and
   b. Protect, restore and enhance the Delta ecosystem
4. Protect and restore important ecosystems;

[1] State of California, Natural Resources Agency and Department of Water Resources: *California Water Plan – Update 2009 for Integrated Water Management* (Bulletin 160-09, Volume 2 – Resource Management Strategies), December 2009

[2] www.waterplan.water.ca.gov/docs/cepu2009/0310final/highlights_cwp2009_spread.pdf

5. Manage and prepare for dry periods;
6. Expand water storage capacity and improve groundwater management;
7. Provide safe water for all communities;
8. Increase flood protection;
9. Increase operational and regulatory efficiency; and
10. Identify sustainable and integrated financing opportunities.

These ten actions directly correlate to the six essential water management tools identified in the CWP Update. As well, the management tools cannot achieve effective results without taking the actions identified in the CWAP. To maximize results within the Southern Sierra Region, land use and water planners, managers, and decision makers must all share the strategic vision of the necessity to collaborate, coordinate and integrate plans to achieve maximum beneficial water management results within the Southern Sierra watershed.

The Southern Sierra Region is home to numerous unincorporated communities within the Fresno and Tulare County jurisdictions as shown on several figures in

The Southern Sierra Region is home to numerous unincorporated communities within the Fresno and Tulare County jurisdictions as shown on several figures in **Chapter 3 Region Description**. The land use and water planning representatives from the various rural and urbanized communities, rural county areas, public lands and public and private water purveyors/districts serve as a link between the IRWMP and local land and water planning efforts and are encouraged to actively participate in Southern Sierra RWMG. Accordingly, many take advantage of the IRWM process to be involved in regional efforts. These representatives provide important data and information and provided critical guidance during the planning process. Further, the local agency members and interested stakeholders individually adopt this IRWMP as a separate action by the various Federal Public Land Management agencies and departments and County Boards of Supervisors.

<u>Jurisdictions of Local Plans</u>

The local planning documents are confined to the area under the Federal, State, county, city, or other local entity's purview. For the cities and communities, the jurisdiction is limited by the city limits or adopted spheres of influence or growth development boundaries, depending on the jurisdiction/planning area document. The county's jurisdiction is limited by the county limit lines and typically applies only to the unincorporated areas of the county. Special districts such as water, conservation, irrigation or flood control, community services and public utility districts will have an adopted district boundary which serves as the jurisdiction limit. Special districts may also have Local Agency Formation Commission (LAFCO) approved spheres of influence. Public lands are all those other lands not owned privately and controlled by the Federal or State governments for the benefit of the general public. These entities typically adopt Land or Resource Management Plans for their entire area of jurisdiction or for distinctly identified sub-areas within the respective Federal or State jurisdiction.

Local Plan Updates

The majority of local area planning documents are either mandated for periodic update or the local agency elects to update them on a generally regular basis for accuracy. To the extent feasible, the IRWMP will consider the most current documents during IRWMP Update processes but will not amend or update the IRWMP based solely on a local planning document update. Although not a common practice or habit yet, members and interested stakeholders should refer to the IRWMP in their local plans where applicable and collaborate to assure maximum attainment of mutually beneficial actions.

Regional Efforts Lead to Local Efforts

The regional planning efforts are intended to serve as a base map or guideline for the entire Region to follow in regards to water resources. The foundation of the IRWMP will continue to be the successful implementation of local projects and programs that help accomplish the Region’s Goals and Objectives. Local agencies without planning documents in place may elect to use the IRWMP in lieu of or as a beginning point for their own local planning documents.

Planning Document Inconsistencies

Inconsistencies may occur occasionally between the regional and local planning documents. Some of these occurrences may be solved through discussion and collaboration between the local agency and the Southern Sierra RWMG. If it is determined the inconsistency is of vital significance to the IRWMP and out of sequence with a planned update, the Southern Sierra RWMG will incorporate updated information into the Annual Report or, if necessary, prepare a special update or encourage the local agencies to meet to collaboratively resolve the inconsistencies to the greatest extent feasible.

The link between IRWM and land use planning has a significant number of common considerations, both providing an opportunity to garner important input on a multitude of issues. The key IRWM issues which could be affected by local planning policy include: the gamut of water resource management and land stewardship tools, such as flood management, groundwater recharge, conjunctive water use, water quality/treatment facilities, water conservation, municipal and recreational development, rural, urban and agricultural activities, conservation, and planning and development reviews and approvals. Further, it is vital that Geographic Information Systems (GIS) data and other data sources collected by and held amongst various public jurisdictions in the Southern Sierra IRWMP area is accurate, consistent and reliable in order to mesh across these jurisdictions. This is of vital importance to accurately understanding current conditions and from which to make reasonable forecasts and projections for the Southern Sierra Region.

Government sector and private water agencies and land owners can encourage local land use agencies to protect groundwater recharge areas; restrict and provide alternatives to development in floodplains; evaluate adequacy of water quality and septic system disposal for new developments; encourage conservation and development of local water, wastewater and storm drain projects to integrate and maximize the potential for meeting regional goals and measureable objectives.

DWR is recommending that land use planning be one of the water management strategies included in an IRWMP. A review of the existing Fresno and Tulare County General Plans and Area/Specific Plans, Municipal Service Reviews, public land and resource management plans and various water planning documents listed in Part 13.2 above was conducted. **Table 12-66 and** Table 12-7**.7** below, are matrices showing columns for the following 6 essential (and one "other" category) water management attributes or strategies defined in the California Water Plan-Update 2009 for Integrated Water Management:

- Reduce Water Demand
- Improve Operational Efficiency and Transfers
- Increase Water Supply
- Improve Water Quality
- Practice Resources Stewardship
- Improve Flood Management
- Other (Drought Planning; Climate Change Adaptation & Mitigation, Alternative Fuels/Renewable Energy Sources, Energy Conservation, or Sustainability)

Each existing land or water planning documents (shown in the rows) were reviewed to determine which water management attribute, if any, is addressed. For this Update, the listed documents were re-reviewed to determine the extent to which any of the "Other" attributes were given consideration. Checkmarks were placed in the respective cells according to whether a policy was in place addressing the various attributes. Blank cells identify where the agency/entity may be lacking a policy to address a particular attribute. The agency/entity can then determine whether it is appropriate they have a policy for that attribute or whether it's "not applicable" to their jurisdictional authorities or responsibilities. In this way the Matrix serves as a checklist showing what agencies/entities are implementing policies addressing what specific management attributes. The Matrix can be used as a living tool -- amended as agencies adopt policies to fill the gaps, visually monitoring the collective efforts to be comprehensive in activating consistent water management activities. Some agencies may be implementing policies or strategies that aren't documented in formal planning documents. The Matrix therefore can help to identify which strategies may need to be specifically addressed in formal documents.

The purpose of the Matrix was to distill into useable form the range of adopted public land management agency policies, Fresno and Tulare County General Plan goals, objectives, policies, and programs, and special district goals and policies, to show the extent to which they address or deal with essential water resource management tools. The review specifically evaluated how each plan document recognizes regional water resources issues; incorporates water management strategies; and how achievement of these goals could be supported by the IRWMP being developed by the Southern Sierra RWMG. The matrix was presented to the Southern Sierra RWMG as a way to summarize key local land use and water policies pertinent to water management. The matrix can serve as a living document to identify the policy "drivers" that provide a basis for integrating land use, water supply plans, and the planning process. To the extent plans or policies do not address a water management attribute indicates where future collaboration or attention is needed to assure efforts are being made on all fronts to implement the essential tools (unless an attribute is not specifically or directly relevant to the study area, such as Delta Conveyances.)

A review of the tables suggests there may be some important “gaps” in water management policies amongst the various land use and water planning entities. These gaps represent key opportunities for agency collaboration to develop mutually beneficial new polices leading to “no regret” or other strategies to improve water management regionally.

A few of the gaps are:

A. The Big Sandy Band of Western Mono Indian Tribe is in the process of preparing a Plan and a companion EIS for the off-reservation Big Sandy Rancheria Resort and Casino project. These documents are currently in draft form. There is, therefore, an opportunity for the Tribe to conduct a review of the six broad water management strategies in these Tables and consider whether there are strategies that can be incorporated into the plan or environmental mitigation measures to be consistent with efforts also being implemented elsewhere in the state and the Southern Sierra Region.
B. An opportunity appears to exist in Tulare and Fresno County to consider incorporating policies more broadly across and consistently within all land use and water management documents to support and encourage municipal (and private system) water recycling programs and/or drinking water treatment, particularly for Disadvantaged Communities that may be struggling with water sources that are at or approaching unsafe contamination levels.
C. An opportunity appears to exist in Tulare and Fresno County to consider adoption of a more comprehensive menu of policies supporting all strategies under Resources Stewardship.
D. Nearly all Irrigation Districts serving agriculture users appear to have an opportunity to develop policies specific to supporting water efficient agricultural land stewardship.
E. Numerous Federal, State and local Land Use and Water Management Agencies appear to have an opportunity to develop policy that more specifically and more comprehensively addresses watershed management. This also presents an opportunity to generate these new policies collaboratively for consistency and alignment across agencies to maximize mutual benefits.
F. Abundant opportunities exist for most of the Federal, State and local agencies to develop policy specific to flood management and control, particularly in light of 2017 being a very wet year with numerous incidents of localized flooding from overtopping waterways and/or failed levees or other water conveyance infrastructure.
G. Discussions among water users, distributors and public land management agencies to better align policies, projects and other land, water and infrastructure management efforts to maximize mutually beneficial results. For example, forest restoration/fuel reduction for water yield enhancement.

Table 12-6 Matrix of Water Management Attributes Employed by Local Planning Agencies

	Reduce Water Use / Demand		Improve Operation Efficiency and Transfers				Increase Water Supply						Improve Water Quality						Practice Resources Stewardship								Improve Flood Manage-ment	Other	
Agencies/Organizations and Type of Plan	Ag Water Use Efficiency	Urban Water use Efficiency	Conveyance - Delta	Conveyance - Regional & local	System Reoperation	Water Transfers	Conjunctive Management & Groundwater	Desalination	Precipitation Enhancement	Recyceld Municipal Water	Surface Storage - CALFED	Surface Storage - Regional & Local	Drinking Water Treatment & Distribution	Ground Water & Aquifer Remediation	Matching Water Quality to Use	Pollution Prevention	Salt & Salinity Manage-ment	Urban Runoff Manage-ment	Ag Lands Steward-ship	Economic Incentives (Loans, Grants, & Water Pricing)	Ecosystem Resoration	Forest Manage-ment	Land Use Planning & Manage-ment	Recharge Areas Protection	Water-dependent Recreation	Watershed Manage-ment	Flood Risk Management	Drought Planning	Climate Change Adaptation & Mitigation, Alternative /Renewable Fuels and Energy Conservation and Sustainability
LAND USE PLANNING DOCUMENTS																													
County of Fresno																													
Fresno County General Plan Policy Document 2000	✓	✓		✓		✓	✓					✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Agriculture and Land Use Element	✓	✓					✓					✓				✓		✓	✓	✓	✓		✓	✓		✓			✓
Public Facilities and Services Element		✓					✓					✓	✓	✓		✓				✓			✓						✓
Draft Water and Sewer System Master Plan Update- Fresno County Department of Public Works and Planning										✓										✓			✓						✓
Sewer System Management Plan- Fresno County Special Districts										✓						✓													
Friant Ranch Community Plan	✓	✓								✓			✓			✓		✓	✓		✓	✓		✓	✓			✓	✓
Friant Ranch Specific Plan		✓										✓	✓			✓		✓	✓		✓			✓	✓			✓	✓
Friant Ranch Infrastructure Master Plan		✓								✓		✓	✓		✓									✓		✓		✓	✓
County of Tulare																													
2030 Update Tulare County General Plan - Part 1- Goals and Policies	✓	✓				✓	✓				✓	✓		✓		✓		✓	✓				✓	✓	✓	✓	✓	✓	✓
2030 Update Tulare County General Plan - Part II - Area Plan Policies (Foothill Growth Management Plan and Mountain Area Framework Plan for identified private inholdings within Federal lands)	✓	✓														✓		✓	✓				✓			✓	✓	✓	
Draft Three Rivers Community Plan		✓					✓						✓		✓	✓		✓	✓				✓					✓	✓
Springville Community Plan		✓											✓			✓		✓					✓		✓	✓	✓		✓
Mountain Plan: Great Western Divide (N 1/2) Sub Area		✓					✓									✓		✓				✓	✓	✓	✓			✓	
Mountain Plan: Kennedy Meadows Sub Area							✓											✓			✓	✓	✓		✓	✓		✓	
State of California - NRA																													
Mountain Home Demonstration State Forest Management Plan																✓			✓		✓	✓	✓		✓	✓			✓
Federal - USDA, National Forest Service																													
Sierra National Forest Land & Resource Management Plan							✓	✓						✓							✓	✓	✓	✓	✓	✓			✓
Sequoia National Forest Land & Resource Management Plan							✓	✓						✓							✓	✓	✓	✓	✓	✓			✓
Inyo National Forest, Forest Land & Resource Management Plan Current Program							✓	✓						✓							✓	✓	✓	✓	✓	✓			✓
Federal - USDI, National Park Service																													
Sequoia-Kings Canyon (SE-KI) National Parks; Final General Management Plan and Comprehensive River Management Plan / Environmental Impact Statement																					✓	✓	✓		✓			✓	✓
Sequoia-Kings Canyon (SE-KI) National Parks; A Climate-Smart Resource Stewardship Strategy									✓												✓	✓	✓						✓

Table 12-7a Matrix of Water Management Attributes Employed by Local Water Purveyors

	Reduce Water Use / Demand		Improve Operation Efficiency and Transfers				Increase Water Supply						Improve Water Quality						Practice Resources Stewardship								Improve Flood Manage-ment	Other	
Agencies/Organizations and Type of Plan	Ag Water Use Efficiency	Urban Water use Efficiency	Conveyance - Delta	Conveyance - Regional & local	System Reoperation	Water Transfers	Conjunctive Management & Groundwater	Desalination	Precipitation Enhancement	Recycled Municipal Water	Surface Storage - CALFED	Surface Storage - Regional & Local	Drinking Water Treatment & Distribution	Ground Water & Aquifer Remediation	Matching Water Quality to Use	Pollution Prevention	Salt & Salinity Manage-ment	Urban Runoff Manage-ment	Ag Lands Steward-ship	Economic Incentives (Loans, Grants, & Water Pricing)	Ecosystem Resoration	Forest Manage-ment	Land Use Planning & Manage-ment	Recharge Areas Protection	Water-dependent Recreation	Watershed Manage-ment	Flood Risk Management	Drought Planning	Climate Change Adaptation & Mitigation, Alternative Fuels/Renew- able Energy, Conservation and Sustainability)
WATER PLANNING DOCUMENTS																													
County of Fresno / Region																													
Fresno Area Regional Groundwater Management Plan	✓	✓					✓			✓		✓	✓	✓	✓	✓	✓						✓	✓		✓			✓
Fresno County General Plan Policy Document 2000	✓	✓		✓		✓	✓					✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Water and Sewer System Master Plan Update-Fresno County Department of Public Works and Planning										✓										✓			✓						
Sewer System Management Plan-Fresno County Special Districts										✓						✓													
County CSA #1	No documentation of relevant policies found.																												
County CSA #31	No documentation of relevant policies found.																												
County CSA #34	No documentation of relevant policies found.																												
County CSA #5	No documentation of relevant policies found.																												
County CSA #50	No documentation of relevant policies found.																												
Fresno County Department of Public Works and Planning - Regional Water Study of the Foothill and Mountain Areas of Eastern Fresno County, March 2006	✓	✓					✓					✓	✓			✓		✓	✓				✓	✓		✓	✓	✓	✓
County of Tulare / Region																													
Storm Water Management Plan, NPDES Phase II		✓		✓	✓		✓									✓		✓			✓		✓	✓				✓	✓
Flood Control Master Plan for the County of Tulare California (1972)					✓		✓											✓					✓	✓		✓	✓		
Tulare LAFCO, Cities and Special Districts Inventory, Group 3 Municipal Service Reviews		✓											✓							✓			✓						
Tulare LAFCO, Cities and Special Districts Inventory, Group 4 Municipal Service Reviews	✓	✓											✓		✓	✓				✓									
Special Districts																													
Fresno Irrigation Distric, Municipal Service Review and SOI Update - Report to the Fresno LAFCo	✓			✓								✓								✓			✓	✓					
Millerton New Town, Millerton New Town Infrastructure Plan		✓								✓		✓				✓												✓	✓
Community of Shaver Lake, Shaver Lake Community Plan		✓					✓				✓		✓								✓	✓	✓		✓	✓			
Big Creek CSD, Municipal Service Review and SOI Update		✓					✓													✓			✓						
Sierra Cedars CSD, Water, Snow Removal, Road Repair		✓																✓								✓			
Kings River Conservation District, Maintains levees and river channel, operates hydro-electric	No documentation of relevant policies found																												
Kings River Conservation District, Lower Kings Basin Groundwater Management Plan Update						✓	✓			✓	✓	✓		✓	✓	✓	✓	✓					✓	✓		✓			
Kings River Conservation District and Kings River Water Association, The Kings River Handbook - 2009	✓	✓		✓			✓																						

Table 12-7b Matrix of Water Management Attributes Employed by Local Water Purveyors

	Reduce Water Use / Demand		Improve Operation Efficiency and Transfers				Increase Water Supply						Improve Water Quality						Practice Resources Stewardship								Improve Flood Manage-ment	Other	
Agencies/Organizations and Type of Plan	Ag Water Use Efficiency	Urban Water use Efficiency	Conveyance - Delta	Conveyance - Regional & local	System Reoperation	Water Transfers	Conjunctive Management & Groundwater	Desalination	Precipitation Enhancement	Recycled Municipal Water	Surface Storage - CALFED	Surface Storage - Regional & Local	Drinking Water Treatment & Distribution	Ground Water & Aquifer Remediation	Matching Water Quality to Use	Pollution Prevention	Salt & Salinity Manage-ment	Urban Runoff Manage-ment	Ag Lands Steward-ship	Economic Incentives (Loans, Grants, & Water Pricing)	Ecosystem Resoration	Forest Manage-ment	Land Use Planning & Manage-ment	Recharge Areas Protection	Water-dependent Recreation	Watershed Manage-ment	Flood Risk Management	Drought Planning	Climate Change Adaptation & Mitigation, Alternative Fuels/Renew- able Energy, Conservation and Sustainability)
WATER PLANNING DOCUMENTS																													
Special Districts *(cont.)*																													
Alta Irrigation District, Amended Groundwater Management Plan	✓	✓		✓		✓	✓					✓	✓	✓		✓		✓		✓	✓			✓		✓	✓	✓	✓
Alta Irrigation District, Water Management Plan Update for Alta Irrigation District Volume 3 of 3																													
Consolidated Irrigation District, Groundwater Mangement Plan	✓	✓		✓			✓							✓		✓		✓						✓		✓			
Fresno Irrigation Districts, Municipal Service Review and SOI Update report to Fresno LAFCo																								✓					
Fresno Irrigation District, Rules and Regulations - Control and Operation of the Water Distribution System	✓			✓		✓	✓												✓	✓			✓			✓			
Orange Cove Irrigation Dist., Water Mngmnt Plan - Five Year Update	✓	✓				✓	✓											✓										✓	✓
Kings River Water District, Groundwater Mngmnt in the Kings River Region - A Comprehensive and Coordinated Effort				✓									✓			✓		✓											
Waterworks District #18, Friant, CA - Fresno LAFCO - Municipal Services Review and Plan for Services																				✓			✓						
Waterworks District #18, Municipal Service Review and Plan for Services		✓																					✓						
Waterworks District #37	No documentation of relevant policies found																												
Waterworks District #38	No documentation of relevant policies found																												
Waterworks District #40	No documentation of relevant policies found																												
Waterworks District #41, Municipal Service Review and SOI Update - Fresno LAFCo	✓	✓																		✓			✓						
Waterworks District #41	No documentation of relevant policies found																												
Three Rivers CSD - Municipal Service Review	No documentation of relevant policies found																												
Alpine Village - Sequoia Crest CSD - Municipal Service Review	No documentation of relevant policies found																												
Ponderosa CSD, Municipal Service Review	No documentation of relevant policies found																												
Springville PUD, Municipal Service Review Final Report	No documentation of relevant policies found																												

Table 12-7c Matrix of Water Management Attributes Employed by Local Water Purveyors

	Reduce Water Use / Demand		Improve Operation Efficiency and Transfers				Increase Water Supply						Improve Water Quality						Practice Resources Stewardship								Improve Flood Manage-ment	Other	
Agencies/Organizations and Type of Plan	Ag Water Use Efficiency	Urban Water use Efficiency	Conveyance - Delta	Conveyance - Regional & local	System Reoperation	Water Transfers	Conjunctive Management & Groundwater	Desalination	Precipitation Enhancement	Recyceld Municipal Water	Surface Storage - CALFED	Surface Storage - Regional & Local	Drinking Water Treatment & Distribution	Ground Water & Aquifer Remediation	Matching Water Quality to Use	Pollution Prevention	Salt & Salinity Manage-ment	Urban Runoff Manage-ment	Ag Lands Steward-ship	Economic Incentives (Loans, Grants, & Water Pricing)	Ecosystem Resoration	Forest Manage-ment	Land Use Planning & Manage-ment	Recharge Areas Protection	Water-dependent Recreation	Watershed Manage-ment	Flood Risk Management	Drought Planning	Climate Change Adaptation & Mitigation, Alternative Fuels/Renew- able Energy, Conservation and Sustainability)
WATER PLANNING DOCUMENTS																													
State of California																													
Association of California Water Agencies, Statewide-California Water Action Plan - 2016 Update	✓	✓	✓	✓		✓	✓					✓	✓	✓	✓	✓		✓	✓	✓	✓			✓		✓	✓		✓
DWR, Draft for Approval - Southern Sierra IRWMP 2018 Update	✓	✓				✓	✓			✓			✓			✓					✓	✓	✓				✓		✓
Federal - USDA, NFS																													
Sierra and Sequoia National Forest, Implementation Plan for the Kings River Special Management Area; Kings, Kings South Fork, and Kings Middle Fork, Wild and Scenic Rivers	✓												✓			✓				✓	✓		✓	✓	✓				
Federal - USDI-NPS																													
Middle and South Forks of the Kings River and North Fork of the Kern River - Final General Management Plan and Comprehensive River Management Plan/EIS																					✓		✓		✓			✓	✓
Sequoia and Kings Canyon National Park California Water Resource Information and Issues Overview Report							✓						✓			✓		✓			✓		✓	✓	✓				✓
Sovereign Nations																													
Big Sandy Band of Western Mono Indian Tribe, Draft Environmental Impact Statement for the Big Sandy Rancheria Casino and Resort (Note this is a draft and not adopted yet.)										✓						✓		✓			✓		✓	✓					

12.4 - Dynamics Between IRWMP & Land Use /Water Planning Documents

There are a myriad of land use and water planning tools being used simultaneously in the State of California germane to the Southern Sierra IRWMP: the California Water Plan (CWP; last adopted 2013, with proposed 2018 Update in progress) and California Water Action Plan (CWAP, implementing the CWP; last adopted 2016), the San Joaquin Valley Blueprint, other IRWMPs for adjacent areas, federal and state public land and resource management plans, county general plans, community or area plans and specific plans, municipal service reviews, Smart Growth and Ahwahnee Principles, urban water management plans, agricultural water management plans, water, sewer and stormwater master plans, and water quality plans.

The Ahwahnee Principles are a collection of development strategies written in 1991 by the Local Government Commission to help communities develop in a more resource-efficient manner.[1] Originally a list of 10 Principles, Economic Development and Water Principles have been added (in 1997 and 2005 respectively). The Ahwahnee Principles relate very closely to the statewide Actions discussed above.

The public agencies in Fresno and Tulare County are already using some of the Ahwahnee Water Principles below to improve the vitality and prosperity of their communities.

Community Principles

1. Community design should be compact, mixed use, walkable and transit-oriented so that automobile-generated urban runoff pollutants are minimized and the open lands that absorb water are preserved to the maximum extent possible. (See the Ahwahnee Principles for Resource-Efficient Communities)
2. Natural resources such as wetlands, flood plains, recharge zones, riparian areas, open space, and native habitats should be identified, preserved and restored as valued assets for flood protection, water quality improvement, groundwater recharge, habitat, and overall long-term water resource sustainability.
3. Water holding areas such as creek beds, recessed athletic fields, ponds, cisterns, and other features that serve to recharge groundwater, reduce runoff, improve water quality and decrease flooding should be incorporated into the urban landscape.
4. All aspects of landscaping from the selection of plants to soil preparation and the installation of irrigation systems should be designed to reduce water demand, retain runoff, decrease flooding, and recharge groundwater.
5. Permeable surfaces should be used for hardscape. Impervious surfaces such as driveways, streets, and parking lots should be minimized so that land is available to absorb storm water, reduce polluted urban runoff, recharge groundwater and reduce flooding.

[1] Local Government Commission, website http://www.lgc.org/ahwahnee/ahwahnee_principles.pdf accessed 3/24/14

6. Dual plumbing that allows gray water from showers, sinks and washers to be reused for landscape irrigation should be included in the infrastructure of new development.
7. Community design should maximize the use of recycled water for appropriate applications including outdoor irrigation, toilet flushing, and commercial and industrial processes. Purple pipe should be installed in all new construction and remodeled buildings in anticipation of the future availability of recycled water.
8. Urban water conservation technologies such as low-flow toilets, efficient clothes washers, and more efficient water-using industrial equipment should be incorporated in all new construction and retrofitted in remodeled buildings.
9. Ground water treatment and brackish water desalination should be pursued when necessary to maximize locally available, drought-proof water supplies.

Implementation Principles

1. Water supply agencies should be consulted early in the land use decision-making process regarding technology, demographics and growth projections.
2. County officials, the watershed council, LAFCO, special districts and other stakeholders sharing watersheds should collaborate to take advantage of the benefits and synergies of water resource planning at a watershed level.
3. The best, multi-benefit and integrated strategies and projects should be identified and implemented before less integrated proposals, unless urgency demands otherwise.
4. From start to finish, projects and programs should involve the public, build relationships, and increase the sharing of and access to information.
5. Plans, programs, projects and policies should be monitored and evaluated to determine if the expected results are achieved and to improve future practices.

California state law requires each city and county to adopt a ***general plan*** "for the physical development of the county or city, and any land outside its boundaries which bears relation to its planning" (Government Code §65300). The California Supreme Court has called the general plan the "constitution for future development." The general plan expresses the community's unique development goals and embodies public policy relative to the distribution of future land uses, both public and private and well as the delivery of essential public services such as domestic water, water for agricultural purposes, sanitary sewer, wastewater treatment, drainage collection and dispersal, and water for sustaining natural resources.

As a result, land use, capital facility and water planning decision-making have a direct relationship to water demand and can have a direct impact on water supply. Some General Plans are more comprehensive than others in the degree to which they comprehensively integrate across the spectrum of land, water, and natural resources management elements.

The Southern Sierra IRWMP boundary (see **Figure 1.1**) is established generally according to the combined watersheds of the following rivers:

- San Joaquin River – southeast aspect only (within Madera and Fresno County), draining to Edison Lake Reservoir, Mammoth Lake Reservoir, Florence Lake

Reservoir, Huntington Lake Reservoir, Shaver Lake Reservoir, and Lake Millerton Reservoir.

- Kings River – Fresno and Tulare County portions only, draining to Courtright Reservoir, Wishon Reservoir, and Pine Flat Lake Reservoir
- Kaweah River – Fresno and Tulare County portions only, draining to Kaweah Lake Reservoir
- Tule River – Tulare County portions draining to Lake Success Reservoir
- Deer Creek – Tulare County portions draining generally northwesterly
- White River – Tulare County portions draining generally northwesterly
- Poso Creek – Tulare County portions draining generally northwesterly
- Upper Kern River – The Tulare County portions of the easterly aspect of the Great Western Divide and the Tulare County portions draining to Lake Isabella Reservoir.

The unincorporated communities and county boundaries in the Southern Sierra Region are shown in Chapter 3 (there are no incorporated cities within the Southern Sierra Region boundary). County planning or public works agency representatives, special district staff, US Forest Service, US Park Service, and Tule River Indian Reservation were valued as participants in the IRWM process. These representatives provide a conduit to the elected bodies through the planning and capital improvement processes. They also support collection of important data and information and provide critical guidance for planning purposes.

Figure 12-1 shows how local planning efforts in the Southern Sierra Region are integrated and how the IRWMP fits into larger scale efforts.

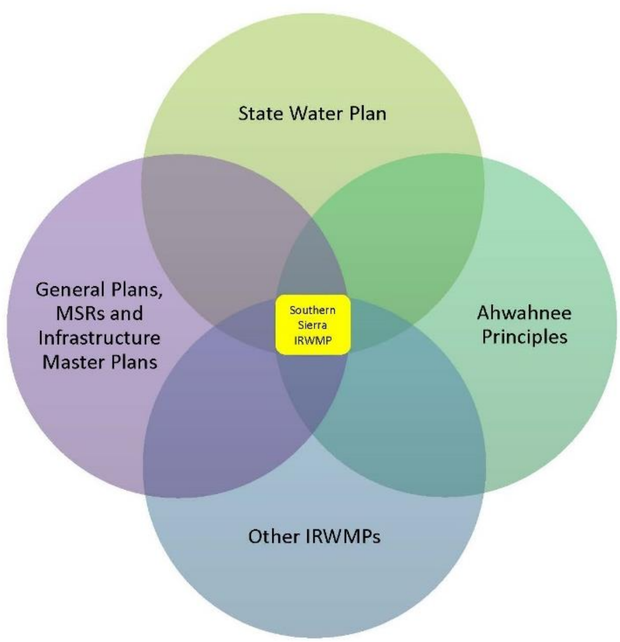


Figure 12-1 IRWMP Relationship to Land Use and Water Planning

In the past, land use and water supply decisions were made independently; however, in recent years state legislation and court decisions have begun changing the planning process to require a greater degree of integration between land use and its accompanying water needs. Two such pieces of legislation, SB610 and SB 221, are companion measures with the intent to promote collaborative planning between cities, counties and water suppliers. SB610 requires the preparation of Urban Water Management Plans and water supply assessments for larger development projects or land use plans. SB221 prohibits a land use agency from approving a subdivision map of more than 500 units without a letter of verification that sufficient and reliable water is available.

Similarly, Local Agency Formation Commissions (LAFCOs) are required to ensure water supplies are available before approving city or district boundary amendments. Additionally, they are responsible for approving a Municipal Service Review (MSR) prior to updating a sphere of influence, which must be updated every five years.

Updates to the General Plan Guidelines recommend that local agencies include a Water Element in their general plans with the intent that the general plans would incorporate the city or county's Urban Water Management Plan (UWMP) (if applicable) and codify requirements to comply with SB610/221.

The Southern Sierra IRWMP process included consideration of the existing land use plans and water planning documents to evaluate which statewide water planning challenges they address and the needed Actions they intend to implement. As an umbrella document this IRWMP serves as a means to coalesce all the activities of Southern Sierra Regional land use planning agencies and water purveyors, and to facilitate ways for them to collaborate to avoid potential for conflicts between the plans and to work cooperatively to gain the maximum benefits Region-wide to achieve sustainable water resources.

A review of the land use planning and water planning documents identified in **Table 12-1** through **Table 12-5** showed the following primary characteristics:

- The Fresno and Tulare County General Plans are characteristically regional in their viewpoints.
- Nearly all the plans aspire to activities which encourage or promote sustainability of water resources.
- The Fresno and Tulare County General Plans devote a sections of their plans specifically to Water Resources and comprehensively address existing conditions (including acknowledgement of overdraft conditions), water quality, water supply, and numerous implementation strategies ranging from prohibiting export of water supplies outside the county (Tulare), to controls to limit contamination, participating in research and development and monitoring of groundwater supplies, encouraging development of recharge basins and groundwater banking, and promoting water use/conservation education.

- Not only do the Federal and State Land Resource Management Plans address the need to protect the upland watersheds to maximize good water stewardship, but the County General Plans contain policies that reflect this same ideal.
- The National Forest, State Forest and National Park resource management plans tend to focus on water quality for maintenance of wildlife and plant habitats including notably, timber resources, and for water service to campgrounds, and deal less directly with actions to maximize collection and down-stream flow.
- The County general plans support general solutions needed to limit or avoid contributing factors of overdraft within their respective jurisdictions through their land use and open space policies; however specificity of actions needed could be enhanced.
- County general plans do not generally identify impacts to irrigation district facilities as a result of development in terms of infrastructure and increases in storm water releases into existing flood control facilities.
- Water supply reliability and safety is discussed in the County general plans but in generalities; the plans could be more specific in directives toward how water supply shall be sustained and assured into the future, and how water quality will be monitored and maintained on an on-going basis.
- The Tulare General Plan being more recently updated than the Fresno County General Plan, does focus on more regional efforts overall due in part to new requirements for general plans; as such it does discuss water issues and necessary implementation actions in more specific terms.
- It is unknown whether new development proposals are reviewed for their consistency with or conflict with adopted Urban Water Management Plans.
- MSRs typically discuss general information regarding recharge and growth, without listing specific implementation plans needed to achieve these goals.

12.5 - Opportunities for Proactive Collaboration between Land Use Planners and Water Managers

As previously discussed, cooperation between land planning and water agency representatives and the IRWM is critical to the successful and effective implementation of regional water management efforts. Establishing new and strengthening existing relationships will contribute to the Southern Sierra Region's water management success. Many of the Land Use and Water Planning documents acknowledge this already. But greater effort to carry this out is needed. There are several key approaches for facilitating the future relationships with local agencies:

1. Internal discussion within the Southern Sierra RWMG regarding inter-related land planning and water planning issues
2. Provide more outreach for detailed review of land use and water planning documents to continue to identify further potential inconsistencies with the purposes of the IRWMP and provide recommendations for modified/new strategies to public lands, County and private/NGO planning and water policy decision makers to achieve mutually benefical results. Form a RWMG task for specifically for this purpose; regular reporting at quarterly meetings.

3. Review and comment on major new land planning projects and policies of the agencies within the Region; assign a RWMG member the task of reviewing Council and Supervisor agendas for opportunities to attend and comment on behalf of the Southern Sierra region.
4. Encourage land-use and water planners /engineers to attend regular RWMG meetings; expand distribution list for email invites.
5. Give presentations on the inter-relatedness of land use planning and water planning issues to Public Lands, County and NGO decision makers
6. Give presentations on water planning and IRWMPs at local chapters for land-use planning professional societies.
7. Exploration of projects that will facilitate the modification of land planning policy to encourage implementation of Region-wide beneficial water management
8. Conduct bi-annual meetings between the RWMG and local land planning representatives for the purposes of discussing upcoming policy changes or implementation of the IRWMP
9. Promote inter- and intra-agency communication between the land use planning and water management/infrastructure staff
10. Maintain a current list of key staff at all federal, state, regional and local government agencies and NGO entities that govern and serve to influence land use and water planning policy and projects and assure they are invited to and made aware of the agenda topics at Group meetings.
11. The implementation measures of the Ahwahnee Principles discussed above also provide important guidance for collaboration that can be followed or adopted by the Southern Sierra RWMG.

The IRWM is committed to maintaining open channels of communication and facilitating continued involvement of, information sharing and collaboration with the land use and water planning community.

12.6 - Information Sharing and Collaboration with Land Use and Water Planning Agencies

As a participant in better managing the State's water supplies, efforts of the RWMG and IRWM can have a positive effect within the Southern Sierra Region. Specifically, conducting and facilitating information sharing and collaboration with Land Use and Water Planning agencies can influence sustainable management of multiple water demands, how water management systems' can better adapt to climate change, and identification of opportunities to off-set climate change impacts.

The following is a summary of the Southern Sierra RWMG's activities in maintaining open channels of communication and facilitating continued involvement of information sharing and collaboration with the land use and water planning community since the 2014 IRWMP was adopted:

1. After the 2016 Rough Fire in the Kings River Watershed, collaborative efforts emerged among multiple partners, lead by the US Forest Service, to monitor

impacts and plan recovery efforts (see Figure 2). These partners and programs will assist in understanding and modeling Kings River hydrology, drought, fire and flood impacts and provide a collaborative basis for planning and implementation.

2. The RWMG participated in a climate change forum sponsored by DWR and other partners potentially linking upper and lower watershed water management and integrating data, research and funding. The RWMG contributed an overview of Sierra climate change impacts, vulnerabilities, potential mitigation and adaptation strategies from the IRWMP.

3. There are several collaborative groups in the Southern Sierra Region including the Sustainable Forests and Communities Collaborative, the Dinkey Collaborative, the Whiskey Ridge and the Willow Creek groups. These groups have relatively focused geographic and action areas. The Southern Sierra Regional Water Management Group seeks to cooperate and collaborate with these groups to integrate with their planning efforts, gather data and incorporate issues, priorities and projects into the regional planning and implementation process.

4. The RWMG and consultants worked with members from the two active collaborative groups in the Region: the Dinkey Collaborative and the Watershed Connections Workgroup. By incorporating knowledge and data from the Dinkey Collaborative in cooperation with members, UC Merced, the Pacific Southwest Research Station, Sequoia and Kings Canyon National Parks and the Sierra National Forest, the RWMG crafted a unique, cutting edge, research, water modelling and implementation project. A portion of this research and implementation project has now been funded as part of a $217,000 Department of Water Resources (DWR) planning grant and represents a new avenue in cutting-edge water management in the southern Sierra’s Kings River Watershed incorporating the Southern Sierra Critical Zone Observatory data and providing modelling and outreach tools as a demonstration for other watersheds. This project became the foundation for a new initiative to re-focus and improve the IRWM Plan. This grant will enable the RWMG to access additional funding for project implementation in the near future as part of Proposition 1 funding. The RWMG provides regular briefings/presentations and will regularly attend the Dinkey Collaborative meetings and share information with other stakeholders.

5. Members of the RWMG participated in a climate change forum sponsored by DWR and other partners Climate Change Impacts and Adaptation Strategies for the Tulare Basin Watershed – A Focus on Agriculture and Disadvantaged Communities potentially linking upper and lower watershed water management and integrating data, research and funding for dis-advantaged and other communities. The RWMG contributed an overview of Sierra climate change impacts, vulnerabilities, potential mitigation and adaptation strategies from the IRWMP.

6. In addition to regular business and meetings, the RWMG completed the three Watershed Action Plans for the San Joaquin, Kings and Kaweah watersheds. These action plans identify common issues and challenges in the watershed and chart pathways to resolve issues through partnerships, programs, studies and projects unique and specific to each watershed. These plans were a key deliverable in our National Forest Foundation Grant.

7. The RWMG's Kings River Watershed Action Plan highlighted the need for collaboration and projects to monitor, evaluate and predict events and create methods to respond. Meanwhile, the Southern Sierra Region is under an exceptional drought and unprecedented tree mortality, in addition to large fires, and potential floods. This makes our combined resources especially important in responding to these conditions and events (see Figure 3). These conditions also offer a perspective on water management during droughts and tree mortality, as it relates to watershed hydrology and water balance.

8. The Sustainable Forests and Communities Collaborative is a community based collaborative focused on the development and conservation of healthy forests and sustainable economies in the Southern Sierra. They focus on projects like increasing volunteerism, sustainable forest management, bioenergy, cultural resources, and watershed restoration. They are known in the community and have a lot of good will and members willing to participate, but their funding source for a facilitator has lapsed.

9. The Whiskey Ridge and Willow Creek planning groups were both collaborative planning groups formed based on planning a project for the Sierra National Forest. Once the plan was developed, these planning groups went inactive – many of their members began working with SFCC, other IRWM groups, or other regional non-profit organizations.

10. The Dinkey Collaborative is largely a planning and monitoring group. The Sierra National Forest implements the collaborative's projects and manages the Collaborative Forest Landscape Restoration (CFLR)-funded program budget. The Group includes expertise and knowledge from many stakeholders and maintains a narrow scope and location focus. The group supports projects such as the Soaproot thinning project, Dinkey North and South, Eastfork, and their newest project, Exchequer.

11. Southern Sierra Regional Water Management Group is a water management group under California water Code and is a California Department of Water Resources-approved Region. The Group completed the first IRWM Plan in 2014. Along with implementing projects in the Plan, the RWMG seeks to develop action plans for the watersheds in the Region. Through the IRWMP and subsequent plans and programs, stakeholders have access to unique sources of funding and can build integrated, competitive projects. The regional nature of the RWMG, capacity, scope, and charge brings the ability to work in multiple watersheds. The locally- focused collaboratives bring substantial local

knowledge and data about resource issues and challenges and opportunities to incorporate data or address issues and challenges. The RWMG would like to incorporate and build upon this local knowledge and work. A regional research and data basis is already included in the IRWMP utilizing, among other resources, the Kings River Experimental Watershed as a resource.

12. The RWMG significantly advanced its planning via watershed action plans and a scope of work and grant application for a IRWMP update, including a UC Merced-driven climate and hydrology research effort. We advanced the implementation of our IRWMP projects via our ability to compete and submit implementation projects in 2018, after completing our IRWMP update and we created pathways for project funding and sophisticated research modelling, forecasting and flood, fire, drought impact analyses.

13. DACs have been an integral part of the planning and implementation process. Springville, an EDA and SDAC (based on community surveys), represented by the Springville Public Utilities District has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential information in the initial IRWMP.

14. For this 2018 IRWMP Update proposal to DWR, the primary data sources for the DAC determination were the Disadvantaged Community Place, Tract and Block Group shapefiles downloaded from the Disadvantaged Communities Mapping Tool established by DWR. Similarly, the DWR EDA Mapping Tool web page was used to indicate which block groups were considered Economically Distressed. Care was taken to confirm that the newly identified EDA communities met the combinations of criteria for income, total population, and unemployment (EDD). Geographic areas were included in our counts if they met either the DAC or EDA criteria. DACs identified at the block group, tract and place levels were all combined as they did not overlap geographically (preventing double counting). Finally, the population estimates for DACs/EDAs were compared to those for the entire SSIRWMP boundary to obtain a percentage of approximately 50%.

15. DACs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in DACs in the Region. Supporting and planning projects and adapting to drought and climate in DACs will be a major focus of the IRWMP update proposed herein. The RWMG seeks to continue to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties Overlay DAC efforts. The RWMG participates in both efforts and will apply information learned since 2008 about the needs in these communities as well as apply information from other DAC-active groups such as the Inyo-Mono RMWG's DAC work to the IRWMP update to best engage and partner with DACs.

16. The The Regional Water Management Group held a project development workshops and field trips on March 2-3, 2017. The workshops/field trips were in two parts/locations because of the size of the Region: a northern workshop, at the US Forest Service – Sierra National Forest Headquarters, and a southern meeting at the Quaker Oaks Farm, outside of Visalia. The workshops were partially conducted indoors, where participants reviewed projects, funding and watershed maps, and a field portion, at a nearby field location. The southern workshop included a driving tour to the Tule River watershed to view the implementation projects at the Circle J/Norris Ranch, in Springville.

17. At the December 2016 meeting, the RWMG determined that a formal workshop should be held where all members and interested parties can collaborate and learn what they can do to fund, integrate and make their projects regional, and climate smart. The workshop components and the goals included:
    - Introduction and discussion the upcoming implementation grant opportunities;
    - Discussion of projects and provide feedback to project proponents on integration, regional nature and competitiveness; and
    - Discussion and recommendation of work plan for project implementation and projects to move forward.

18. The RWMG held quarterly meetings in March, June, a kick-off planning Regional Water Management Group meeting on September 7, 2017, in Fresno, and December, where IRWMP chapters and chapter-sections were discussed and preliminarily-approved chapters 3, 4 and 5 of the updated IRWMP.

19. The Three Rivers Water Supply Study was included in the Three Rivers Community Plan Update and the US Forest Service - Sequoia National Forest continued meadow restoration efforts with its NEPA grant to evaluate 20 meadows on the Kern Plateau, while Sierra National Forest may have up to three meadows projects to contribute. With the current grant, a research and modelling program geared toward understanding climate change, drought, floods, water supply and effective resource management and knowledge to action framework to educate and inform stakeholders, including communities will be applied to the water management portfolio in the Southern Sierra.

20. In 2017, instead of exceptional drought, many areas experienced above-average rainfall and flooding. This was a great relief from the drought but highlighted the need for flood planning and understanding landslides and debris flows in the Southern Sierra.

21. SRT and other regional collaborators planned and executed a highly effective program for the Headwaters to Groundwater Symposium. Initiative, momentum and will were garnered during the symposium and will be used to advance watershed-scale planning and implementation and garner financial support.

22. Regarding the process for moving projects concept/idea to proposals, the RWMG and Project Team met with various members and stakeholders to discuss new projects, including a study of wetland springs, and landslides and debris flows, as well as an exotic species eradication effort. SRT will serve as project proponent for the *Arundo donax* Eradication Project and other watershed protection projects. KEC met with the National Forest Foundation, Blue Forest Conservation to discuss funding and planning the project and a potential WaterSmart grant proposal. KEC coordinated with UC Merced, Provost and Pritchard Consulting, and Sierra Resource Conservation District (will assist with some Fresno County outreach) to draft and execute the necessary contracts for the planning grant process.

23. The Tulare Basin Disadvantaged Community (DAC) Program, under the auspices of the County of Tulare was awarded a DWR grant to work with an advisory committee to develop DAC projects and programs for Tulare Basin DACs.

24. In addition, the Mountain Counties Funding Area DAC program is under way and has submitted a proposal to DWR and will have regular meetings. The Southern Sierra Regional Water Management Group has participated in the Coordinating Committee steering the effort and initiated discussions of DAC mapping, issue identification and projects scoping and outreach in eastern Fresno County.

25. For our proposal to DWR, the primary data sources for the DAC determination were the Disadvantaged Community Place, Tract and Block Group shapefiles downloaded from the Disadvantaged Communities Mapping Tool established by DWR. Similarly, the DWR EDA Mapping Tool web page was used to indicate which block groups were considered Economically Distressed. Care was taken to confirm that the newly identified EDA communities met the combinations of criteria for income, total population, and unemployment (EDD). Geographic areas were included in our counts if they met either the DAC or EDA criteria. DACs identified at the block group, tract and place levels were all combined as they did not overlap geographically (preventing double counting). Finally, the population estimates for DACs/EDAs were compared to those for the entire SSIRWMP boundary to obtain a percentage of approximately 50%.

26. The DACs and EDAs cover areas with a total population of 16,084. This represents 50.2% of the permanent regional population of 32,040. The Region has a relatively low permanent population due to its rural and mountainous nature, but does accommodate millions of seasonal and part time visitors each year.

27. DACs have been an integral part of the planning and implementation process. Springville, an EDA and SDAC (based on community surveys), represented by the Springville Public Utilities District has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential

information in the initial IRWMP.

28. DACs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in DACs in the Region. Supporting and planning projects and adapting to drought and climate in DACs will be a major focus of the IRWMP update proposed herein. The RWMG seeks to continue to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties Overlay DAC efforts. The RWMG participates in both efforts and will apply information learned since 2008 about the needs in these communities as well as apply information from other DAC-active groups such as the Inyo-Mono RMWG's DAC work to the IRWMP update to best engage and partner with DACs

29. The DACs and EDAs cover areas with a total population of 16,084. This represents 50.2% of the permanent regional population of 32,040. The Region has a relatively low permanent population due to its rural and mountainous nature, but does accommodate millions of seasonal and part time visitors each year.

30. DACs have been an integral part of the planning and implementation process. Springville, an EDA and SDAC (based on community surveys), represented by the Springville Public Utilities District has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential information in the initial IRWMP.

Chapter 13 - STAKEHOLDER INVOLVEMENT

This chapter discusses all aspects of the Southern Sierra Regional Water Management Group's (RWMG) stakeholder involvement/public outreach efforts, including stakeholder recruitment and engagement strategies, communication about the Integrated Regional Water Management Plan (IRWMP) and its updates, and general outreach to the public. The RWMG defines stakeholder involvement as the efforts and strategies used to recruit and engage a diverse group of stakeholders to participate in the RWMG and to raise awareness about integrated regional water management in the Region. Throughout this chapter, "public outreach" carries the same meaning as "stakeholder involvement" and the two terms are used interchangeably.

Stakeholder involvement is considered fundamental to the success of the RWMG. The goals of the RWMG's stakeholder outreach efforts include:

- Inform public of water resources issues, planning, and projects in the Region through mialings, annual reports, Regional Water Management Group public meetings, and project workshops;
- Recruit stakeholders via networking, meetings, direct engagement, flyers, articles, press releases and Regional Water Management Group public meetings, to become involved in the process, and become RWMG members;
- Solicit input for IRWMP development, project development, and decision making at public workshops, Coordinating Committee and Regional Water Management Group meetings and briefings.

13.1 - Public Outreach Process

The public outreach process incorporates nine primary outreach methods, which are illustrated in **Figure 13-1**, and are discussed below. More detail on stakeholder outreach is also found in **APPENDIX N -** Communication and Outreach Plan .

Figure 13-1 Public Outreach Methods

<u>Stakeholder Coordinator</u>
The RWMG has a part-time Stakeholder Coordinator who serves as the lead outreach coordinator for the RWMG. Most of the work performed by the Stakeholder Coordinator relates to public and stakeholder outreach, and the planning and organizing of RWMG and other meetings.

<u>Meetings</u>
The RWMG convenes six meetings per year, held bi-monthly, with its members and stakeholders. Additionally, the RWMG holds monthly Coordinating Committee meetings, and may convene other special events and sub-committee meetings as the occasion arises. RWMG meetings are open to the public and include a public comment period during which any individual or organization has an opportunity to speak. Meetings are held in Fresno (at two different locations) and Visalia, which are approximately 55 miles apart. Because the Region is so vast, meetings cycle through the three venues to reduce transportation time and costs for local residents and agencies. Each venue provides appropriate facilities to conduct the meetings, and accommodate conference call participation. Meeting dates and details are announced with ample planning time by email, through individual outreach to targeted stakeholders, and are posted to an online calendar hosted on the RWMG's website. Announcements provide ample lead time for invitees to plan attendance. Participation via telephone conference line is also possible by prior arrangements with the Stakeholder Coordinator.

The RWMG utilizes professional meeting facilitators to help engage stakeholders and ensure their comments are heard. In 2011, the RWMG received a grant from the Department of Water Resources for meeting facilitation services from the Center for

Collaborative Policy at Sacramento State University. Facilitation services were provided from 2011-2014. The facilitator helped to further develop the RWMG's governance structure, refine the process, facilitate important meetings and briefings, develop informational outreach materials, and assist with IRWMP development.

Printed Material

The RWMG has developed several water planning briefing documents and presentations that it has distributed in an effort to raise awareness about and expand participation in the RWMG and the IRWM planning process. These items can be found on the website and are described in **Appendix N.** The RWMG also updated its brochure in 2014, which can be found in **Appendix O**. The brochure is used to educate the public and recruit new members. The brochure is distributed at presentations and sent to stakeholders who have expressed interest in the RWMG.

Focused Outreach

The RWMG/Stakeholder Coordinator performed specific, focused outreach to important stakeholders and groups such as DACs (see **Section 13.5**) and Native American tribes in recognition of their tribal sovereignty (see **Section 13.6**). The focused outreach typically includes direct contact with the stakeholders, individuals, or groups via briefings, letters, emails, and/or presentations delivered to the groups (please see **Appedix N**.).

Email List

The RWMG maintains an email list that receives announcements of all RWMG meetings, meeting agendas, meeting minutes, important water management news, grant opportunities, and other topics that may be of member interest. The email distribution list is comprised of MOU signatories and others who have expressed interest in the RWMG and IRWMP. In 2018, the email list from 2014 was updated and consolidated, and includes 108 contacts. Recipients include engineering consultants, community organizations, homeowner associations, sovereign tribal nations, non-governmental organizations, water agencies, resource conservation districts, cities, counties, special districts, state agencies, neighboring IRWMP groups, watershed groups, ditch companies and utilities.

Articles

The RWMG has written and submitted several press releases and letters to the editor to regional news outlets to publicize and promote the RWMG and to make important announcements.

To notify the public about the IRWMP process and related activities, the RWMG circulated various press releases and articles that resulted in newspaper publicity, social media, website posts and cross-links, as well as legally-required public noticing for IRWMP update and adoption.. The RWMG's IRWMP update was discussed and announced during project development and outreach workshops on March 2-3, 2017 and at the UC Merced/SSRWMG field workshop in October, 2017, the Tulare Basin JPA meetings in 2017, and The Watershed Connections Workshop in October, 2017. At least three articles were published in The Kaweah Commonwealth, a Three Rivers newspaper, describing the Three Rivers Community Plan Update and associated environmental documents, the Three Rivers Hydrologic Capacity Study Project which became a part of the water supply study in the Community Plan Update. All press releases, articles, and reports are also posted on the RWMG website. All press releases and articles are also posted on the RWMG website.

Press releases and newspaper publicity will continue to be an important outreach strategy, especially to announce grant awards, completed projects, and other RWMG successes.

Presentations

The Stakeholder and RWMG Coordinators (and other members) have delivered numerous PowerPoint presentations to various groups in an effort to raise awareness about integrated resource management in the Southern Sierra, educate the general public and stakeholders about issues and opportunities, and to encourage participation in the RWMG. Some of these presentations are provided in **Appendix P**. These presentations are revised and updated at least once every year to maintain the relevancy of the content. Topics in the presentations include RWMG history, DAC and Tribal issues, ongoing and completed projects, successes, future milestones/goals, and stakeholder outreach. Following is a list of some organizations that received presentations during 2017 and the first half of 2018:

- Tulare Basin JPA/IRWM group – Monthly updates and presentations
- Sierra Water Workgroup – 6/10/13; 6/12/14
- Sierra Tribal Forum – 8/08/13
- Springville Public Utility District – 8/12/13
- Tulare Lake Basin Forum – 10/18/13
- Tule River Indian Tribe at Tule River Indian Reservation – 5/07/14

The stakeholder coordinator also regularly attends meetings for the following local agencies (often quarterly meetings). Presentations are given to these agencies every year:

- Central Sierra Watershed Committee
- Tulare County Water Commission
- Tulare County Resource Conservation District
- Sierra Resource Conservation District
- Three Rivers Town Hall
- Yosemite/Sequoia Resource Conservation and Development Council
- Dinkey Collaborative
- Tulare Basin Watershed Connections Work Group

Website
The Southern Sierra RWMG website is independently hosted on www.southernsierrarwmg.org. In 2018, the website was expanded from the website developed in 2013-14 to include multi-media, comprehensive document history, IRWMP draft and final chapters, scientific papers, presentations from RWMG meetings and other informative events, including video tours of watershed-based field trips and workshops. Website content is cross-linked to social media. The website also contains information on the RWMG, a list of members, information on IRWMPs, the complete Southern Sierra IRWMP document, educational information and resources for members and the general public, funding opportunities, RWMG accomplishments, meeting calendar, meeting minutes, meeting agenda, governance materials, a description of the Region, project details, and project application forms. In the time leading up to the completion of the IRWMP, the website has provided drafts of the chapters along with an announcement of its update completion in October 2018. The website will serve as a data repository for the RWMG. It hosts meeting minutes, agendas, and materials for the majority of past meetings, and will continue to do so for all RWMG meetings.

Local Agency and Sovereign Nation Native American Tribe Updates
The RWMG regularly updates numerous local agencies and Sovereign Native American Tribes on its activities, either formally through briefings and presentations or informally through phone calls, emails, and/or in person. The stakeholder coordinator also regularly attends meetings for the agencies and tribes listed above under 'Presentations' and provides regular updates. RWMG updates are a standing agenda item for several of these agencies. Many RWMG members also regularly update their governing bodies during Board and Council meetings.

Outreach and Coordination with Neighboring IRWMPs
Outreach and coordination is also performed with seven neighboring IRWMP groups. These efforts are described in Section 15.7 in the Coordination and Integration chapter, and include coordination via email lists, Letters of Agreement, and attending meetings and conferences.

13.2 - Stakeholder Identification and Recruitment

Stakeholders are necessary to implement the IRWMP and resource management strategies. Therefore, a strong list of members and interested stakeholders is fundamental to the long-term success of the RWMG. The RWMG has made it a top priority to identify, recruit, and engage a broad range of stakeholders in its process to prepare and implement the IRWMP and other resource management strategies. As a result of its recruitment efforts, the RWMG has successfully engaged a strong list of members and interested stakeholders that represent a diverse range of interests. The RWMG does not have regular staff or funding, own land or facilities, and generally will not be able to implement projects. Project implementation will rely on the stakeholders with administrative support from the RWMG.

<u>Breadth of Membership</u>
Current members of the RWMG (MOU signatories) include:

- Big Sandy Rancheria of Mono Indian Tribe
- California Department of Fish and Wildlife
- Desert and Mountain Resource Conservation and Development Council
- Fresno Metropolitan Flood Control District
- Inyo National Forest
- Lyles College of Engineering, Fresno State
- Pacific Southwest Research Station
- Revive the San Joaquin
- San Joaquin Valley Leadership Forum
- Sequoia and Kings Canyon National Parks
- Sequoia National Forest
- Sequoia Riverlands Trust
- Sierra and Foothill Citizen's Alliance
- Sierra Club – Tehipite Chapter
- Sierra National Forest
- Sierra Resource Conservation District
- Springville Public Utilities District
- Tulare Basin Wildlife Partners
- Yosemite/Sequoia Resource Conservation and Development Council

The list above represents a broad range of interests including: water supply, water quality, environment/habitat, cultural, recreation, agriculture, resource management, hydropower, sanitation, disadvantaged communities, non-profit organizations, Native American Tribes, and local, state and federal agencies. The RWMG continues to identify communities and stakeholder groups to outreach to. The stakeholders, who participate but are not formal members, include a similar range of interests.

Any stakeholder organization with an interest or role in water management in the IRWMP area may join the RWMG. A group who wants to join the Southern Sierra RWMG as a Member should notify the RWMG, sign the MOU, and adopt the IRWMP. Any entity who would like to discontinue their participation may do so at any time. The MOU is non-binding and non-regulatory.

Throughout the development of the draft IRWMP, from 2008 through 2014, and the IRWMP update, the RWMG conducted extensive outreach to engage stakeholders in the preparation of the Plan. As a result of these efforts and the attraction of participating in a collaborative, regional resource management process, most of the major stakeholders identified in the Region are now actively participating in the IRWMP as Members or Stakeholders. A few stakeholders, however, are not involved, either because they have not responded to RWMG outreach efforts, or because they have not completed the internal process to sign the MOU. A few stakeholder groups have emergred from DAC-specific data analyses, such as small communities with water systems. As part of the 2014 IRWMP update, the RWMG has discussed strategies to engage those stakeholders who remain on the sidelines of participation. As a result, the Stakeholder Coordinator has made direct contact with DACs, local water companies, and Native American Tribes to encourage their participation.

13.3 - Stakeholder Involvement in IRWMP Development

Stakeholder involvement in IRWMP development began as early as 2008 when Sequoia Riverlands Trust, Sierra Nevada Alliance and Sierra Nevada Conservancy launched the IRWM process. The efforts to develop the initial draft IRWMP, which was completed in 2013, are not discussed in detail here. More information can be found in the 2013 Draft IRWMP and the RWMG's Regional Acceptance Process application found on the website.

Following, are details on stakeholder involvement/public outreach efforts between 2013 and 2014, during which time the RWMG updated and expanded its draft IRWMP to meet State standards.

13.3.1 Public Outreach for 2014 IRWMP Update

The public outreach process for preparing the 2014 IRWMP included the following:

- The intent to prepare an updated IRWMP was announced at a regularly scheduled RWMG meeting in early 2013. The item was noted in the regular RWMG agenda and published in local news outlets (i.e. publicly noticed).
- In compliance with the California Water Code, the RWMG published notices that the IRWMP was being updated and considered for adoption. The notices were published in the Fresno Bee and Visalia Times Delta, which are the most widely circulated newspapers in the Valley and Mountain areas of the RWMG. Copies of the notices are included in. The first notice, published on July 24 and July 31, 2013, informed the public that the RWMG was updating the IRWMP to address new IRWMP standards, and that the general public was invited to participate. The second notice, published on September 27, October 4, and November 11, 2014, informed the public that the RWMG was intending to adopt the updated IRWMP and solicited public comments on the document.
- Through a series of about 20 interactive meetings over a 14-month period, the RWMG reviewed each proposed IRWMP standard and the content in the existing IRWMP. During these sessions, the stakeholders shared ideas and concerns, and came to consensus on the information to be included in the updated IRWMP.
- All of the public outreach methods listed in Section 13.1 was used to inform the public about the IRWMP update and to solicit input.
- The RWMG notified the public of the revised IRWMP and its availability for review through a local newspaper notice, an announcement on the website, an email notification, and verbally at a RWMG meeting on September 11, 2014. The draft IRWMP was placed on the RWMG website, and members each had hard copies available at their offices for the public to view. Hard copies were also placed in several geographically dispersed locations for the public to review the IRWMP. These included: Provost & Pritchard Consulting Group offices in Clovis and Visalia,

Sequoia Riverlands Trust office in Visalia, Springville Public Utility District office, Three Rivers library, Sequoia-Kings Canyon National Park, Sequoia National Forest, and Auberry public school. Stakeholders were given 30 calendar days to review the IRWMP and provide comments.

- 103 comments were received from the general public and RWMG members. A list of comments was developed and discussed at the RWMG's regularly scheduled meeting on November 13, 2014 and addressed in the final version of the IRWMP.

13.3.2 Public Outreach for 2018 IRWMP Update

The public outreach process for the 2018 the IRWMP Update included the following:

- The intent to prepare an updated IRWMP was announced at multiple regularly scheduled RWMG meeting in 2016 and early 2017. The item was noted in the regular RWMG agenda and published in local news outlets (i.e. publicly noticed in July 2017).
- In compliance with the California Water Code, the RWMG published notices that the IRWMP was being updated and considered for adoption. The notices were published in the Business Journal, which is a reasonably-priced, widely circulated newspaper. Copies of the notices are included in **Appendix Q**. The first notice, published on July 11 and July 18, 2018, informed the public that the RWMG was updating the IRWMP to address new IRWMP standards, and that the general public was invited to participate. The second notice, published on September 17, and September 24, 2018, informed the public that the RWMG was intending to adopt the updated IRWMP on October 25, 2018 and solicited public comments on the document.
- Through a series of about 10 interactive meetings over a 12-month period, the RWMG reviewed each proposed IRWMP standards and the content in the existing IRWMP. During these sessions, the stakeholders shared ideas and concerns, and came to consensus on the information to be included in the updated IRWMP.
- All of the public outreach methods listed in Section 13.1 were used to inform the public about the IRWMP update and to solicit input.
- The RWMG notified the public of the revised IRWMP and its availability for review through a local newspaper notice, an announcement on the website, an email notification, and verbally at a RWMG meeting on September 6, 2018. The draft IRWMP was placed on the RWMG website, and members each had hard copies available at their offices for the public to view. Hard copies were also placed in several geographically dispersed locations for the public to review the IRWMP. These included: Provost & Pritchard Consulting Group offices in Clovis and Visalia, Sequoia Riverlands Trust office in Visalia, Springville Public Utility District office, Three Rivers library, Sequoia-Kings Canyon National Parks, Sequoia National Forest, and Auberry public school. Stakeholders were given 30 calendar days to review the IRWMP and provide comments.
- Three comments were received from the general public and RWMG members. A list of comments and draft responses were developed and discussed at the special RWMG meeting on October 25, 2018 and addressed in the final version of the IRWMP.

13.4 - Equal Opportunity for Participation

The RWMG policies and governance structure provides equal opportunities for general public, government and non-government agency/organization, and sovereign nation participation and helps ensure a balanced group of members. The RWMG has also developed policies to involve stakeholders who choose not be become full members. The following policies help to ensure balanced and fair participation for all stakeholders:

- Membership in the RWMG is open to any agency, organization or company that signs the MOU. The right to become a member is based primarily on having a local presence in the IRWMP area and an interest in water resources management. The type or size of an organization are not factors.
- There are no dues associated with becoming a member or interested stakeholder. Therefore, financial capacity does not preclude organizations from becoming members. This is considered important since it allows DACs and smaller organizations to fully participate.
- Organizations not willing or able to sign the MOU may still attend meetings and participate as interested stakeholders, but are not allowed to vote in the event that consensus cannot be reached.
- The general public is welcome to attend RWMG meetings. Private individuals are not allowed to become members of the RWMG, but can be added to the list of interested stakeholders. Input from any member of the general public is considered regardless of their associations or history.

<u>Technology and Information Access</u>
Some stakeholders, especially DACs, may not have access to technology or transportation needed to participate in RWMG meetings and other activities. The RWMG has made several efforts to overcome these barriers:

- Meetings are rotated each month between Fresno and Visalia to reduce travel distances for local residents.
- Call-in options are available for Coordinating Committee and RWMG meetings via coordination with Stakeholder Coordination meeting facilitator.

13.5 - Disadvantaged Communities and Ecomonically Distressed Areas

Critical water supply and water quality issues relevant to DACs and EDAs within the Region are important concerns for the Southern Sierra RWMG. Many communities within the RWMG boundaries meet the state definition of a disadvantaged community or economically distressed area. A DAC is defined by DWR as, having a median household income less than 80 percent of the statewide MHI. An EDA is more recently defined by Proposition 1 as, primiarily, having a household income between 80 and 85 percent of statewide MHI, but also one characterized by other factors such as financial hardsip, unemployment and population density. Special efforts have been made to inform and engage DACs within the planning area about the IRWM process. DAC participation is encouraged, and is one reason that dues are not required to become a member.

To help identify EDAs, DWR has developed the *EDA Instructions and Mapping Tool*.[1] This tool can assist potential Proposition 1 Grant fund applicants in determining whether their project is located in or benefits an EDA. The instructions provide guidance on defining the relevant terms contained in the EDA definition and the current comprehensive data available for evaluating those terms.

13.6 - Native American Tribes

The IRWMP area includes three Federally reconginized sovereign Native American tribes (Big Sandy Rancheria Band of the Mono Indian Tribe, Table Mountain Rancheria Chukchansi Band of Yokuts and the Monache Inidan Tribe, and Tule River Indian Tribe of the Tule River Indian Reservation) as well as many Federally unrecognized tribes including many considered to be California Native American Tribes. Although there are many regulatory requirements stipulating circumstances underwhich consultation with Native American Tribes must be conducted "government-to-government", there is no such express restriction applicable to the development of IRWM Plans. Consequently, the Stakeholder Coordinator, in the spirit of equal opportunity for participation, has reached out to the local Native American Tribes to encourage their participation and membership. This outreach is on-going as part of the IRWMP development, as part of the IRWMP development. The tribes are also on the email distribution list. One tribe, the Big Sandy Rancheria, is an RWMG MOU signatory making the Tribe a formal voting member and the Tribal Council adopted the IRWMP.

13.7 - Decision Making

The RWMG's decision-making process is transparent and all stakeholders are afforded the opportunity to provide input on decisions. The RWMG's decision-making structure requires the group to reach consensus on decisions. The MOU also includes a voting process in the event that consensus cannot be reached. Decisions are generally made by the formal members, comprised of the MOU signatories. However, all stakeholders have opportunities to provide input, comments and recommendations on decisions at RWMG meetings and/or through participation in work groups and special committees. More information on decision making is provided in Section 2.6 of the Governance Chapter.

13.8 - Future Outreach

Future public outreach will follow the model that the RWMG has been successfully employing throughout its development. Going forward, the Public Outreach Plan will

[1] California Department of Water Resources, *Proposition 1 Economically Distressed Areas Instructions.* Website accessible at https://www.water.ca.gov/LegacyFiles/irwm/grants/docs/Resources/EDA/P1_Economically_Distressed_Areas_Instructions_June_2016.pdf. *Economically Distressed Areas Mapping Tool* accessible here: https://gis.water.ca.gov/app/edas/.

include the nine methods described in Section 13.1 – Public Outreach Methods, with greater emphasis on publicizing the successes of the group. The public outreach strategy will be assessed annually and modified as deemed appropriate by the group. Important topics for future educational efforts include water supply and quality, ecosystem restoration, drought, and climate change impacts.

Most organizational stakeholders in the Region are already members or interested stakeholders, but some have not yet actively participated. The RWMG recognizes that the opportunity for a stakeholder to become involved is not limited to the beginning stages of plan development. A stakeholder may become involved later as their awareness of IRWM increases or new issues or concerns develop. Consequently, the RWMG will continually recruit new stakeholders to further increase the depth and diversity of membership and participation.

Chapter 14 - COORDINATION AND INTEGRATION

14.1 - Introduction

Coordination and integration are two closely related IRWMP standards intended to help ensure IRWMP members are working together. For the purposes of the IRWMP we have combine these two topics. The Southern Sierra Regional Water Management Group (RWMG) was formed with the intent of establishing a foundation for coordination and integration within the Region. This IRWMP describes a variety of processes for RWMG members and stakeholders to coordinate and integrate water management efforts. This chapter describes these processes and references other sections of the IRWMP where specific efforts are discussed in greater detail.

Coordination involves public outreach and facilitation efforts to bring stakeholders together and work as a unified group. Coordination efforts can include specific tasks or implementation of on-going policies and procedures. The goals of coordination include the following:

- Reduce current and future conflicts among local agencies and stakeholders
- Identify opportunities for regional or multi-agency projects
- Increase awareness of adjacent IRWMPs and their efforts
- Improve awareness of tribal, state and federal agency resources, plans and projects
- Effective use of regional technical expertise and knowledge
- Provide opportunities to advance public education
- Resource identification and pooling
- Increase efficiencies of various federal, state and local planning processes (NEPA, CEQA and permitting)

Integration is defined as combining separate pieces into an efficient unified effort. The broad goal of regional water management is to integrate the stakeholders into a single entity for addressing water-related regional issues. Coordination and integration include five main components, as shown in **Figure 14-1**. The central component is Project Selection and Implementation. Each of these components will be discussed in subsequent sections.

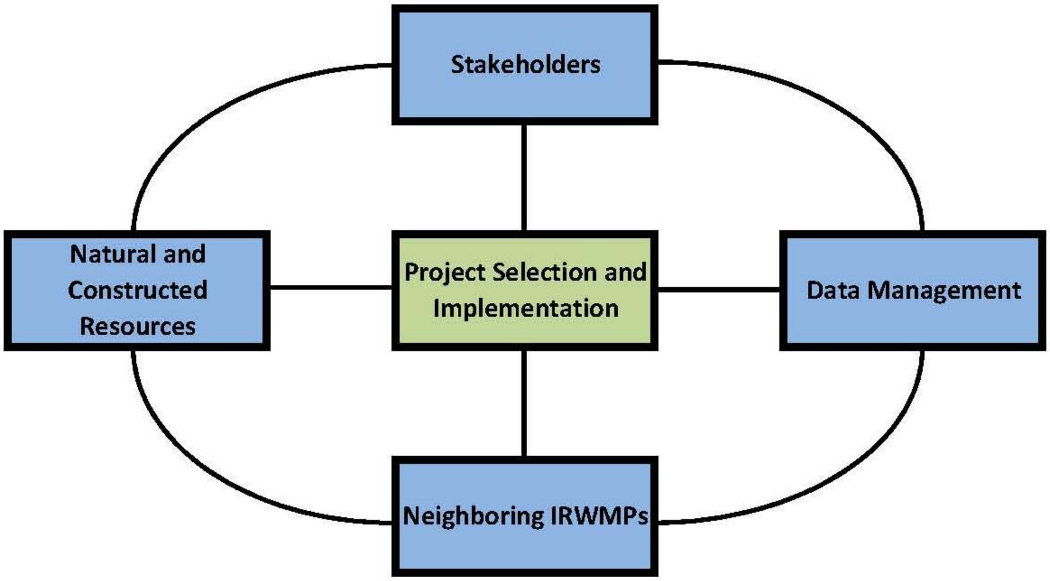


Figure 14-1 Coordination and Integration Components

Coordination and integration efforts generally overlap, and therefore they are jointly discussed below. Coordination and integration are covered in several IRWMP chapters, so the discussions below are introductory and refer to other IRWMP sections for more details.

14.2 - History of Coordination and Integration

Prior to the formation of the RWMG, the Southern Sierra Region has had no history of IRWM planning. The lack of specific IRWM planning efforts does not mean planning has not taken place, however it has been done individually by agencies with responsibility over specific areas. The Southern Sierra IRWMP was initiated through the actions of the Sequoia Riverlands Trust, the Sierra Nevada Alliance and the Sierra Nevada Conservancy based on their respective concerns that the Region was missing out on essential planning and management resources. With funds from a Sierra Nevada Conservancy 'seed' grant, an initial organizational meeting was held on May 21st, 2008. This meeting involved public agencies, non-profit organizations and interested stakeholders that became the Regional Water Management Group. Following this initial meeting, the RWMG participants began aggressive public outreach and held monthly meetings. Outreach was conducted to numerous interest groups, federal, state and local agencies and non-governmental organizations. Over the course of the planning work (2008-2014) the RWMG and project staff have compiled a list of current water-related plans and studies for the area and worked with various stakeholders to identify goals, objectives and specific projects that should be part of an IRWMP. This is truly the first 'integrated' planning effort that has taken place for the Region.

14.3 - Stakeholders

The RWMG has established a governance structure that fosters both integration and coordination of stakeholders through the following:

- The members are organized under the RWMG Memorandum of Understanding (MOU) which provides a formal and structured organization to manage regional water resources (Chapter 2 - Governance). The RWMG is a separate entity from each member, but all members are integrated through the Coordinating Committee and the Regional Water Management Group. Each member is asked to provide input and contribute to this IRWMP and its long-term success through project development and implementation.
- The governance structure allows any stakeholder to participate as an interested stakeholder. Interested stakeholders do not need to sign the MOU; they can participate in all RWMG efforts but are not entitled to vote on decisions. Coordinating Committee meetings provide all stakeholders a forum to exchange ideas and provide input. Various Work Groups have also provided opportunities for stakeholders to provide input on specialized topics. The Coordinating Committee and Regional Water Management Group meetings are each held about every other month.
- Outreach to DACs is important since they have some of the greatest needs, are often underrepresented, and provide some of the best opportunities to receive grant funding. The RWMG will continue focused efforts to recruit more DACs to attend meetings and become formal members of the RWMG.
- The RWMG uses a variety of public outreach methods to inform stakeholders of their efforts and accomplishments, and solicit comments on projects and studies (Chapter 14 – Stakeholder Involvement). A new website for the RWMG was launched in 2014 (http://www.southernsierrarwmg.org/) and will play a significant role in providing information on meetings, funding opportunities, and projects, and thus help to integrate the efforts of the RWMG members.

14.4 - Natural and Constructed Resources

The watersheds of the Southern Sierra IRWMP include significant valuable natural resources and constructed water infrastructure. Several agencies working together have significantly more resources than one working alone. Therefore, the integration of resources has the ability to enhance the outcome of any project. Resource integration can include sharing data, technical expertise or access to infrastructure. Resources integration is addressed as follows:

- The IRWMP provides various details on the members, interested stakeholders, water infrastructure, regional water supplies and other natural resources in the IRWMP Region (Chapter 3 – Region Description). This data informs stakeholders on the roles and responsibilities of other stakeholders, and the infrastructure and natural resources within their area of responsibility (as appropriate). This ensures that stakeholders have the necessary background data to participate in regional planning and decision making.

- The IRWMP area includes three sovereign Native American tribes including the Big Sandy Rancheria, Table Mountain Rancheria and Tule River Indian Reservation. These tribes have separate governance and land management structures than the local, state and federal agencies. Sharing data, technical expertise and infrastructure with the tribes can benefit both the tribes and other RWMG stakeholders.
- This IRWMP includes a climate change vulnerability assessment and a local climate change model (Chapter 16 – Climate change). This is an integrated assessment for the watersheds of the Southern Sierra Region, and helps to show potential climate change impacts (including fire risk, precipitation, snow fall, duration and melt-off), to the Region as a whole.

14.5 - Project Selection and Implementation

The RWMG coordinates and integrates projects through the following policies and procedures:

- The RWMG uses an integrated process to solicit, review and recommend projects for funding based on the RWMG's goals and objectives (Chapter 6 – Project Review Process). The process requires input from a Project Review Work Group.
- The RWMG has listed the general benefits of regional water management (Chapter 7 – Impacts and Benefits). The goal of this list is to inform stakeholders of the value of coordinating and cooperating on regional efforts.
- The RWMG has identified the benefits and impacts of implementing different types of projects (Chapter 7 – Impacts and Benefits). This information is provided for stakeholders within the Southern Sierra Region and neighboring IRWMPs. The purpose of this list is to help improve coordination among parties benefiting and impacted by new projects.
- The RWMG solicits and publishes a list of projects so each stakeholder is aware of proposed projects. This list can also help prevent duplication in new projects, or identify multi-agency projects. The list will be updated annually and incorporated into a RWMG Annual Report (see Section 14.6 below).

14.6 - Data Management

The RWMG has successfully developed several programs to coordinate and integrate data management among the different parties in the Southern Sierra RWMG. These programs include the following:

- The RWMG plans to prepare an annual report that will integrate data from the members and interested stakeholders, evaluate progress in meeting regional goals and objectives, document progress in implementing projects, and document proposed amendments to the IRWMP.

- Data will be shared with the public through the RWMG website, final reports for RWMG projects, public outreach efforts, RWMG meetings, public workshops, and targeted outreach
- When appropriate, RWMG members will submit data to relevant state databases so the information is publicly available (see Section 9.8 – Data Sharing and Distribution).

14.7 - Neighboring IRWMPs

The Southern Sierra RWMG abuts seven different IRWMP Groups as shown in **Figure 14-2**. Below is a discussion on these IRWMP groups and their similarities, differences and existing relationships with the Southern Sierra RWMG.

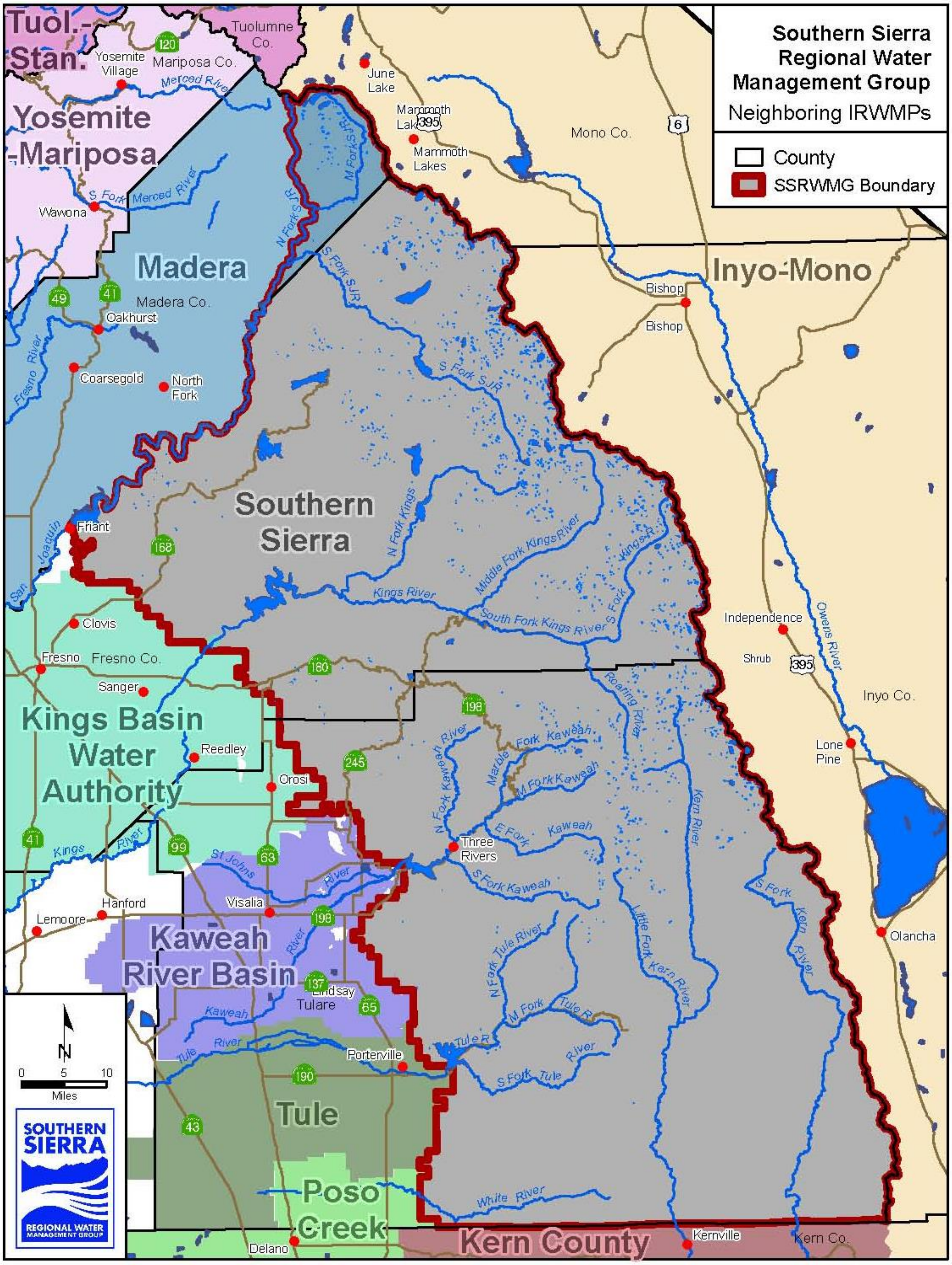


Figure 14-2 Neighboring IRWMP Groups

The various IRWMP groups have made efforts to coordinate their boundaries as much as possible, and the Southern Sierra IRWMP only overlaps with the Madera IRWMP. **Appendix R** includes copies of agreements with some of the neighboring IRWMPs. The boundaries inevitably split watersheds for the major rivers and streams (see **Figure 3-1. Region and Watershed Boundaries** in Region Description Chapter). This was unavoidable due to the overall size of the watersheds and the different focus of different IRWMP groups, which generally cover mountain or valley areas. The Southern Sierra IRWMP is unique in the total percentage of federally owned land and low population density. Some neighbors are substantially different, such as IRWMPs in the San Joaquin Valley that use large quantities of water for agriculture and include medium and large-sized cities. The Southern Sierra IRWMP does not currently have any major conflicts with other IRWMP groups.

Madera IRWMP. The Madera IRWMP is located north of the Southern Sierra IRWMP and covers the entire area of Madera County. The Madera IRWMP has many similarities to the Southern Sierra IRWMP including large mountainous area, upper watersheds of major water systems, generally low, rural population centers that rely on hard rock wells, and high fire risks. The Southern Sierra IRWMP desired to include the entire portion of the San Joaquin River watershed located west of the Sierra Nevada divide and south of the San Joaquin River. This has created a small overlap with the Madera IRWMP. Both IRWMP groups have agreed that joint management of the overlap area would be feasible.

Inyo-Mono IRWMP. The Inyo-Mono IRWMP shares the entire eastern border of the Southern Sierra IRWMP. The borderline is the Sierra-Nevada divide so they do not share water resources, but have similar physical environments near the crest of the Sierras.

Kings Basin Water Authority IRWMP. The IRWMP for the Kings Basin Water Authority (formerly the Upper Kings Basin Water Forum) lies to the west of the Southern Sierra Region. The IRWMP Region is just north of the Kaweah River Basin IRWMP. This area receives most of its surface water from the Kings River and relies heavily on watershed management in the Southern Sierras to provide reliable and high quality surface waters. Kings Basin Water Authority’s boundary was negotiated with the Southern Sierra RWMG and is delineated largely on the borders of the DWR Bulletin 118 Kings Subbasin, towns and special districts.

Kaweah River Basin IRWMP. The Kaweah River Basin IRWMP lies to the west of the Southern Sierra IRWMP and north of the Tule IRWMP. The areas were negotiated with the Kaweah River IRWMP. The area relies partially on Kaweah River surface water supplies, with other demands met with other surface water supplies and groundwater. Kaweah River water supplies are impacted by watershed management in the Southern Sierra Region.

Tule IRWMP. The Tule IRWMP is located west of the Southern Sierra IRWMP just below existing rangeland. The border was negotiated with the Tule River IRWMP group. The area relies partially on Tule River surface water supplies with other demands met from

other surface water supplies and groundwater. Watershed management performed in the Southern Sierra Region can impact Tule River water quantity and quality.
Kern County IRWMP. The Kern County IRWMP lies to the south of the Southern Sierra IRWMP. The border was negotiated as the Tulare County/Kern County boundary. This boundary is not hydrologically based and, as a result, the Kern River, White River and Poso Creek watersheds fall into two IRWMP areas. Consequently, coordination is very important for comprehensive watershed management in these watersheds.

The group will continue to coordinate with other IRWMP groups to help identify potential inter-regional projects, or projects that involve and cross over two or more IRWMP areas. Inter-regional projects could also involve upstream and downstream interests in a watershed; for example the IRWMP that covers the upper watershed and the IRWMP that covers the downstream valley area that uses most of the water originating in the watershed. Project could include watershed management efforts that increase forest health and reduce fire risk, while at the same time increasing water yield and improving runoff for downstream areas. The Tulare Basin Wildlife Partners is involved with several IRWMP groups, and has begun dialogue between some upstream and downstream IRWMPs to address this issue. Other unifying projects could include responses to a natural disaster, emergency preparedness, catastrophic wildfire management, and restoration. In the past DWR has set aside some IRWMP implementation funding specifically for inter-regional projects.

14.8 - Multi-IRWMP Organizations

The Southern Sierra RWMG also communicates and coordinates with other IRWMP groups through the three multi-IRWMP organizations described below:

Sierra Water Workgroup. The Sierra Water Workgroup was formally organized in 2011 to help coordinate and facilitate the efforts of 11 IRWMP areas in the Sierra Nevada Mountains. Participating groups that neighbor the Southern Sierra RWMG include the Madera IRWMP and Inyo-Mono IRWMP.

Roundtable of Regions. The Roundtable of Regions is an ad-hoc group of representatives from IRWMP regions around the State. The group was formed on the notion that each IRWMP is unique but that all have many of the same interests. The group provides a forum for IRWMP practitioners (people working on IRWM planning and implementation) to discuss their interests, share information, and provide recommendations to the Department of Water Resources on the IRWM grant program. This group holds regular conference calls and occasional face-to-face summits.

Tulare Lake Basin Regional Water Management Group. The Tulare Lake Basin Regional Water Management Group is comprised of several IRWMP groups that coordinate and share information on regional water resources in the Tulare Lake Basin. This area is downstream of the Southern Sierra Region and relies strongly on snowmelt and river flow from the Southern Sierra Region.

14.9 - Coordination with Native American Tribes

The IRWMP area includes three recognized tribes and numerous unrecognized tribes. Coordination with the tribes is important since their rancherias and reservations cover a significant portion of the IRWMP area, they share many common goals with the other stakeholders, and they often bring unique ideas for project development. It should also be noted that historical tribal lands cover an even greater area than existing rancherias and reservations. IRWMP members have attended Sierra Tribal Forum meetings at the National Forest Service office in Clovis to inform tribal representatives of the on-going IRWMP activities. Outreach and communication will continue through focused efforts to encourage membership and participation in the RWMG governance and project development.

14.10 - Coordination with State and Federal Agencies

State Agencies

The California Department of Fish and Wildlife is a MOU signatory and regularly attends RWMG meetings. The RWMG has also worked closely with the Department of Water Resources (DWR) since the group began informal meetings in 2008. The DWR has played an important role in helping the group form, identify funding opportunities, collect data and performed a hydrologic study on the Three Rivers area at the request of the RWMG. The RWMG considers DWR a strong ally and hopes to continue their partnership with DWR as the RWMG matures.

In some cases, State agencies may play roles in providing regulatory approval for a project. This could occur if the project is on State-owned land, or if permits or approvals are required from one or more agencies. The California Department of Fish and Wildlife, Department of Conservation, and State Water Resources Control Board's Regional Water Quality Control Board and Division of Drinking Water all fall into these categories.

Federal Agencies

Five Federal agencies have signed the MOU including Sequoia National Forest, Sierra National Forest, Inyo National Forest, Sequoia and Kings Canyon National Parks, and the Pacific Southwest Research Station. These are important participants since they cover a large portion of the IRWMP area. They have also been active participants at RWMG meetings. The Devils Postpile National Monument is an interested stakeholder and has been encouraged to participate.

In some cases Federal agencies may play roles in providing regulatory approval for a project. This could occur if the project is on Federally-owned land, or if permits or approvals are required from one or more agencies. All of the agencies listed above, in addition to the Environmental Protection Agency, Bureau of Land Management, and United States Army Corps of Engineers fall into these categories.

Chapter 15 - Climate Change

15.1 - Introduction

Climate change is affecting California in many measurable ways; sea levels are rising, days and nights are warmer, snowfall is becoming rain and water temperatures are increasing. All of these changes are impacting our water resources now; continuation of these trends has the potential to significantly impact the sustainability of the State's water supplies, with serious consequences in the State's ability to meet ever-growing demand. Recently, the ability to meet demands has been further hampered by a multi-year drought. In the future, more frequent and more severe droughts are being predicted. In addition, climate projections point to continued increases in storm intensities.

> Climate change is a long-term alteration in global weather patterns such as precipitation, temperature, wind, and severe weather events. Climate change can occur from both natural causes (e.g. influences from the Earth's natural orbital cycle) and anthropogenic causes (resulting from the influence of human beings on nature). Greenhouse gas concentrations, including methane and carbon dioxide cause warming. Anthropogenic release of these gases interacts with natural drivers of climate change.

Further climate changes are projected to generate water resources vulnerabilities in the Southern Sierra Nevada. These vulnerabilities are discussed in detail later in this chapter in Sections 15.3 and 15.4. Generally speaking, however, increases in temperatures will affect the timing and amount of runoff, thereby affecting timing and quantity of water availability for storage and human consumption. In addition, water quality is vulnerable to increased potential for more frequent and longer duration droughts, severe storms, wildfires and lower late summer flows.

The California Department of Water Resources (DWR) recognizes that climate-change projections have some uncertainty, and thus use a range of projections from different climate models to inform scenarios for future planning (*CalEPA*, 2015). While DWR requires that planning for a changing climate be acknowledged and incorporated to the greatest degree possible into Integrated Regional Water Management Plans, it is also responsible and prudent resource management to use the best available information to guide local and regional planning, even if that goes beyond the minimum requirements of DWR. Further, due to the acknowledged range in temperature and precipitation projections, water managers should acknowledge the range of projected future conditions rather than just the mean, and include uncertainties in the water planning process, including regulatory, environmental, economic, social and other conditions affecting water-related institutions, infrastructure and services. Paleoclimatic evidence, such as ice cores, lake varves (layers of sediment), and tree rings show a correlation between greenhouse gas concentrations and global temperatures (Ruddiman, 2002). For nearly 30 years there has been scientific concensus that climate change is occurring and that human-caused emissions of heat-trapping gases are the primary causes (Houghton et al. 1990). Two climate extremes, droughts and floods, are of particular interest to California water managers and water users. While California has experienced multi-year droughts in the past century, including a 5-year drought from 2012-2016, the paleoclimate record shows evidence of multiple droughts of this duration per century-decadal droughts during the past millennium (Meko et al., 2014). While multi-year droughts are recurring and natural events, climate warming increases their severity and impact on the southern Sierra (Bales et al., 2018).

The extent and range of climate-change impacts in the Southern Sierra IRWM area include variable (more and less) precipitation patterns and river flows, rising temperatures, and earlier or faster snowmelt. California is expected to experience dramatically warmer temperatures during this century, ranging from 2.0 to 2.9°C (3.6 to 5.2°F) by mid-century and 2.4 to 4.6°C (4.3 to 8.3°F) by the end of the century (He et al., 2018). Climate-change impacts projected to affect the Southern Sierra Region, associated with these magnitudes of warming, include: i) more critically dry periods, including multi-year droughts, ii) increasing demand from a growing population as temperatures rise, iii) earlier snowmelt and runoff, and iv) increased competition for water among urban and agricultural water users and environmental needs. These impacts are exacerbated by overpumping of groundwater, which is addressed through the Sustainable Groundwater Management Act, and by increasing wildfire intensity. Climate projections provide a range for future increases in temperature, and even the lowest estimates would have serious impacts.

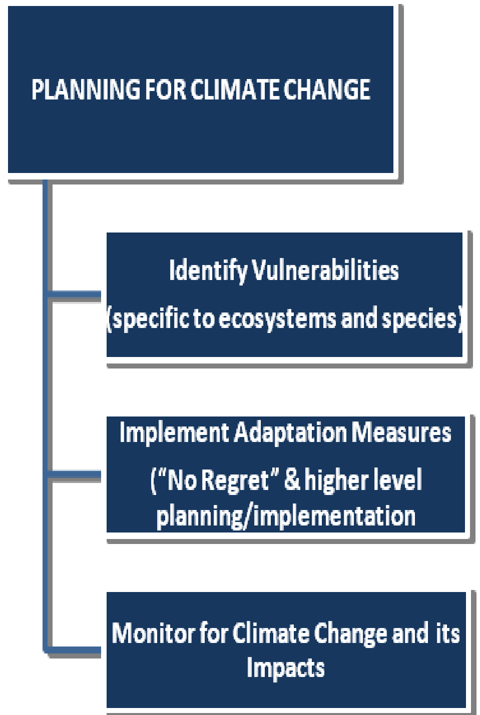


Figure 15-1 General Strategy to Plan for Climate Change in Southern Sierra IRWMP

Specific topics addressed in this chapter include:

- Key climate change literature sources,
- General impacts from climate change,
- A vulnerability assessment for the Southern Sierra IRWM area using the Vulnerability Assessment forms from the DWR *Climate Change Handbook*
- Vulnerability assessment and adaptation & mitigation strategies for the Southern Sierra Region
- Climate change monitoring
- Consideration of greenhouse gas emissions in the project review process
- Climate Change in other IRWMP Chapters

15.2 - Literature Sources

Numerous documents were used to evaluate climate change in the Southern Sierra IRWM area. Published government reports included the *Climate Change Handbook for Regional Water Planning*, (DWR and EPA, 2011). This handbook is the most recent and most practical climate change document published by the DWR, and provides numerous tools for addressing climate change. This document is not required for preparing IRWMPs; however, DWR does recommend its use. Other reports include the *Perspectives and Guidance for Climate Change Analysis*, also published by DWR.

Understanding of the effects of climate change on watershed hydrology in the Sierra Nevada has been rapidly increasing, particularly in regards to the interaction effects with vegetation. Consequently, a heavy emphasis was placed on the recent scientific literature. Other climate change references included California Natural Resources Agency (2009), California State University at Fresno (2008), Conrad (2012), ClimateWise (2010), DWR (October 2008), Institute (2014), California Resources Agency (2008) workshop; final report and presentations (hosted on http://climate.calcommons.org/).

Some local water and land use documents address climate change, including the Fresno and Tulare County General Plans. To the extent that they are enumerated, the climate change goals and policies in these documents are generally consistent with this IRWMP. Typical climate change mitigation measures include energy efficiency requirements at new developments, compact urban development and promoting development of renewable energy. Climate change is missing from many older planning documents; however, it is being addressed in most new planning efforts.

15.3 - Impacts from Climate Change

Introduction

An increase in global atmospheric greenhouse gas concentrations is contributing to higher temperatures in California (Office of Environmental Health Hazard Assessment, 2018). As greenhouse gas concentrations continue to rise, further changes to California's climate are anticipated, with additional effects on California water resources, ecosystems, and economy. The extent of these effects will depend on the ultimate level and timing of peak greenhouse gas concentrations, i.e. the extent to which the global community reduces greenhouse-gase emissions to the atmosphere and removes previously emitted greenhouse gases from the atmosphere. Under the Paris Climate Accord in 2015, a framework was established for limiting the rise in global temperatures under two degrees Celsius. In California, policies have been put in place to reduce greenhouse gas emissions to at least 40% and 80% below 1990 levels by 2030 and 2050, respectively (California Air Resources Board, 2017). These policies will help to moderate increases in temperature but uncertainty remains regarding how high greenhouse gas concentrations will be in the future.

Global climate models (GCMs) are mechanistic models used to understand and predict how changes in variables such as greenhouse gas concentrations will affect future climate at global scales. GCMs are developed and maintained by numerous research groups around the world, with each group using a slightly different approach to modeling the underlying atmospheric physics. The 5th Coupled Model Intercomparison Project (CMIP5) is a coordinated experiment to simulate each GCM using the same forcing inputs (i.e. greenhouse gas concentrations). This project permits the comparison of output between different GCMs, providing an estimate of the uncertainty in climate projections. As future concentrations are unknown, CMIP5 uses four different scenarios, or Representative Concentration Pathways (RCPs), to force the models (van Vuuren et al., 2011). The four RCPs, RCP2.6, RCP4.5, RCP6.0, and RCP8.5, represent different levels of greenhouse gas emissions and accumulated concentrations in the atmosphere. The four pathways roughly equate to aggressive, moderate, little and no action being taken to reduce greenhouse gas emissions, respectively.

Spatial output from individual GCMs is generally greater than 100km by 100km, limiting our ability to directly apply GCM results to heterogeneous areas such as the Southern Sierra Region, which is topographically, climatically, ecologically and hydrologically variable. To address this, output from GCMs are downscaled, or transformed to a higher resolution, in order to be analyzed at a regional scale. Two commonly used approaches for downscaling are dynamic and statistical. Dynamic downscaling involves running high-resolution, regional mechanistic models using low resolution GCM output as the driving data. Alternatively, statistical downscaling consists of developing statistical relationships between local-scale climate variables and large-scale climate variables that can be modeled by GCMs (Abatzoglou and Brown, 2012).

In this section, we review of what is known about climate change impacts on California and the Sierra Nevada. In addition, we incorporate new understanding about the how projected changes will affect the Southern Sierra Region by including key findings from a climate change report, *Evaluating Climate Change Effects on the Hydrology of Southern Sierra Nevada Basins*, which was produced by the Sierra Nevada Research Institute (SNRI) at the University of California, Merced with funding provided by the IRWM (Bart et al., 2018). This study was conducted to improve understanding of the effects of climate change on the Southern Sierra Region by investigating 1) how the climate in the Southern Sierra Region will change throughout the 21st century, 2) how these changes in climate will directly impact hydrology in the Region, and 3) how changes in climate will alter vegetation and vegetation disturbances in the Region which will have further effects on the Region's hydrology. The full report can be found in **Appendix M**. All figures in this section and all results referring specifically to the Southern Sierra Region are derived from the report.

Temperatures

Temperatures throughout California and the Sierra Nevada are increasing. Over the period from 1918 to 2006, maximum and minimum temperatures in California rose an average of 0.07°C and 0.17°C per decade, respectively (Cordero et al., 2011). These trends have accelerated since 1970 (Cordero et al., 2011) and particularly during the past decade, with the four hottest years on record occurring between 2014-2017 (Office of Environmental Health Hazard Assessment, 2018). These increases in temperature are consistent with climate projections and indicate that California is already seeing the effects of climate change. In the Sierra Nevada, significant warming has also been observed, although the increases have been smaller than for California as a whole (0.08 and 0.21°C per decade for maximum and minimum temperatures, respectively) (Cordero et al., 2011). For both the Sierra Nevada and California, nighttime temperatures have been rising faster than daytime temperatures.

California temperatures are projected to continue to increase during the 21st century. Using downscaled CMIP5 GCM projections, He et al. (2018) estimated that California temperatures would increase between 1.8 and 2.0°C by mid-century and 2.2 to 2.4°C by the end of the century, even under the optimistic RCP4.5 scenario. Slightly higher estimates are projected for the Southern Sierra Region. For RCP4.5, mean annual maximum temperatures are projected to increase 2.5°C by mid-century (2040-2069) and 3.3°C by the end of the century (2070-2099) (Figure 15-2). Under the RCP8.5, temperatures are projected to increase 3.4°C and 5.2°C, respectively, over the same time periods. Mean annual minimum temperatures in the Southern Sierra Region are projected to increase 2.3°C (2040-2069) and 2.9°C (2070-2099) under the RCP4.5 scenario and 3.1°C (2040-2069) and 5.0°C (2070-2099) under RCP8.5. All of these finding indicate that temperatures in the Southern Sierra Region are going to substantially increase in the future. Further, projections indicate that maximum temperatures will increase more than minimum temperatures. These changes run counter to currently observed temperature increases in California, where minimum temperatures are increasing faster than maximum temperatures. However, He et al. (2018) has reported similar findings throughout California.

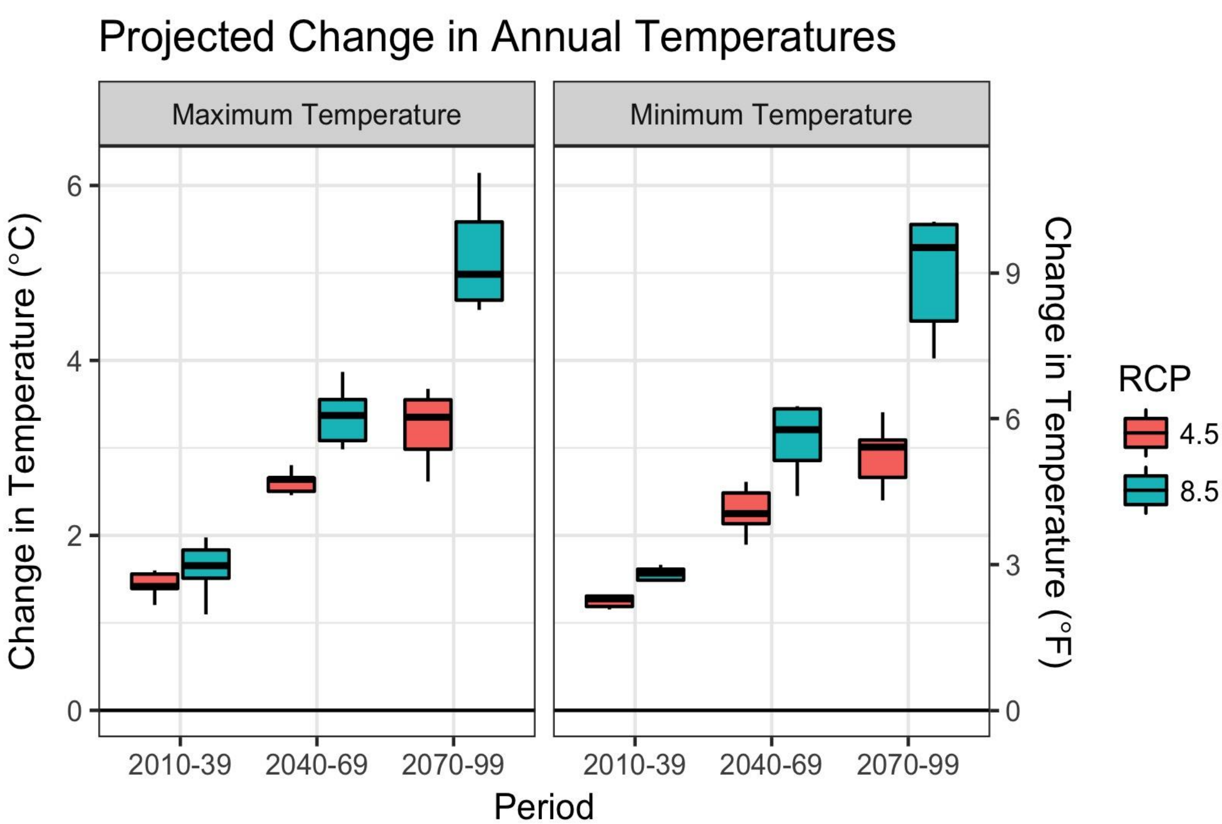


Figure 15-2 Projected changes in mean annual temperatures for the Southern Sierra Region, relative to 1950-2005 baseline. Variability in projections represents different GCMs. Historical baseline values of maximum and minimum mean annual temperatures are 15.4°C and 2.2°C, respectively

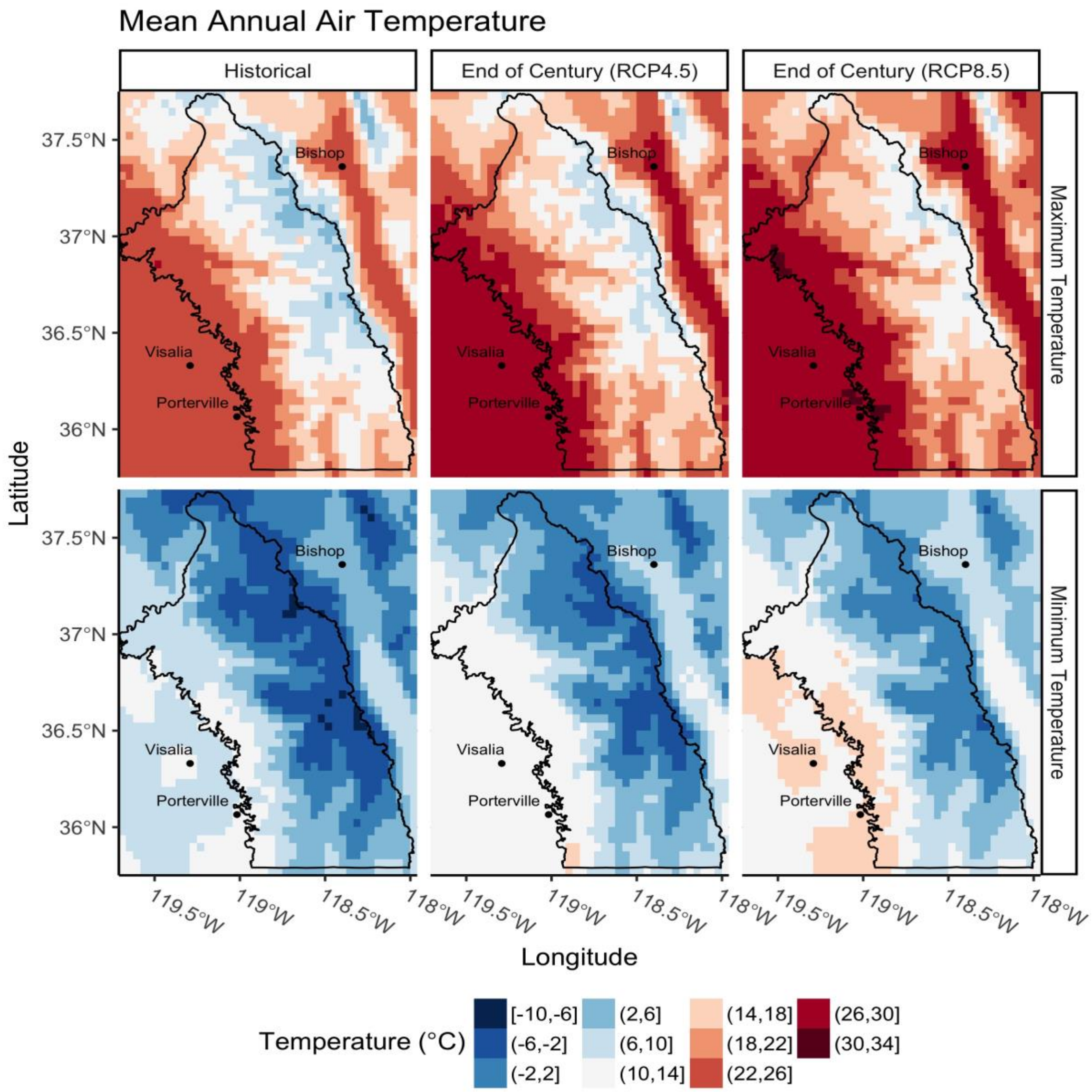


Figure 15-3 Map of mean annual maximum and minimum temperatures under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

Projected increases in temperatures are expected to vary seasonally in the Southern Sierra Region. Increases in winter (Jan-Feb-Mar) maximum temperatures are projected to be slightly smaller than seasonal maximum temperatures during the remainder of the year (Figure 15-4). While winter maximum temperatures will still be well above historical baseline levels, the relatively smaller increases may aid in snowpack accumulation. However, this will be counterbalanced by relatively larger increases in maximum temperatures during the non-winter months, which will increase evaporative demand, decrease soil moisture and increase forest water stress. For seasonal minimum temperatures, the summer (Jul-Aug-Sep) season is projected to show the largest relative increase in temperature (Figure 15-5).

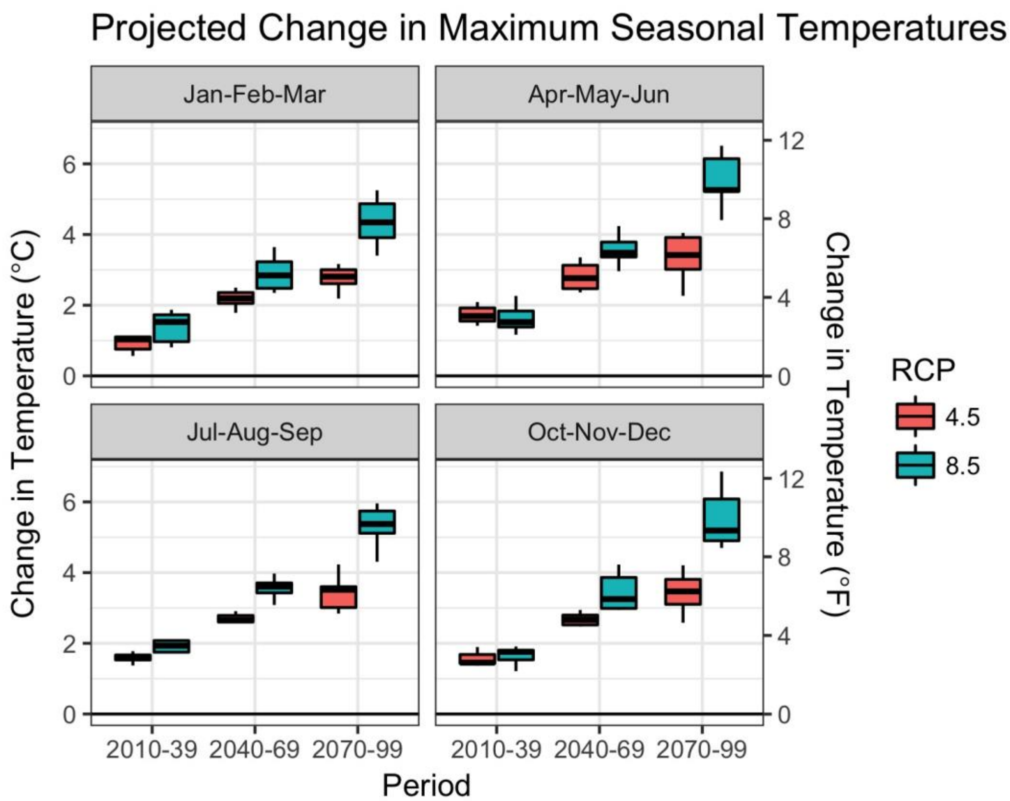


Figure 15-4 Projected changes in maximum mean seasonal temperatures for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline values of maximum mean seasonal temperatures are 8.3°C, 17.4°C, 24.4°C and 11.5°C for Jan-Feb-Mar, Apr-May-Jun, Jul-Aug-Sep, and Oct-Nov-Dec, respectively.

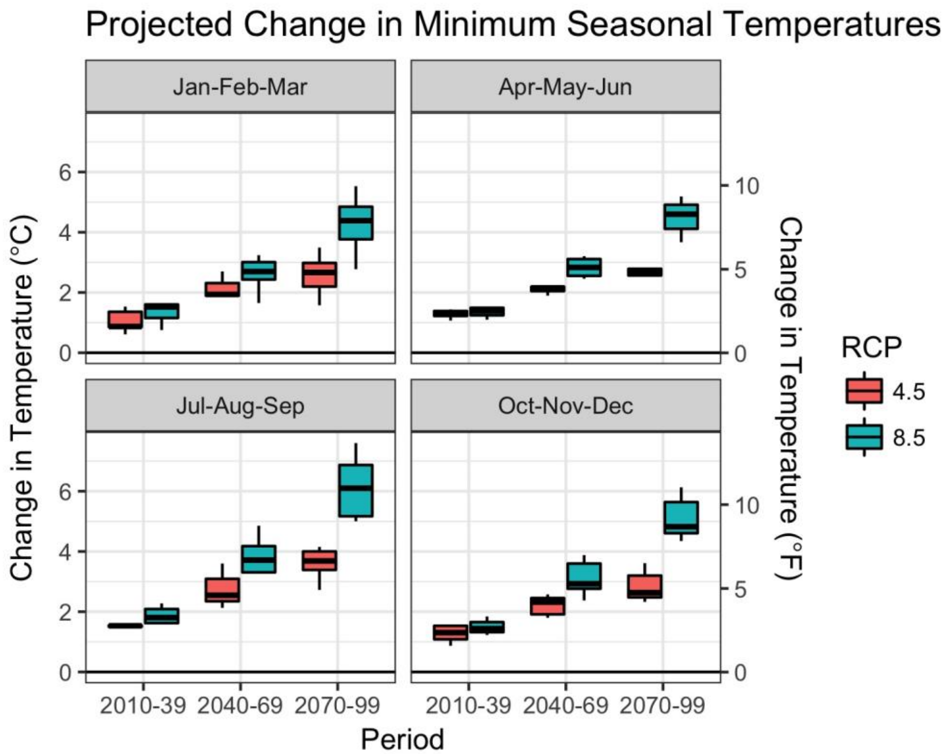


Figure 15-5 Projected changes in minimum mean seasonal temperatures for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline values of minimum mean seasonal temperatures are -3.6°C, 3.5°C, 9.6°C and -0.7°C for Jan-Feb-Mar, Apr-May-Jun, Jul-Aug-Sep, and Oct-Nov-Dec, respectively.

The frequency of heat waves, which are defined as when daily maximum and minimum temperatures exceed a respective percentile threshold, are projected to increase in California (Diffenbaugh and Ashfaq, 2010; Gershunov and Guirguis, 2012). Gershunov and Guirguis (2012) found that both humid nighttime heat waves and dry daytime heat waves will increase with climate change in California, though they note the former is expected to increase more intensely. Extreme heat waves are well-documented to have an adverse affect on ecosystems, agriculture and human health (Meehl and Tebaldi, 2004). It will be important for communities within the Southern Sierra Region to take precautions to protect vulnerable populations during extreme heat waves (Guirguis et al., 2013).

Increases in temperature are a primary driver behind many of the other climate change related effects that are documented in the remainder of this section. For example, changes in snowpack, streamflow timing, forest vulnerability, wildfire, and bark beetles are each influenced by increases in temperature. Hence, temperature can be considered a key metric for accurately predicting how climate change will affect the Southern Sierra Region.

Precipitation

Precipitation in California exhibits Mediterranean-climate characteristics, with most precipitation falling during the winter season (November to March) while the remainder of the year is dry. Precipitation in California is also highly variable, with inter-annual variability being the highest in the U.S and annual precipitation totals varying by up to an order of magnitude (Dettinger et al., 2011). This variability is partly due to atmospheric rivers constituting a substantial fraction (20% to 50%) of the total annual precipitation in California (Dettinger et al., 2011). Since California receives relatively few atmospheric river events in a given year, a swing of a few more or less storms during a wet season can produce large differences in total precipitation.

Downscaled GCM climate projections for California have generally indicated minimal changes in annual precipitation under future warming scenarios (Hayhoe et al., 2004). For the recent CMIP5 GCM projections, He et al. (2018) found that projected annual precipitation ranged from +50% to -25% depending on the individual GCM/scenario investigated (He et al., 2018). Collectively however, the models showed small increases in precipitation (1% - 11%) across different regions of California under the RCP4.5 scenario. Similar changes in precipitation are projected for the Southern Sierra Region. The average increase in annual precipitation among all the downscaled models was 5%-10% for the Southern Sierra Region, although the variability in the projections encompasses both positive and negative changes in annual precipitation (Figure 15-6 and 15-7).

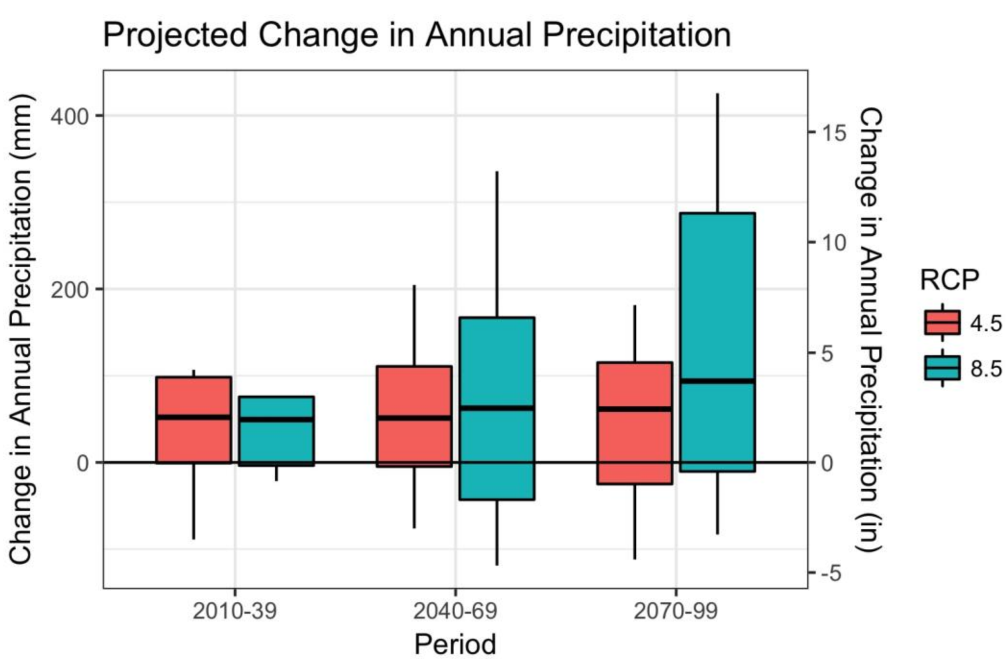


Figure 15-6 Projected changes in annual precipitation for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline annual precipitation is 819 mm/year (32 in/year).

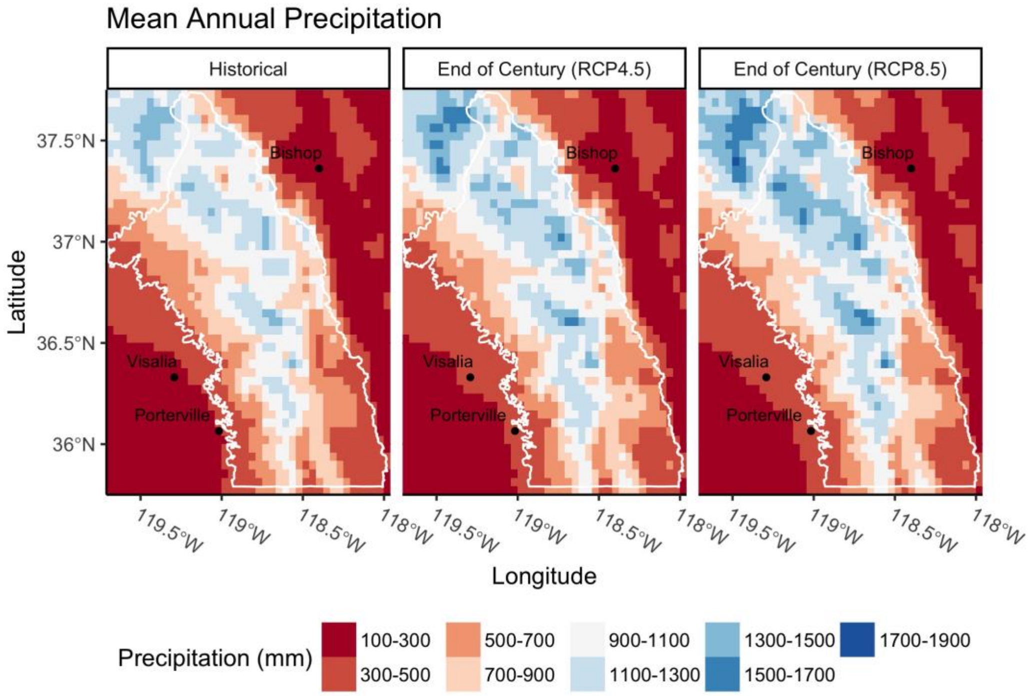


Figure 15-7 Map of mean annual precipitation under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

Although the average amount of precipitation in the Southern Sierra Region is projected to only slightly increase with climate change, there is mounting evidence that inter-annual variability of precipitation will substantially increase, with dry years becoming drier and wet years becoming wetter (Pendergrass et al., 2017). Berg and Hall (2015) have reported that by the end of the century, extremely dry years will become 1.5 - 2 times more frequent and extremely wet years will become 3 times more frequent, with the number of average years becoming more scarce. Climate change will also increase year-to-year volatility swings. Swain et al. (2018) report that transitions from extreme drought to extremely wet conditions, such as was observed from the 2012-2016 drought to the wet 2016/2017 winter, is projected to increase 25% to 100% by the end of the century.

This increase in precipitation extremes will make management of water resources in the Southern Sierra Region more challenging. Excess precipitation during wet years frequently cannot be stored in reservoirs due to flood risks. Flood risks in the Southern Sierra Region are also increasing due to precipitation shifts from snow to rain. An increase in extremely wet years will only exacerbate this problem. On the other hand, a greater number of very dry years will stretch water supplies in the Southern Sierra Region and the San Joaquin Valley as a whole.

Drought

Due to high precipitation variability, California has always been subject to multi-year droughts, where precipitation totals fall well below normal. However, the recent multi-year drought and projected future droughts are different because periods of low precipitation are more likely to coincide with periods of high temperatures, increasing atmospheric water demands and making conditions drier. It was this combination, very little precipitation and record high temperatures, that contributed to the severity of the California drought (Shukla et al., 2015). As temperatures continue to rise, drought risk is predicted to become even more severe in the future even in the absence of precipitation change (Cook et al., 2015).

For the Southern Sierra Region, the magnitude of droughts under climate change will depend on how dry conditions are, how warm conditions are, and over how many years these conditions persist. In a recent study, He et al. (2018) used a drought index, the Standardized Precipitation-Evapotranspiration Index (SPEI), to investigate changes in future drought severity in California. They found that in the Tulare region of California, which encompassed most of the Southern Sierra Region, that the severity of droughts would increase throughout the century, indicating that small increases in precipitation for the region would not offset the effects of higher temperatures.

Snowpack

Snowpack in the Southern Sierra Region is being affected in numerous ways as temperatures increase in California. Foremost, a larger proportion of precipitation is falling as rain than as snow. This effect is most pronounced near the rain-snow transition zone, as this zone is particularly sensitive to temperature changes since winter temperatures hover near the freezing point. Increasing temperatures cause the rain-snow transition zone to migrate upslope and produce a smaller snow footprint. Throughout the western U.S., the areal extent of historical snowfall area is expected to decrease by an average of 30% under RCP8.5 scenarios (Klos et al., 2014). For the Southern Sierra Region, the amount of area that is predominately snowfall-driven, defined as locations where the probability of snowfall compared to rainfall is greater than 90%, is projected to decrease by approximately 50% by the mid 21st century under a RCP 8.5 scenario (Figure 15-8).

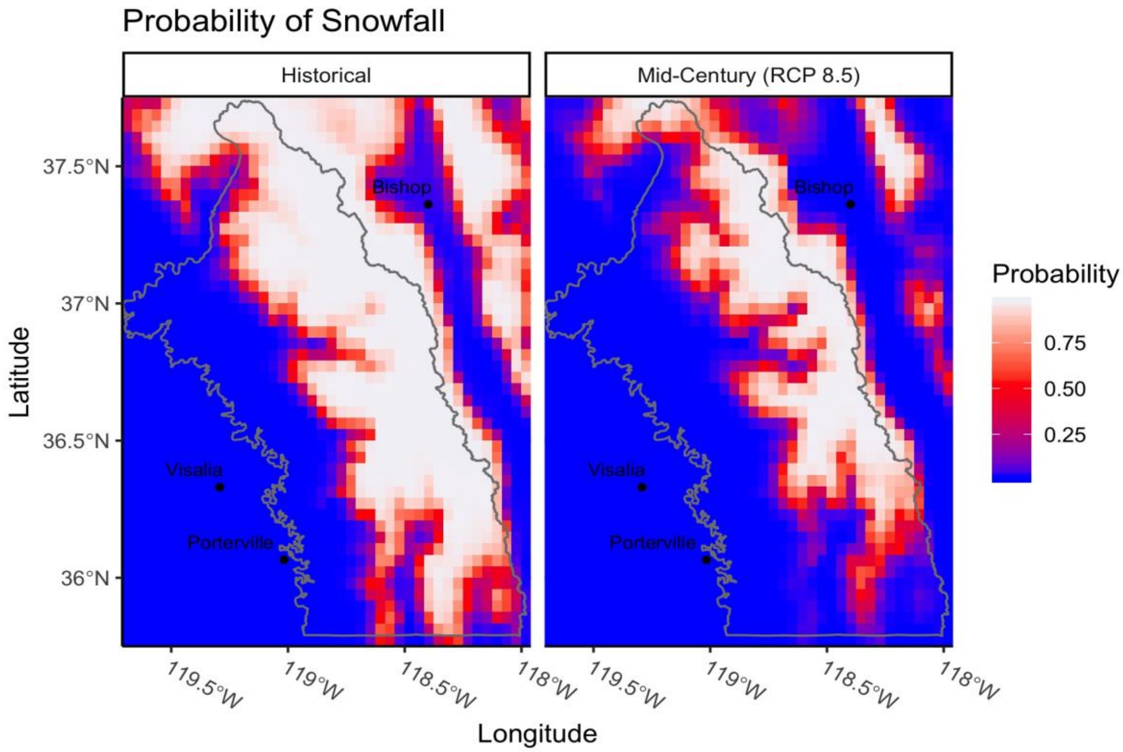


Figure 15-8 Map of the probability of snowfall compared to rainfall for the Southern Sierra Region under two scenarios: Historical (1979-2012) and Mid-Century (2035-2065) RCP8.5 using a 20-model GCM mean. Blue indicates areas of predominately rainfall, white is predominately snowfall and red is the rain-snow transition zone. Data from Klos et al. (2014).

Winter snowpack will persist for a shorter period of time with climate change. This is partly due to less snow accumulation and partly due to more rapid snowmelt. Projections for the western U.S. suggest that the snow-covered period may decrease by 25 days/year by the mid-century under RCP8.5 (Naz et al., 2016). A more transient snowpack will also have implications for the measurement of snow water equivalent (SWE) on April 1st, the traditional date when the snowpack is measured for forecasting spring streamflow. Naz et al. (2016) project that April 1 SWE may decrease by 50% by mid-century across the western U.S. (RCP8.5). Further, a study by Young et al. (2009) found that the greatest reduction in snowpack would be at mid-elevations between 1750-2750m.

To understand how climate change will alter snowpack and streamflow in the Southern Sierra Region, downscaled temperature and precipitation projections for the Kings River watershed, a major river in the central part of the Southern Sierra Region, were used as inputs into the Variable Infiltration Capacity (VIC) hydrologic model. Results from the VIC model indicate that for the Kings River watershed, snowpack is projected to decrease during all months, with the greatest decreases being observed during the early spring months (e.g. March, April, May) (Figure 15-9). These changes will have considerable implications for water resources. In the Southern Sierra Region, snowpack accumulation during the winter wet season acts as a water reservoir that is slowly released as temperatures warm throughout the spring and summer. Reductions in this reservoir will complicate water resource management in the Region and will likely necessitate that alternative storage solutions be found such as groundwater banking.

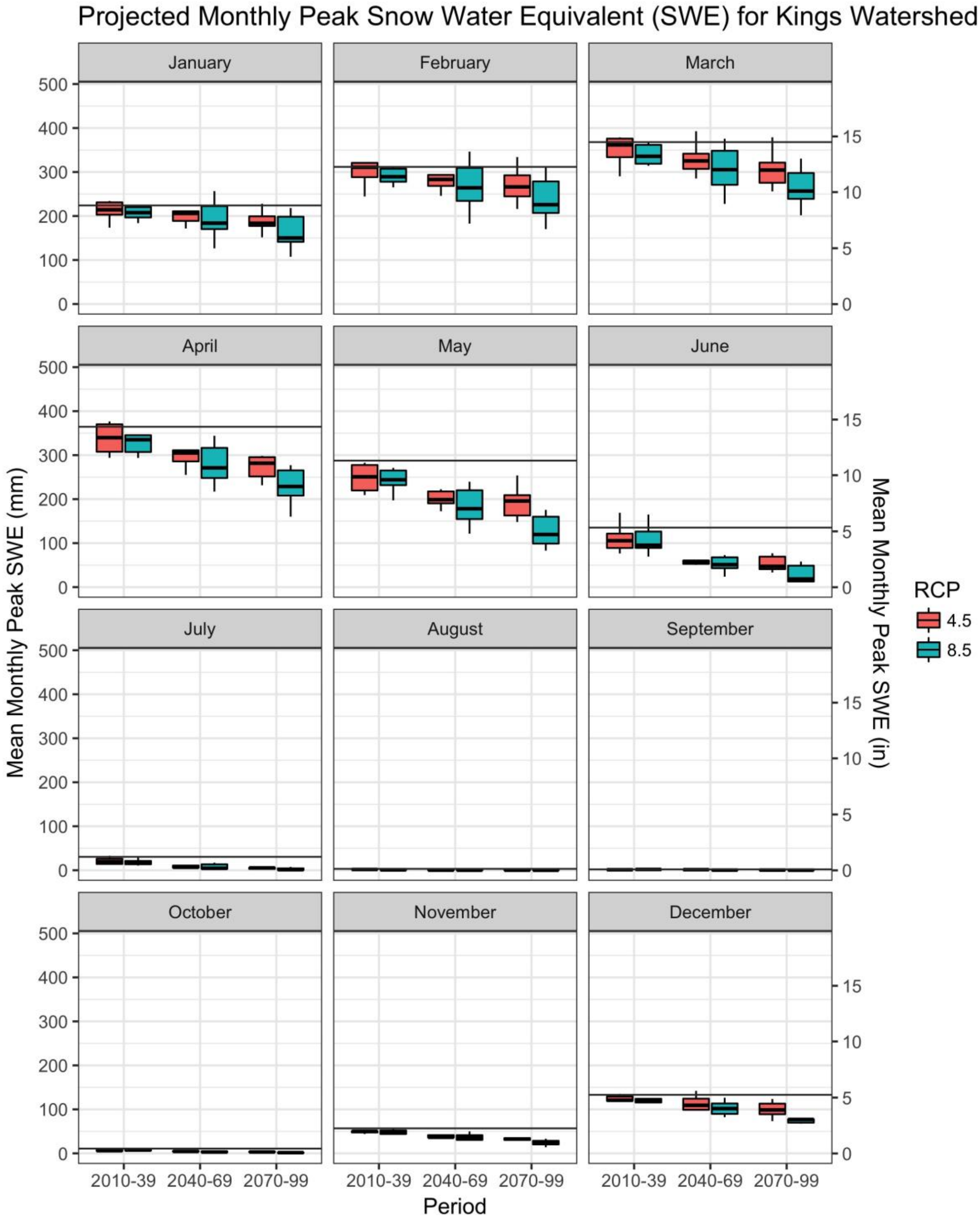


Figure 15-9 Projected changes in mean monthly peak snow water equivalent (SWE) for the Kings River Watershed in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey lines represent historical mean monthly peak SWE.

Streamflow

Climate change is already affecting both the timing and total amount of streamflow that feeds downstream reservoirs in the Sierra Nevada and this effect is expected to grow as temperatures continue to rise (Vicuna and Dracup, 2007). Reductions in snowpack and higher temperatures will shift streamflow to the winter months, leaving less water available for spring and summer flows when water resource demands are greatest. Less streamflow during the summer months will also worsen water quality, as many quality issues are flow dependent. Combined, these issues will likely strain the existing 20th century water resource infrastructure that is not equipped to handle a 21st century streamflow regime.

For the Kings River in the Southern Sierra Region, total mean annual streamflow is not expected to change substantially under future climate change (Figure 15-10). The range of streamflow change projections for the six GCMs used in the analysis includes both small increases and decreases in annual streamflow, with the median estimate being slightly positive. Nevertheless, while total annual streamflow is not projected to change substantially, changes in snowpack accumulation will have a major effect on the timing of streamflow.

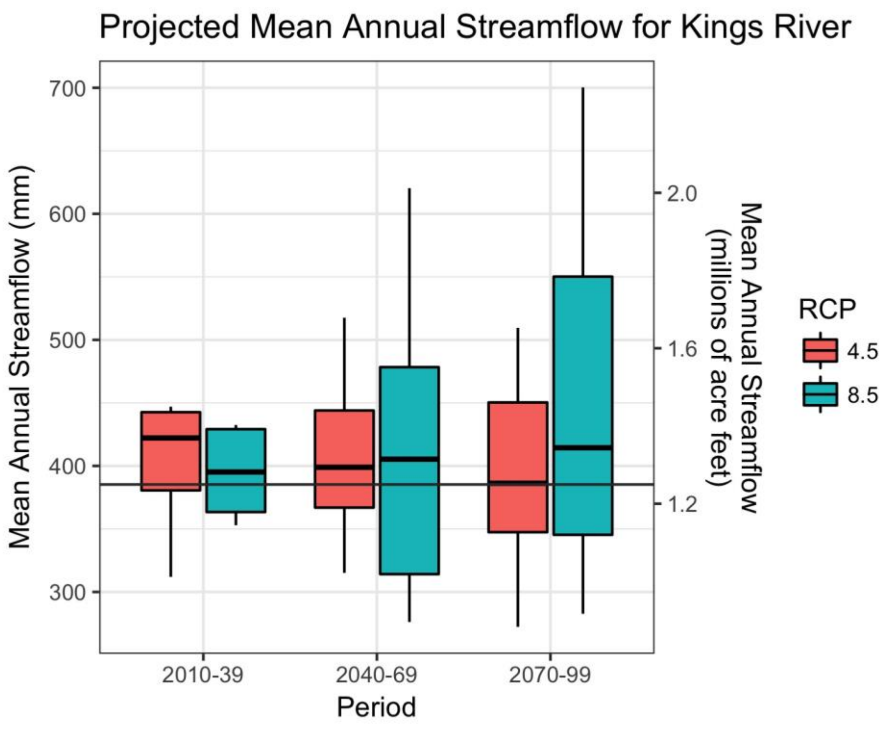


Figure 15-10 Projected changes in mean annual streamflow for the Kings River in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey line represents historical mean annual streamflow.

Precipitation in the Southern Sierra Region is a mix of rain at lower elevations and snow at higher elevations. Streamflow generation from rainfall occurs relatively quickly, with streamflow often peaking within hours/days of a rainfall event. Streamflow generation from snowpack, on the other hand, is delayed and depends on subsequent changes in energy inputs (e.g. temperature, radiation) to melt the snowpack. Since most precipitation in the Southern Sierra Region occurs during the winter and since the Southern Sierra Region is characterized by very high elevations, streamflow generation from snowpack has historically been the dominant control on streamflow. However, as rising temperatures shift the rain-snow transition zone to higher elevations, a higher fraction of streamflow will be generated from rainfall, increasing streamflow during the wet winter months. Across the western U.S, Li et al. (2017) has estimated that the contribution of streamflow originating from snowpack by the end of the century will decrease by one third under an RCP8.5 scenario. This earlier shift in the timing of streamflow has already been shown to be impacting streamflow. Stewart et al. (2005) demonstrated that across Western North America, streamflow timing has shifted 1 to 4 weeks earlier since the mid-20th century. This trend will continue as temperatures continue to rise. Schwartz et al. (2017) project that by the end of the century, streamflow may shift up to 80 days earlier under an RCP8.5 scenario and up to 30 days earlier under an RCP4.5 scenario.

For the Kings River Basin, the effect of projected higher temperatures on streamflow timing can be illustrated by comparing projected changes in monthly streamflow (Figure 15-11). Under both RCP 4.5 and RCP 8.5 scenarios, monthly streamflow increases during the winter and early spring (January through May) due to less snowpack accumulation. Peak runoff, which has historically occurred during June, will shift to May with climate change and streamflow during the months of June and July will decrease. Other watersheds within the Southern Sierra Region are likely to show a similar pattern of streamflow change as the Kings River, although the magnitude of change may differ due to differences in watershed characteristics.

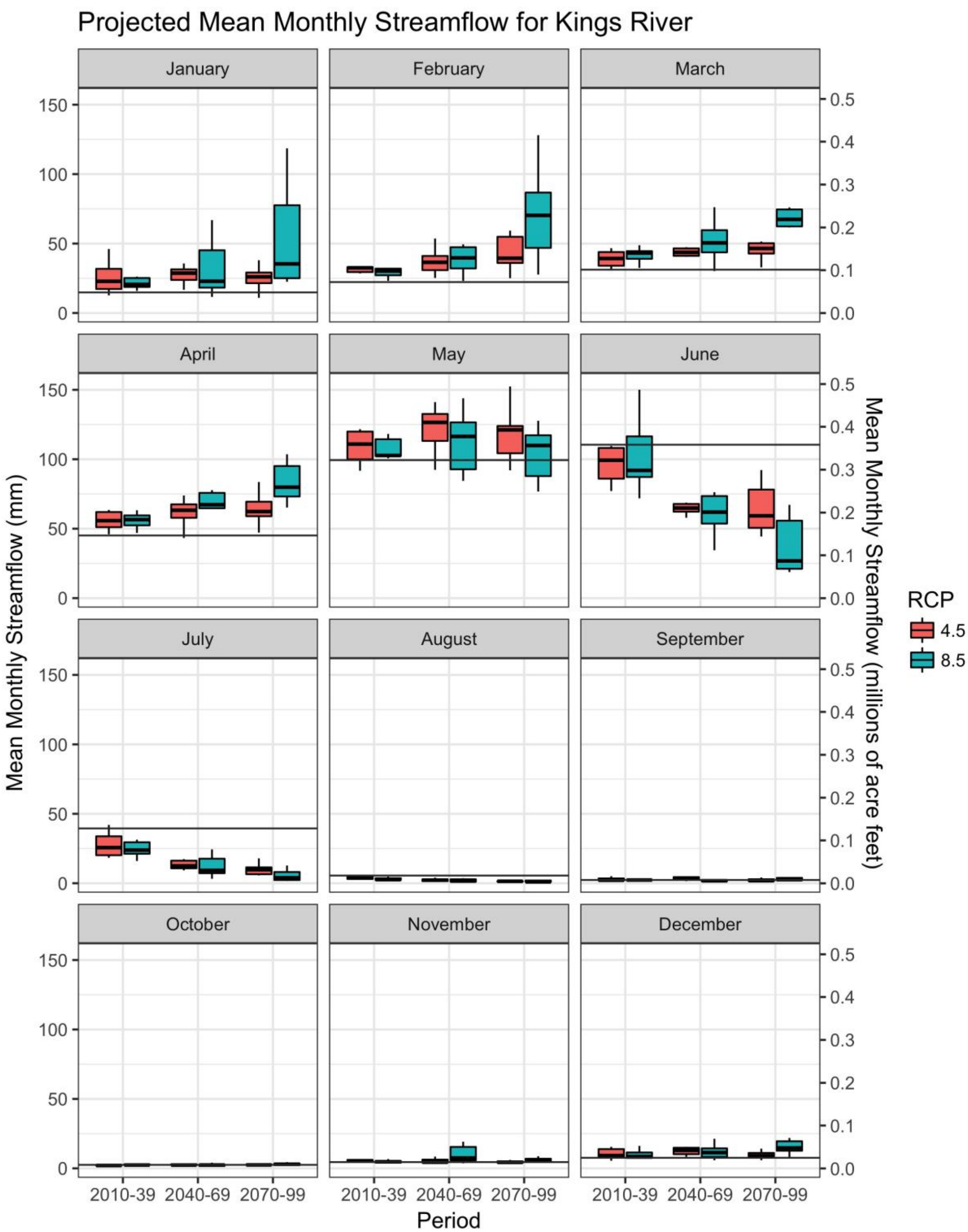


Figure 15-11 Projected mean monthly streamflow for the Kings River in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey lines represent historical mean monthly streamflow.

A shift towards greater winter streamflow will increase the risk of floods within and downstream of the Southern Sierra Region. Das et al. (2013) found that by the end of the 21st century, streamflow flood events with 50-year return periods in the southern Sierra

Nevada would increase by 50% to 100%. These increases were attributed in part due to warm storms that produce rainfall at higher elevations, but also in part to an increase in the size and frequency of large storms events (Das et al., 2011). Many of the largest floods in the Sierra Nevada are associated with rain-on-snow events, when high snowlines cause rain to fall on previously established snowpack and streamflow contributions include both rain and melted snow. Rain-on-snow events are disproportionately associated with warm atmospheric rivers (Guan et al., 2016) and atmospheric rivers are projected to become more frequent and more severe under climate change (Dettinger, 2011; Hagos et al., 2016).

Increased flood risk will introduce additional constraints on the operation of major water supply/flood-protection reservoirs downstream of the Southern Sierra Region. To minimize flooding in the San Joaquin Valley during the winter months, reservoirs are required to draw down water levels to provide space to accommodate large runoff events, such as those associated with atmospheric rivers. As the risk of larger winter runoff events increases with climate change, the rules governing reservoir flood space may need to be revised to allow for more space, as the current rules reflect historical streamflow regimes, not future ones (Brekke et al., 2009). This would reduce the amount of water that can be stored during the winter season. In the spring, snowmelt has historically been used to fill the reservoirs. However, the reliability of snowmelt being sufficient to fill the flood reserve space in reservoirs is decreasing as the Sierra snowpack is diminished. These issues with surface storage suggest that alternative methods for storing water may need to be pursued in the Tulare/San Joaquin basins, including groundwater recharge. Changes in reservoir operations may also impact hydropower generation, which will affect energy production in California.

With more winter streamflow projected under climate change, a corresponding decrease in summer flows is also projected. These flows, which occur when seasonal temperatures are highest and water demand is greatest, are important for both riparian ecosystems and water management. In the Sierra Nevada, Godsey et al. (2014) found that for every 10% decrease in snowpack, annual minimal flows may decrease by 1% to 22%, depending on the watershed. An additional concern is that the length of the low flow season will be extended under climate change, further stressing aquatic ecosystems in the Southern Sierra Region.

<u>Water Quality</u>

Climate change will impact water quality in the Southern Sierra Region by altering stream temperatures and sediment loads. Stream temperature is a key regulator of riparian ecosystems and higher water temperatures frequently have an adverse affect on native species, affecting species distributions, growth rates and reproduction (Isaak et al., 2017). Stream temperature has been found to be sensitive to rising temperatures. Ficklin et al. (2013) projected that, depending on the watershed, spring and summer stream temperatures in the Sierra Nevada will increase between 1.0 and 5.5°C by the end of the century under a high greenhouse gas scenario. Isaak et al. (2017) found that August stream temperatures in Central California will increase by about 1.0°C by the end of the century. Using the same dataset generated by Isaak et al. (2017), August stream temperatures for the Southern Sierra Region are projected to increase from 0.3°C to 1.6°C, with an average change of 0.9°C (Figure 15-12). In each of these studies, lower elevation streams showed a greater increase in temperature than higher elevation streams.

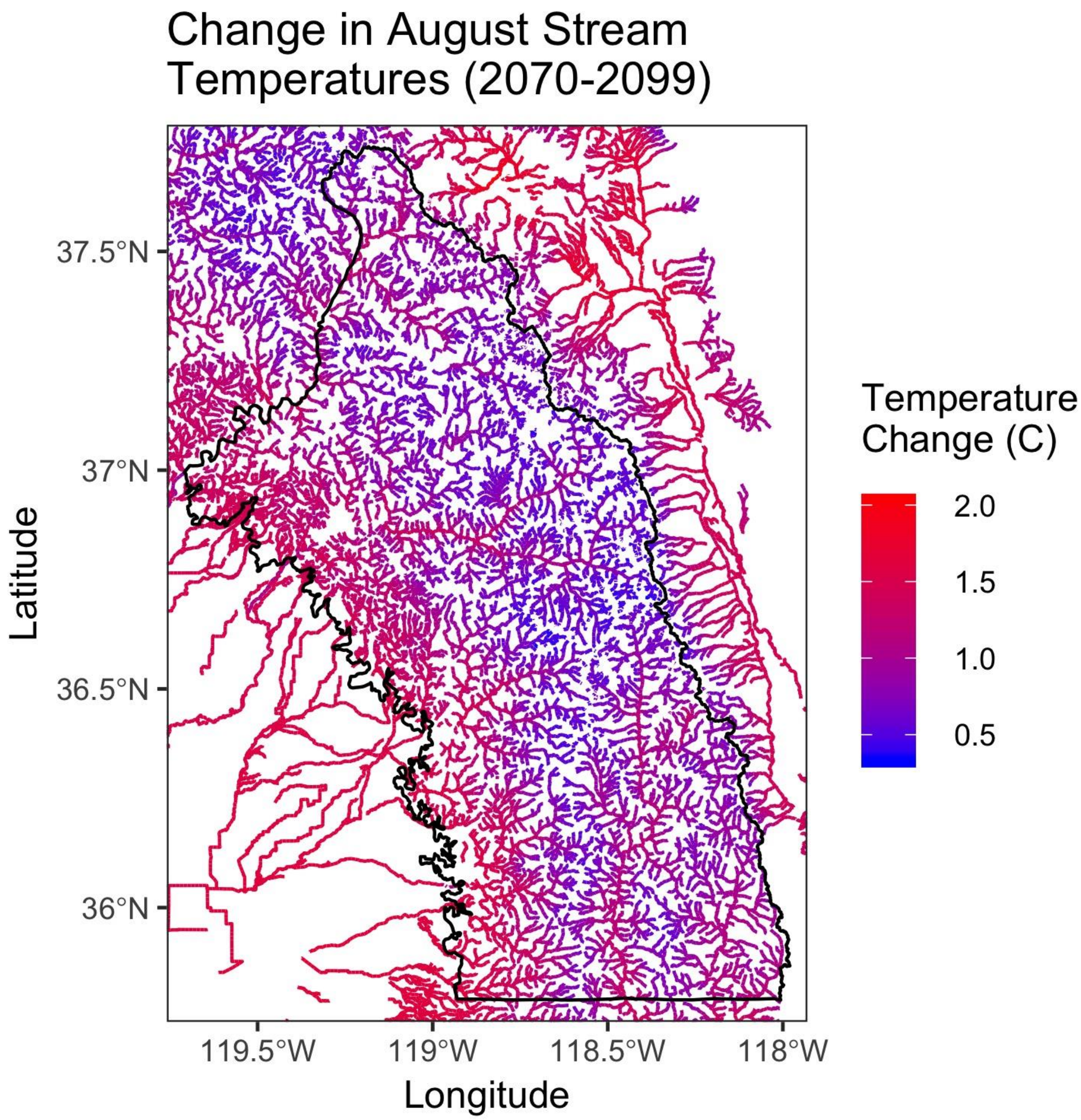


Figure 15-12 Projected change in August stream temperatures in the Southern Sierra Region for the period 2070 to 2099. Data from Isaak et al. (2017).

Changes in land cover and streamflow regimes may alter stream sediment load in the Southern Sierra Region. Due to granitic substrate, many rivers in the Southern Sierra Region are sediment limited (Riebe et al., 2001). However, an increase in winter flows has the potential to increase sediment erosion and transportation. During the spring and summer seasons, Ficklin et al. (2013) reported that sediment concentrations in Sierra Nevada steams should decrease under future climate change scenarios. However, the effect on sediment loads during the winter season remains unclear and points to the need for further research. The trend of increasing wildfire in a warmer climate is a special concern for sediment.

Vegetation Transformation

Vegetation affects watershed hydrology in the Southern Sierra Region through processes such as canopy interception and transpiration, which influences how much water is available for streams or groundwater recharge. Vegetation water use differs by vegetation type (e.g. forests, shrubs, grasses) as well as through time as vegetation grows. Consequently, changes in the distribution of vegetation on a landscape will have an effect on hydrology and the management of water resources. One of the main drivers of vegetation change on a landscape is vegetation disturbance, including drought, wildfire, and bark beetles. In this section, we document how climate change is altering vegetation disturbances in the Southern Sierra Region and how these changes affect both vegetation and water resources in the region.

During the 2012-2016 California drought, an unprecedented forest mortality event produced over 129 millions dead trees in forests throughout California (Moore, 2017). The Southern Sierra Region was one of the hardest hit regions in the state, with exceptionally high levels of mortality observed in the lower montane forest. The severity of the mortality event was a direct consequence of the severity of the drought, which combined multiyear low precipitation levels with record high temperatures. Forest vulnerability to drought is projected to increase with climate change and mortality events such as the California incident are likely to become more common and widespread (Allen et al., 2015). Young et al. (2017) found that during the California drought, mortality throughout California was concentrated in areas with higher levels of water stress. Using a similar dataset for the Southern Sierra Region, Figure 15-13 shows that forest mortality (mort.tph) in 2015 occurred in areas that had relatively dense vegetation (i.e. high tree per hectare) for a given level of water stress, which was represented as the difference between precipitation and potential ET. This supports the notion that forest mortality is linked to both forest management and meteorological conditions. Forest water stress will continue to increase as temperatures rise with climate change, increasing mortality rates. In the Southern Sierra Region, a drought with comparable precipitation to the 2012-2016 drought but with temperature increases representative of the end-of-century RCP4.5 and RCP8.5 scenarios could be expected to increase forest mortality by 15% and 27%, respectively, compared to the 2012-2016 event (see **Appendix M** for full methodological details). The effects of forest mortality can linger for decades and it will be necessary to account for mortality in the management of water resources in the Southern Sierra Region. A recent study by Bales et al. (2018) estimated that the large number of dead trees in the Kings River watershed decreased forest ET during the recent drought, which may have increased water availability for streamflow by up to 15%.

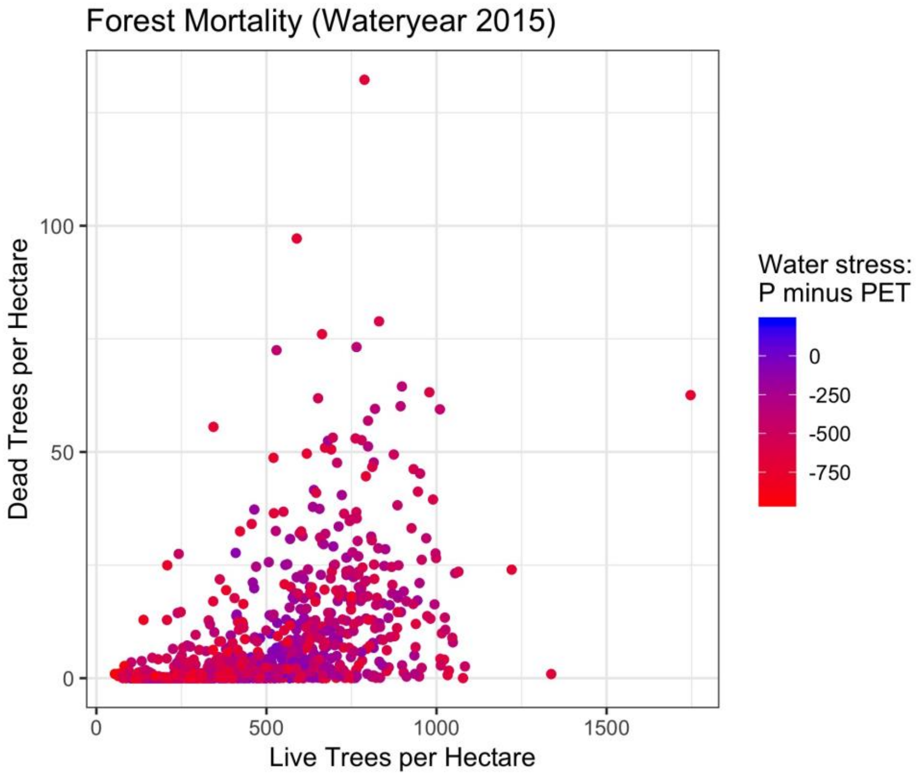


Figure 15-13 Relation between mortality (trees per hectare) and forest density (trees per hectare) in the Southern Sierra Region during the 2015 wateryear. Each data point represents mortality for a 4-km^2 pixel within the Region. More negative water stress (precipitation minus potential ET) values indicate greater water stress.

Wildfires are an episodic form of land-cover change in the Sierra Nevada. Lower montane forests in the Sierra were historically characterized as having a low-severity fire regime, where the forest understory would regularly burn from wildfire but the forest canopy burned less frequently due to a lack of ladder fuels. Fire suppression over the past century has led to a build-up of understory fuels in many Sierra Nevada forests and made these forests more susceptible to high severity wildfire that affect the forest canopy. Climate change is magnifying this problem, as higher air temperatures increase fire intensities by drying out dead fuels more rapidly. In recent decades, wildfires in the western U.S. have been found to be increasing in size (Dennison et al., 2014) and in total area burned (Westerling, 2016). Indeed, the two largest wildfires ever recorded within the Southern Sierra Region occurred in the last two decades, the 2002 McNalley Fire and the 2015 Rough Fire. Some of this increase is likely due to the fuels buildup, but Abatzoglou and Williams (2016) have demonstrated that part of this increase can be attributed to higher temperatures associated with climate change. Stephens et al. (2018) has suggested that the recent forest mortality event in the Sierra Nevada has increased the risk of surface fires, though this is counterbalanced by a decrease in the risk of crown fire.

Wildfire is expected to become more common in the Southern Sierra Region throughout the 21st century under climate change. The mean annual percent area burned averaged over the Southern Sierra Region is projected to increase from 0.5% per year historically to between 0.75% and 1% by the end of the century under the RCP 4.5 scenario (Figure 15-14). The projections for mean annual percent area burned under the RCP 8.5 scenario are higher than the RCP 4.5 scenario but also more uncertain, suggesting that the Southern Sierra Region could experience substantially more wildfire than currently occurs (Figure 15-14).

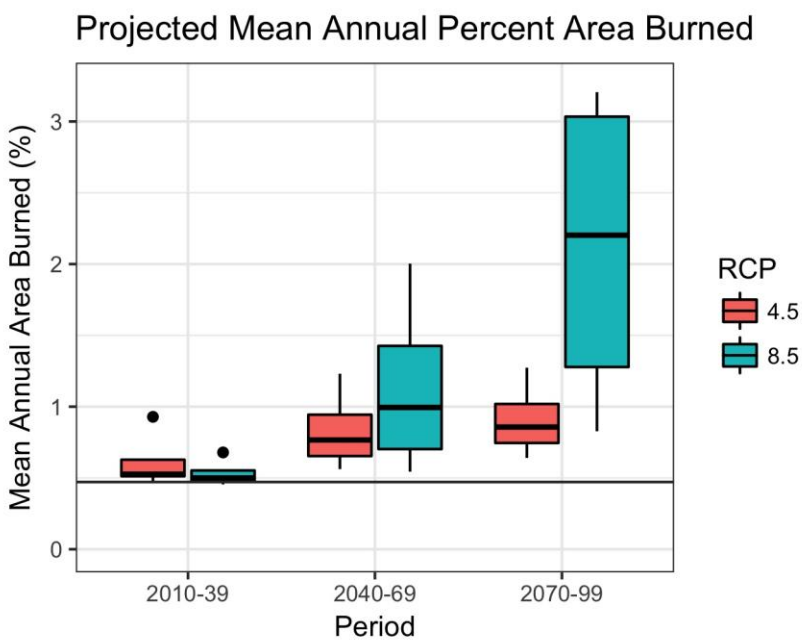


Figure 15-14 Projected changes in mean annual area burned by wildfire for the Southern Sierra Region under a medium population growth scenario. Variability in projections represents different GCMs. Horizontal dark grey line represents historical mean annual area burned. Data provided through www.cal-adapt.org.

Wildfire, through modification of vegetation and soils, affects watershed hydrology. The elimination of vegetation decreases vegetation interception and transpiration, which in the short term may increase annual streamflow. Across the Western U.S., Wine et al. (2018) estimated that 2 to 14% of long-term annual streamflow is generated from vegetation reductions brought about by wildfire. Wildfire may also increase baseflows, though the magnitude of this effect varies from watershed to watershed (Bart and Tague, 2017). Wildfire also impacts soil properties through a process that increases the hydrophobicity of soils. Hydrophobicity decreases soil infiltration during rainfall events and increases overland flow. This change can increase peak flows and the potential for large erosional events (Carroll et al., 2007; Doerr et al., 2006). Given that the frequency of wildfire is being altered under climate change, the modified effect of wildfire on streamflow and water resources will need to be accounted for in water management.

Bark beetles are a pathogen in western U.S forests, invading vulnerable trees in order to reproduce. Although outbreaks of beetles are natural, their spread has historically been kept in check by cold winter temperatures (Bentz et al., 2010). As winter temperatures rise with climate change, outbreaks are becoming larger and more severe (Bentz et al., 2010). Bark beetles contributed to forest mortality event during the recent California drought and will likely have a larger impact on Sierra Nevada forests in the future.

Forest management is frequently used to decrease forest vulnerability to vegetation disturbances and climate change. Forest management may include mechanical treatments such as forest thinning where individual trees are removed from a forest stand to reduce the density of the remaining forest. It may also include prescribed fire, which attempts to replicate the effects of low severity wildfires and remove understory vegetation. Managed wildfire offers perhaps the greatest potential for fuels reduction, though the outcomes are not as predictable as for fuels management by prescribed fire or mechanical thinning. Forest management can help to improve forest health by creating less competition for water resources (Grant et al., 2013). Forest management also has the potential to reduce overall forest ET, which in some cases may increase streamflow. There is evidence that increases in streamflow following forest thinning are greatest in watersheds that are not water limited and that the magnitude of streamflow change depends on the level of treatments conducted (Roche et al., 2018; Saksa et al., 2017). Thus, the management of water resources in the Southern Sierra Region will necessitate accounting for forest management practices.

Most vegetation species in the Sierra Nevada are adapted to the precipitation and temperature range of their present distribution. In general, vegetation growth at the lower elevations of a species distribution is water-limited, as evaporative demand is greater at lower elevations due to higher temperatures. Vegetation growth at higher elevations of a species distribution, on the other hand, is generally cold-limited. As temperatures rise with climate change, an upslope shift in vegetation is expected in the Sierra Nevada. This shift is not expected to be uniform, however, as some species are likely to migrate more easily than others. Also, in many cases, invasive vegetation may replace former species. At lower treeline in the Sierra Nevada, recent evidence has shown that a transition from forest to shubland and/or grasslands is already occurring in some regions (Collins and Roller, 2013; Stevens and Latimer, 2015). Likewise, increased vegetation growth in the high elevation sub-alpine forest in the Sierra Nevada has also been observed in the last decade (Millar et al., 2004). The effect of vegetation transformations on watershed hydrology is likely to vary based on watershed characteristics and the extent/timing of vegetation transformation. In the lower montane forest of the Southern Sierra Region, Bart et al. (2016) found that tree-to-shrub type conversion may increase streamflow up to 40%, depending on the species and size of invading shrubs. This contrasts with the effect of vegetation expansion at higher elevations, as Goulden and Bales (2014) reported that vegetation expansion could decrease streamflow by up to 26% in the Kings River watershed. The ultimate effect of vegetation transformations on streamflow in the Southern Sierra Region will depend on the balance of vegetation changes across the full elevational gradient of the Sierra Nevada.

Besides water, vegetation transformation also has implications on carbon sequestration, as vegetation and soils in the Sierra Nevada are an important store for carbon. Recent studies that incorporate climate change, vegetation change and wildfire into predictions have found that the amount of carbon that is stored in the Sierra Nevada will severely decrease by the end of the century (Liang et al., 2017). This process is largely due to the transition from forests to shrublands and grasslands in the Sierra, which do not store as much carbon. This transition of the Sierra Nevada to a net source of carbon to the atmosphere will further contribute to the problem of climate change.

Summary

The California water system is especially vulnerable to climate change due to its dependence on mountain snow accumulation and snowmelt processes. The Sierra Nevada snowpack is the largest seasonal water “reservoir” in California. Rising temperatures decrease snow accumulation, resulting in earlier stream runoff. This will also reduce usable seasonal storage behind the large mountain-front dams, owing to the need to reserve more space for flood control as the large winter snowstorms transition to large winter rainstorms. This has implications for linking downstream water-storage and flood-control solutions, e.g. through managed aquifer recharge.

Climate change could also have some limited positive effects on the Southern Sierra Region such as less frost damage to crops, longer grazing seasons, less demand for winter heat, longer summer recreation seasons, higher overall precipitation in some areas, and less extreme cold during harsh winter storms. However, these positive aspects will be small in comparision to the many negative effects of climate change on the Region. With significant portions of forest lands having not burned for over 100 years, the risks of catastrophic wildfires has increased. Many special species of the Southern Sierra Region, (Giant Sequoia, Pacific Fisher) adapt very slowly if at all due to their dependence on special ecosystems which may change at a faster rate. Furthermore, water systems are designed for historic climate patterns, and warmer temperatures will generally be detrimental since they will increase water demands and reduce snowpack storage. The risks to the Region from no action are clear and include a reduction in available water supply, greater groundwater overdraft, urban water shortages, higher water costs, and lower agricultural output.

15.4 - Vulnerability Assessment Checklist

The SNRI report for this IRWMP (**Appendix M**) provides information on potential climate change vulnerabilities for water-related resources of the Southern Sierra Nevada. (The primary water features in the Southern Sierra Region are fully described in **Chapter 3 - Region Description**.) Overall, the timing of water availability for storage and human consumption is highly vulnerable due to the projected seasonal changes in runoff. In addition, water quality is highly vulnerable based on the greater potential for drought, severe storms, wildfire, and lower late summer flows.

In addition, a local vulnerability assessment (VA) was performed using the ‘Vulnerability Assessment Checklist’ found in the *Climate Change Handbook for Regional Water Planning* (EPA and DWR, 2011). This checklist, provided below, evaluates vulnerabilities to water demand, water supply, water quality, flooding, ecosystems and habitats, and hydropower from potential climate change.

1. Water Demand

1.a - Are there major industries that require cooling/process water in your planning Region?

No. The Region is primarily foothill and mountain terrain with no major industrial facilities. Although neighboring IRWM regions have many such industries the Southern Sierra area contains mostly family-operated agricultural operations (primarily citrus and stone fruit orchards and animal grazing) and rural and recreational residential and locally oriented commercial activities, as well as recreational uses and support commercial. Therefore, the more common cooling processes are likely to occur at food processing/cold storage facilities, restaurant and hotels.

1.b - Does water use vary by more than 50% seasonally in parts of your Region?

Yes. Summer water demand is significantly higher due to the especially large influx of tourists visiting the National Forests and National Parks and to support the summer season agricultural uses and irrigated pastures. Ditch companies in the Southern Sierra area frequently divert water year-round, but most of the water diversions occur mainly June through September for agriculture, residential and commercial use.

1.c - Are crops grown in your Region climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops?

Yes. As noted above, the area does contain some agricultural operations. A large portion of the foothill area is grass- and range-land used primarily for cattle grazing. Significant increase in temperatures could result in heat stress for cattle. Crops grown are primarily orchards and vineyards on a relatively small scale. The Region typically experiences hot dry summers, and, as a result, most of these crops have so far relatively good heat resistance in this Region. Changes in heat patterns will impact crop and vineyard yields if there is a significant increase in temperature. Within the range of model projections, changes in heat patterns will increase the demand for crop irrigation water. Although freezing temperatures are harmful to vineyards, stone fruit and other crops, they are beneficial to some permanent crops that need a certain number of chilling hours below freezing for an effective dormancy. Freezing temperatures also kill some types of pests. Therefore, a reduction in the number of freezing days could negatively impact some crops.

1.d - Do groundwater supplies in your Region lack resiliency after drought events?

Yes. Groundwater provides the critical water supply, however, the supply is held in highly fractured bed rock and therefore its resilience is not dependable during or after prolonged drought. Water levels in wells will drop as a function of the size, number and connectedness of the fractures intersected by the individual well. Again due to the fractured nature of the sub-strata, forced or artificial recharge is not effective. No accurate or reliable data exists on the amount/supply of water in the fractured aquifers, but it is well understood that the amount of water is dependent on recharge via precipitation and snow melt, all of which are highly effected by a warming climate.

1.e - Are water use curtailment measures effective in your Region?

Perhaps, to the extent that water conservation measures may be practiced on a voluntary basis by residences due to the cost to pump from private wells. Additional education from the smaller mutual water companies concerning the benefits to conservation may prove helpful in increasing conservation measures. For example, Springville Public Utility District (SPUD, or District) has a phased water use program in place, where currently they are in Phase II which restricts residential landscape watering to two times per week for one hour total duration each time. Water for agricultural purposes is not currently restricted. Phase III restrictions would be implemented at such time as the District determines that not enough water can be pumped from the existing Tule River pump to keep the 1.8 million gallon reservoir filled. At that point all outside domestic water use would be restricted. With these restrictions in place 45% less water (7 million gallons) has been used so far during the summer months of 2014.

1.f - Are some in-stream flow requirements in your Region either currently insufficient to support aquatic life, or occasionally unmet?

Yes, however the impact is more keenly felt on flows downstream of the South Sierra Region. Pursuant to the San Joaquin River Restoration Agreement, minimum in-stream flow requirements have been instituted beginning at Friant Dam (Reach 1) which provide for flows sufficient to support aquatic life all along the rivers to the Delta. These flows have one of the highest priorities for the surface waters, and flows are insufficient only in an extreme drought. Kings River has a minimum 100cfs minimum flow below Pine Flat Dam; insufficient in most years during warmest portion of summer and in both extreme and exceptional drought years. Under Climate Change that period of unsuitable water temperatures will expand to the majority of the reproductive period of cold water fishes.

2. Water Supply

2.a - Does a portion of the water supply in your Region come from snowmelt?

Yes. The majority the surface water comes from snowmelt in the upper headwaters of the watersheds and is the source of groundwater and surface water. Surface water, however is not the primary source of water used in the Southern Sierra Region, but rather groundwater extracted from the fractured bed-rock. Therefore, the Southern Sierra Region is vulnerable to climate change impacts related to rising temperatures and shorter winter seasons, particularly on snow pack including earlier spring runoffs, less water storage as snowpack, and more frequent rain-on-snow events that could cause increased erosion and early or more prolonged flood releases out of reservoirs. SPUD and Three

Rivers Community Services District are served by surface water from the Tule and Kaweah Rivers respectively. Three Rivers CSD users are currently under “boil water” orders; these orders have been in effect beginning every year in June in the most recent past few years.

2.b - Does part of your Region rely on water diverted from the Delta, imported from the Colorado River, or imported from other climate-sensitive systems outside your Region?

Yes. The closest community that falls within Southern Sierra boundary might be Millerton new town community of Brighton Crest. The community is dependent on a water contract that County has for Cross Valley Water which originates from the Delta. Also, the Edison and PG&E power companies’ ability to store water for energy generation in the upper reaches of the San Joaquin River are subject to certain restrictions that require release of water to downstream water users in the Los Banos area when water deliveries from Delta are insufficient to meet Water Exchange Contractor needs for delivery. For the first time in over 60 years, The Power Companies with dams on the San Joaquin had to release water this year from their storage facilities to make up for lack of Delta water for Los Banos area users.

2.c - Does part of your Region rely on coastal aquifers? Has salt intrusion been a problem in the past?

No, the Region does not rely on coastal aquifers.

2.d - Would your Region have difficulty in storing carryover supply surpluses from year to year?

Occasionally. The local reservoirs have some capacity to store carryover water from year to year without encroaching on flood control space for neighboring IRWM regions. The space to store the water and ability to keep it in storage, depends on the hydrology and to some extent determinations of the associated power companies. In some years, agencies can carryover water and in other years they cannot. Additional carryover storage capacity would be welcomed by the local water agencies. Of the known 33 dams in the Region, 24 are operated by Southern California Edison or PG&E. The other reservoirs/dams are operated by the Army Corps of Engineers, Bureau of Reclamation, US Forest Service, County of Tulare, and a couple private interests. Please refer to Chapter 3 Region Description for additional information about the area dams/reservoirs. Under climate change we may lose capacity from more precipitation in the form of rain and less as snowfall.

2.e - Has your Region faced a drought in the past during which it failed to meet local water demands?

Yes, and currently, PUDs, CSDs and mutual water companies are having difficulty meeting demand in the current drought conditions. Drought conditions are expected to increase in intensity and duration as a result of predicted climate changes. There are known serious issues for PUDs and CSDs when there are competing with adjacent users. Stressors will all be intensified with climate change. During this current drought, groundwater shortages have also been experienced in the National Parks and Forests.

2.f - Does your Region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas?

Yes. Invasive species threaten many ecosystems especially in the lower elevations. Many non-native species are naturalized and alter disturbance regimes and evapotranspiration. Many higher elevation ecosystems in the Southern Sierra remain relatively exotic-free. Some invasive plant species can clog natural waterways if they are not properly managed, so most agencies include vegetation clearing as part of their maintenance activities. Agencies in the area have been alerted to the potential for invasive species and how to help prevent their spread. Predatory striped bass are currently in many of the foothill reservoirs. Non-native wild pigs can disrupt many foothill ecosystems, through extensive soil disturbances especially ecosystems along warm waterways. Trout are not typically considered native above 6,000 ft. elevation (except in the Kern River watershed where they are native up to 9,000 ft.). Above 6,000 ft. they were stocked fish and now prey on native amphibian species' larvae. The combination of these stressors – predation and climate change, will significantly reduce already threatened populations.

3. Water Quality

3.a - Are increased wildfires a threat in your Region? If so, does your Region include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion?

Yes. Increased wildfires are a threat in the Southern Sierra Region due to the increased density of vegetation and the lack of prescribed burns in both the Sequoia National Forest and National Park. There are 33 reservoirs located in the Region (please refer to Chapter 3 Region Description). Vegetation surrounds these reservoirs, and it is generally sparse in the immediate vicinity of the lower elevation reservoirs. But because these reservoirs collect water from the entire watershed, fires and disturbances from higher elevations pose a large water quality concern. Higher elevation reservoirs have thick forest on the reservoir rim and in the watershed, or are located in steeper terrain where post-fire erosion could potentially affect water quality. Following intense fires the ground is littered with fire debris which is somewhat thick and oily or slick making it somewhat impervious (hydrophobic) and therefore contributes to excessive runoff if the fire is followed immediately by heavy rain. Current predictions suggest higher fire frequency and intensity, and longer fire seasons. This increases the risk of erosion and water quality concerns.

3.b - Does part of your Region rely on surface water bodies with current or recurrent water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change?

Yes. There are known impaired or potentially impaired water bodies. These are discussed in Chapter 3.11 – Water Quality. However, most reservoirs are high enough in elevation that they do not receive significant concentration of nitrogen or other nutrients that encourage unnatural algal conditions. However aerial deposited nitrogen and pesticide residues are increasing over time and studies are being conducted to monitor the effects in ponds, lakes and aquatic environments. These reservoirs are not typically storage for domestic use; rather their primary purposes are to store water for agriculture, flood prevention and for recreational purposes. Domestic water is primarily drawn from wells. However, several districts use surface water supplies for domestic use.

Eutrophication is the process by which a body of water becomes rich in dissolved nutrients from fertilizers or sewage, thereby encouraging the growth and decomposition of oxygen-depleting plant life and resulting in harm to other organisms. Warmer water could cause conditions that lead to eutrophication. However, the surface waters in the Region, Kings River, San Joaquin River, Kaweah River and Tule River, (and related tributaries) are derived from Sierra snowmelt, and are cold and very pure, but with elevated nitrogen from atmospheric (airborne) deposition. These waters have few nutrients that support algae growth and it is generally not a problem. However, algae is a problem in the streams, canals, and other water bodies that carry Sierra waters to downstream users and other end points and can become a problem during very low flows at the distal end of the rivers.

3.c - Are seasonal low flows decreasing for some water bodies in your Region? If so, are the reduced low flows limiting the water bodies' assimilative capacity?

Decreases are projected, however the trends are not yet clear. Water bodies in the Region are vulnerable to very low seasonal flows during extreme and exceptional drought. Decreases in low flows for the local water bodies have been observed, although no detailed analysis has been performed. Changes in annual low flows from climate change would be difficult to identify in reservoirs, unless significant and statistically significant over time, since low flows already vary due to natural climate variations and management of reservoir releases. If snow-pack does decrease as predicted it will leave many water bodies without a low flow and maybe entirely dry late in the season.

3.d - Are there beneficial uses designated for some water bodies in your Region that cannot always be met due to water quality issues?

Yes. Quality of many local surface waters decline dramatically in drought. For example, supplies in 2014 were not able to meet all beneficial uses, which include recreation, hydropower, aquatic habitat, irrigation, and municipal water use. Groundwater quality varies throughout the Region and is not suitable for municipal use in some areas owing to natural and human-caused water quality issues. Groundwater quality may degrade further as groundwater levels decline. Climate change impacts are likely to exacerbate.

3.e Does part of your Region currently observe water quality shifts during rain events that impact treatment facility operation?

Yes, even though surface waters in the Region generally have excellent water quality, storm activity can cause very high turbidity. Climate change is expected to increase these turbidity-causing events.

4. Sea Level Rise

The Southern Sierra Region is at elevations ranging from 600 to 14,500 feet above mean sea level and is approximately 150 to 400 miles from the ocean. Therefore, sea level rise is not a threat to the Region.

5. Flooding

5.a - Does critical infrastructure in your Region lie within the 200-year floodplain? DWR's best available floodplain maps are available at: http://www.water.ca.gov/floodmgmt/lrafmo/fmb/fes/best_available_maps/.

Comprehensive reliable flood data for the Southern Sierra Region is generally not available. Flood data generally does not extend into the foothill and mountain regions, except where flood plains were recently re-mapped extending 100 and 500 year flood zones on waterways upstream of population centers. Areas of potential flooding in the foothill and mountain area are most likely to occur adjacent to the major rivers in incised river canyons. It is assumed that major structures and infrastructure built with State or Federal funds would be located outside the 100 or even 500 year flood zones, although this may only be true for more recent construction. Some houses, roads, and water supply and treatment infrastructure (wells, canals, etc.) are also located in the localized floodplains adjacent to the rivers. Major flooding affecting limited roadways in and out of developed areas could cause serious disruptions to essential emergency-response services. Climate change is expected to exacerbate these conditions. Austin (2012) provides detailed discussions on historical floods in the Region.

5.b - Does part of your Region lie within the Sacramento-San Joaquin Drainage District?

No.

5.c - Does aging critical flood protection infrastructure exist in your Region?

Yes. The majority of dams and reservoirs in the area exceed 50 years in age and therefore are likely subject to regular, thorough inspections for signs of weakening or serious disrepair. Major flood control facilities are generally at the lower elevations in the foothill Region and include Friant Dam/Millerton Lake Terminus Dam/Lake Kaweah, Success Dam/Lake Success, Shaver Lake Dam/Lake, and Pine Flat Dam/Lake. In addition, Friant Dam on the San Joaquin River impacts flooding along the San Joaquin River, at the northern boundary of the adjacent Madera Region. With the possible exception of Success Dam, these facilities are all considered to be in good condition.

5.d - Have flood control facilities (such as impoundment structures) been insufficient in the past?

No. Major flood control facilities including dams have been sufficient in past years. Levee systems are typically found on the valley floor, consequently levee breaks along the Kaweah, Tule, San Joaquin, and Kings Rivers would likely not cause serious problems in the Southern Sierra area, but in most cases would flood farmland and perhaps portions of population center. There are numerous small impoundments of unknown structural integrity in the Southern Sierra Region that may already be at risk. Climate change could pose heretofore unidentified additional risks to this infrastructure.

5.e - Are wildfires a concern in parts of your Region?

Yes. Wildfires are a particular concern in the foothill and mountain areas of all the watersheds in the Sierra Nevada. Fire risk is one of, if not the most, critical issue facing the Southern Sierra Region. The Sierra Nevada watersheds, including the Southern Sierra Region are a primary source of the State's water supplies. Therefore the health of these watersheds is crucial to a sustainable yield of water supply, not only with this Region, but within the State as well. Under climate warming, wildfire risk will be exacerbated. Vegetation will play a role as well in future wildfire patterns, particularly since [adaptive] changes in vegetation may take decades or centuries to keep pace with changes in climate."

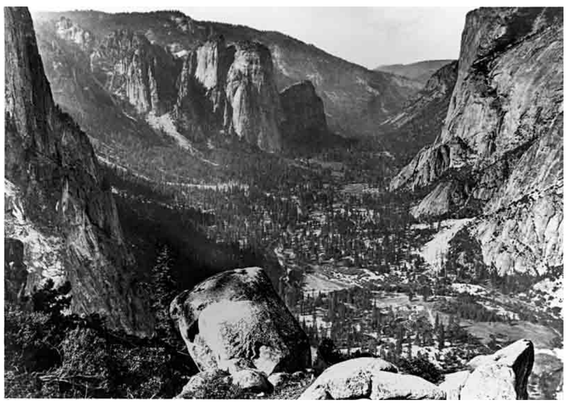
Currently foothill and mountain watersheds are largely heavily forested with overgrown stands of trees and brush that have not burned in many years, thereby raising risk of catastrophic, stand-destroying wildfires such as the McNally Fire of 2002 in the Southern Sierra Region or the Rim Fire of 2013 in the Yosemite-Mariposa Region.

While many wildfires cause little damage to the land and pose few threats to fish, wildlife and people downstream, catastrophic fires result in severe short- and long-term problems: loss of vegetation exposes soil to erosion; runoff may increase and cause flooding; sediments may move downstream and damage houses or fill reservoirs, degrade surface water quality, put endangered species and community water supplies at risk; and increasing acreage of ground stripped by catastrophic fires of all water holding vegetation will result in increases in flood potential, as well. Coupled with earlier snow melt from rising temperatures, the timing of surface water supply to the urban and agricultural areas on the Valley floor outside the Region, will also change. The Forest Service Burned Area Emergency Response (BAER) program addresses these situations with the goal of protecting life, property, water quality, and deteriorated ecosystems from further damage after the fire is out.

The numerous other fires occurring throughout foothill and mountainous areas of the Sierra Nevada during the summers of 2013 and 2014 seem to be an indicator of the increasing frequency and intensity of fires occurring in the Southern Sierra Region (e.g.

Aspen Fire (2013) and French Fire (2014). Public expenditures for fire suppression rise with increasingly catastrophic fire events. Southern Sierra Region federal land management agencies are beginning to shift their focus to proactive fire suppression through emphasizing wildfire prevention policies which may have greater effects on both forest and watershed health and significant benefits to water management.

Although, in a different Region, the two historical photographs below taken of Yosemite Valley[1] clearly show the increase of forest density over a century's time. These photos likely reflect forest density conditions in many of the National Forests and Parks in the Sierra Nevada of California, where once timber harvesting was good not only for the economic reasons, but for the health of the forest ecosystems and watershed itself.



View from Union Point, 1866

View from Union Point, 1961

6. Ecosystem and Habitat Vulnerability

6.a - Does your Region include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues?

Yes. Substantial sedimentation and erosion issues occur along nearly all of the Region's inland aquatic habitats. There are numerous sources of these issues. Climate change will likely pose substantial risks to these habitats.

6.b - Does your Region include estuarine habitats which rely on seasonal freshwater flow patterns?

No.

6.c - Do climate-sensitive fauna or flora populations live in your Region?

Yes. The westerly aspect of the Sierra Nevada is characterized by steep slopes. Associated with the steep slopes are individually unique and well-defined bands

[1] National Park Service, Photo Gallery, Historical Images of Yosemite National Park, http://www.nps.gov/media/photo/gallery.htm?id=B17BC4E5-155D-4519-3EC6B73FCE2806A8

containing specific bio-physical correlations at specific gradients and elevations. This means elevation-dependent vegetation bands characterize the mountainous area of the Southern Sierra Region. The result of this phenomenon, especially with the added influences of climate change, is that as the upper elevations warm, the vegetation bands will contract, and bio-specific habitats will contract, or even disappear; leaving plants and animals vulnerable to potential extinction. A variety of native and imported flora and fauna live in the area and many are climate sensitive because they have restricted distributions, populations, or are unable to migrate or their migration routes are modified or eliminated. This natural climate sensitivity is compounded by pockets of current and future rural and agricultural development.

6.d - Do endangered or threatened species exist in your Region? Are changes in species distribution already being observed in parts of your Region?

Yes. Many State and Federally listed threatened and endangered species (for example three sub-species of golden trout) are found in the area. Several studies document noticeable changes in species distribution owing solely to climate change. Potential future development together with climate change poses significant risks to endangered and threatened species

6.e - Does the Region rely on aquatic or water-dependent habitats for recreation or other economic activities?

Yes. Passive and motorized recreation is an important part of the local culture in all watersheds, especially local reservoirs, including fishing and water sports. These recreational opportunities also provide a major benefit to the local economy.

6.f - Are there rivers in your Region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life?

Yes. The San Joaquin River and Kings River both have schedules for minimum environmental flows sufficient to support aquatic life all along the rivers to the Delta. These flows are the highest priority water uses, and are likely to be met, except possibly in an exceptionally dry year. These flows have one of the highest priorities for the surface waters, and flows are insufficient only in an extreme drought. Pursuant to the San Joaquin River Restoration Settlement Agreement, minimum in-stream flow requirements are prescribed as the flow necessary to restore reasonable habitat to support a spring salmon run and have been instituted up to Friant Dam (where Reach 1 begins) at which provide for flows. Kings River has a min 100cfs minimum flow below Pine Flat Dam; insufficient in most years during warmest portion of summer and in both extreme and exceptional drought years. Under Climate Change that period of unsuitable water temps will expand to the majority of the reproductive period of cold water fishes. During the warmest summer months water temperatures may reach levels unsuitable for old water fisheries which the minimum flows are designed to maintain.

6.g - Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in your Region? If so, are coastal storms possible/frequent in your Region?

No.

6.h - Does your Region include one or more of the habitats described in the Endangered Species Coalition's Top 10 habitats vulnerable to climate change (http://www.itsgettinghotoutthere.org/)?

Yes. The Southern Sierra Region which encompasses areas of the California Sierra Nevada Mountains which are included in the list of top 10 habitats vulnerable to climate change. The *It's Getting Hot Out There* report notes the area is home to a variety of State and Federal listed threatened and endangered species. Climate change threats include rapid warming, having more winter rains instead of snow and experiencing an earlier snowmelt with less snowpack. Other threats include population growth, recreation and changing land use.

6.i - Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within your Region? Are there movement corridors for species to naturally migrate? Are there infrastructure projects planned that might preclude species movement?

Yes. In the foothills and forested areas east of the valley floor area, large un-fragmented wilderness areas are found.

7. Hydropower

7.a - Is hydropower a source of electricity in your Region?

Yes. Hydropower is generated at 24 of the 33 dams in the SS Region. The bulk of the electricity is sold to the local power company and delivered to the electric grid, so it is not necessarily used directly in the Southern Sierra Region, although small amounts of this valuable resource are used in the Region.

7.b - Are energy needs in your Region expected to increase in the future? If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in your Region?

Yes. Energy demands are likely to increase in the Region due to population growth, and to accommodate any climate change. No new major hydropower projects are planned for the area and are probably not likely to be pursued due to permitting difficulties. Some small hydropower projects are being considered along canals or at existing dams to utilize fish release flows. However, the energy generated from these projects would be small.

15.5 - Vulnerability Assessment and Adaptation Strategies

The DWR's October 2008 publication "Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water", suggests there are multiple strategies that can help reduce the risks presented by climate change. To be successful, however, the report states these adaptation strategies must be well-coordinated at the state, regional and local levels in order to maximize their effect: "No single project or strategy can adequately address the challenges California faces, and tradeoffs must be explicitly acknowledged and decided upon. That said, planning and investing now in a comprehensive set of actions that informs water managers and provides system diversity and resilience will help prepare California for future climate uncertainty." The requirement to fully develop the potential of Integrated Regional Water Management planning is Strategy No. 2 of ten strategies set out in the report.

Table 15-1 Climate Change Adaptation Strategies for California's Water[1]

Type of Strategy	Purpose of Strategy
Investment Strategy	Strategy 1: Provide Sustainable Funding for Statewide and Integrated Regional Water Management
Regional Strategies	Strategy 2: Fully Develop the Potential of Integrated Regional Water Management
	Strategy 3: Aggressively Increase Water Use Efficiency
Statewide Strategies	Strategy 4: Practice and Promote Integrated Flood Management
	Strategy 5: Enhance and Sustain Ecosystems
	Strategy 6: Expand Water Storage and Conjunctive Management of Surface and Groundwater Resources
	Strategy 7: Fix Delta Water Supply, Quality and Ecosystem Conditions
Improving Management and Decision-Making Capacity Strategies	Strategy 8: Preserve, Upgrade and Increase Monitoring, Data Analysis and Management
	Strategy 9: Plan for and Adapt to Seal Level Rise
	Strategy 10: Identify and Fund Focused Climate Change Impacts and Adaptation Research and Analysis

The DWR also defines 'no-regret' strategies as actions that provide measurable benefits today while also reducing vulnerability to climate change (EPA and DWR, 2011). In other words, they are strategies that provide benefits with or without climate change or reductions of greenhouse gases. As such, these are actions that can be taken within each IRWM planning area, independent of, but in furtherance of strategies, particularly Strategy 2, being pursued on a statewide level. For instance, constructing a water bank would provide needed water supply benefits in the present (Strategy 6), but could mitigate climate change impacts through floodwater capture (Strategy 4), increasing water storage, and enhancing wetland habitat (Strategy 7). The Water Education Foundation

[1] California Department of Water Resources, "Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water", October 2008.

(2010) believes that planning for climatic uncertainty will also benefit planning for regulatory, environmental, economic, and social uncertainty.

The IRWMP RWMG concluded that no-regret strategies should comprise the majority of adaptation measures. Achievable “no-regret” management practices for tackling climate change concerns that the Southern Sierra Region can employ include:

- Continued investment in local water conservation;
- Diversification of local water supply portfolio;
- Practicing integrated flood management;
- Increasing conjunctive use of available water supplies;
- Protecting and restoring water-related ecosystems;
- Increasing water reuse and recycling;
- Monitoring local and regional water use activities;
- Tracking related legislation;
- Investigating water supply/energy relationships and coordinating with larger water utilities; and
- Following the State’s required adaptation strategies and legislation.

Although these ‘no-regret” strategies provide benefits with or without climate change or reductions of greenhouse gases , the threat of climate change further justifies the need for many water management strategies already being used in the Region, as well as putting in place many that are not. Furthermore, climate change adaptation is not in conflict with current Goals and Objectives of the Region or the State.

Most of the resource management strategies described in Chapter 5 would assist with climate change adaptation. However, the following strategies were deemed the most practical and effective for climate change adaptation in the Southern Sierra Region:

- Improve urban and agricultural water use efficiency
- Increase use of recycled water (where energy efficient and/or where minimal greenhouse gases result)
- Revise land use planning policies to encourage conservation (e.g. low impact development or water efficiency and conservation standards)
- Develop groundwater recharge and banking projects
- Develop water storage projects inside and outside of the Southern Sierra Region
- Increase ability to capture floodwater both for flood control and water supply
- Encourage forest thinning (mechanical, prescribed burn and other management options), restoration of mountain meadows, wetlands, and riparian areas to possibly increase and regulate flows resulting in more summer runoff
- Change crop types to accommodate climate change

The overall theme with these strategies is to expand the tool box of accommodations and actions that can be taken to help the Region adapt to extreme conditions (drought and floods) that climate change and increase of greenhouse gases may cause.

Table 5.1 in Chapter 5 – Resource Management Strategies is a matrix of the range of water management strategies set forth in the 2013 California Water Plan and their relative potential benefits for the Southern Sierra IRWMP area. The benefits are evaluated based upon whether the listed strategies are not applicable to the Region, applicable to Region, or applicable, but limited in area or in the potential for project approval. Drought Planning was added as a strategy by the Southern Sierra RWMG.

On June 5, 2014, a Climate Change Workshop was hosted by the Southern Sierra Regional Water Management Group. Dr. Marni Koopman of the GEOS Institute, who prepared a report (GEOS Institute, 2014) interpreting various climate change models in support of November 2014 SS IRWMP, was the featured speaker. Other speakers included team members of Provost & Pritchard Consulting Group (co-author of November 2014 SS IRWMP), Sequoia National Forest and Sequoia and Kings Canyon National Parks. Attendees of the workshop included staff of various local, state and government agencies, local non-profits, other private-sector consultants.

Dr. Koopman and a series of other speakers defined key terms such as vulnerability, adaptation and mitigation and noted that the scale and extent of climate change impacts can vary based on how people in a particular Region respond. Dr. Koopman and others described and commented on current and potential strategies for mitigation of climate change relative to agriculture, forests, the economy, water supply and habitat. Dr. Koopman and others described and commented on current and potential strategies for adaptation and mitigation. At this workshop it was noted that the scale and extent of climate change impacts can vary based on how people in particular Region respond. "No Regret' strategies were encouraged for consideration since they enhance resource conservation with or without climate change. Presenters stressed that vested interests within the Region as well as in the downstream regions can benefit from climate change adaptations and mitigation measures implemented in the South Sierra Region; activities in the Southern Sierra IRWM could affect water resource vulnerabilities in other water management regions, so actions need to be coordinated across boundaries.

Climate change adaptation is one or a series of actions that seeks to reduce the severity of climate change impacts to human and natural systems. The adaptation measures identified below do not address a specific quantified impact, but rather focus on a range of potential measures implemented to begin to minimize the negative effects of reductions in snowpack, river flows, flooding, and sea levels, and maximize groundwater storage capabilities, water conservation and water re-use where appropriate. Since climate change predictions will never be perfect, flexibility and diversity in adaptation measures is fundamental. The adaptation measures will also help the Region to improve resiliency, which is defined as the ability to return to original conditions after a disturbance or impact.

One of the primary impacts of climate change will be its exacerbating influence on existing stressors, which occur primarily through land management practices. As climate change progresses, reducing existing stressors will become increasingly necessary for retaining many of the services provided by functioning watersheds.

At the conclusion of the workshop presentations, a breakout exercise was conducted. Four groups were formed and asked to brainstorm climate change vulnerabilities and adaptation and mitigation strategies for four pre-determined categories:

- Watersheds and Water Quality
- Changing Precipitation Patterns and Management (including flooding)
- Effects of Wildfire Reoccurrence on Water Quality and Quantity
- Groundwater Resources (fracture flow and diminishing well capacity)

Initial breakout results are shown below in **Table 15-2.**

Table 15-2 Climate Change Workshop - Breakout Group Results

Climate Change Category	Vulnerabilities	Adaptation & Mitigation Strategy

Watersheds and Water Quality	• Ephemeral Streams
	  ○ Vulnerable to irregular hydrology
	  ○ Fire, floods, decreased water quality (erosion)
	  ○ Human communities
	    ▪ Increased early spring run-off
	    ▪ Increase in fire
	    ▪ Increased cost
	  ○ Animal and plant communities
	  ○ Recreation
		• Forest and vegetation management
		  ○ Restoration (streamside)
		  ○ Land use designations/ policy (buffer; conservation easements)
		• Create more water storage
		• Education
		  ○ Planning (e.g. community and disaster)
		  ○ Conservation
		• Increase storage through recharge
		• Planning and implementing conservation planning (corridors)
		  ○ Prescribed fire
		  ○ Invasive species control
		• Restoration (water quality)
		  ○ Education
		  ○ Planning
		  ○ Diversity
		  ○ Community involvement

Changing Precipitation Patterns and Management	• Inadequate water storage
	• Drought
	• Flood preparedness
	• Infrastructure
	• Fire
	• Economic resilience
		• Re-flood Tulare Lake
		• Increase dam size
		• Modify/alter watershed
		  ○ Vegetation management
		  ○ Meadow restoration
		• Transient storage

Climate Change Category	Vulnerabilities	Adaptation & Mitigation Strategy
	○ Tourism ○ Cattle • Ecological resilience	○ Slow water flow through system ○ Moving water around • Increase downstream stream capacity ○ Setbacks ○ Inadequate flood control • Increase accuracy of forecasts • Cloud seeding • Infrastructure resiliency
Effects of Wildfire Reoccurrence on Water Quality and Quantity	• Overly dense forests ○ Results in fire; uncharacteristically severe fires & more frequent catastrophic fire ○ Results in lower water storage capacity from increased uptake ○ Loss of water through evapotranspiration • When forests burn ○ Soil is lost from increased erosion ○ Lose absorption capability ○ Erosion/sedimentation leads to lower water quality/loss of aquatic habitat ○ Ash is erosive itself	• More natural and prescribed fire at the landscape scale • Data collection, better modeling, and social science research that informs outreach and education • Education on the tradeoffs between prescribed fire vs. natural fire, benefits of natural fire, and consequences of a lack of fire
Groundwater Resources (fracture flow and diminishing well capacity)	• Loss of surface water that recharges groundwater • Limited storage space of aquifer • Water flows quickly through the system • Wells not deep enough • Economic interests • Groundwater exports • Concentration of pollutants in ground water	• Water conservation • Cloud seeding • Water recycling (grey water) • New funding sources for climate change/drought adaptation • Use more surface water • Require sustainable water supplies for new developments

Climate Change Category	Vulnerabilities	Adaptation & Mitigation Strategy
	• Already overdrafted groundwater resources • Lack of water planning • Population growth • Disadvantaged communities • Lack of water recycling	• Drill deeper wells/drill more wells • Drought tolerant landscaping • Renewable energy for well pumps • Require sustainable water supplies (prevents overdevelopment)

Based on the results of the Climate Change Workshop Break-out Group Exercise **Table 15-2** shows the highest priority vulnerabilities and highest priority adaptation and mitigation strategies (with no necessary direct correlation) identified for the Southern Sierra Region.

Table 15-3 Priority Vulnerabilities and Adaptation & Mitigation Strategies

Vulnerabilities	Adaptation & Mitigation Strategy
Drought	Forest and vegetation management (streamside restoration and land use policy encouraging conservation)
Inadequate Water Storage	Education*
Overly Dense Forests	Restoration education and community involvement
Altered Fire Regimes	More natural and prescribed fire at the landscape scale, including mechanical thinning and other management options
Population Growth	Water Conservation
Already Overdrafted Groundwater Resources	Water Recycling
	New funding sources for climate change/drought adaption
	Research that includes data collection better modeling, and social science research that informs education and outreach
	Education on the benefits of large natural fires and prescribed fires

* Noticeable overlap occurred across the breakout groups. Education was listed more than once (denoted by a *), thus representing common group thinking.

The attendees expressed the idea that vulnerabilities should be re-evaluated at least every five years to reflect changes in local cropping, water demands, water supplies, new facilities, and climate change projections and to adjust strategies as appropriate.

15.6 - Climate Change Monitoring

Climate change monitoring includes two components: 1) monitoring hydrologic, meteorological, ecosystem and social attributes for climate change and impacts; and 2) monitoring advances or changes in climate change science, policy and projections.

The Southern Sierra Region already includes a network for monitoring the hydrology, meteorology, water demands, water use, crop yields and wildlife. However, numerous improvements to monitoring and data management and availability are needed. The Region may not receive the attention needed due to its remote nature and low population. The importance of water management starting at the headwaters in the upper elevations of this and other National Park and Forest areas however, may be key to successful statewide water management and achievement of sustainable water yields. Improvements to numerous areas of hydrologic and environmental monitoring would aid in tracking climate change and managing water.

Historically water projects have been designed and are operated on the assumption that future hydrology will mimic past hydrology. Climate change puts these assumptions in jeopardy and going forward, planning and operations need to incorporate non-stationary hydrology. Given uncertainties, this means providing more resiliency to prepare for a much warmer climate, which can be both wetter or drier in various periods. Future projects should not continue to be designed based on past hydrology. The quality and quantity of data has improved in recent years, is readily available and provides robust scenarios for future conditions. In particular, water managers should prepare for more severe droughts and flooding.

The science of climate change, and the tools to mitigate and adapt to climate change, are robust, and will continue to improve. As a result, every five years as part of the California Water Plan Update process, DWR will provide revised estimates of changes to sea levels, droughts, and flooding that can be expected over the subsequent 25 years. The RWMG will also stay apprised of new studies, reports, literature, legislation, and climate change model runs that are pertinent to the area. New data and guidelines are being published on a frequent basis, and several climate change clearinghouses ease the effort to find this data. When needed, this literature will be shared with the RWMG members and interested stakeholders, and incorporated into the IRWMP updates.

15.7 - Mitigation of Greenhouse Gas Emissions

Mitigation of climate change can be achieved by selecting and promoting projects that help to reduce greenhouse gas emissions (GHG) emissions. While the RWMG is not responsible for air quality management, and they can only have a small impact on global emissions, it is both responsible and responsive for climate goals to consider emissions in project selection in view of the negative impacts climate change may have on water resources and the region overall.

All of the resource management strategies described in Chapter 6 can assist with climate change mitigation through reduction in energy demand, ecosystem enhancement, or carbon sequestration. For instance, water conservation can reduce energy demands to pump, convey, and treat water supplies, although it should be noted that some water conservation measures do require additional energy input. Another example is riparian area restoration, which can sequester carbon and create habitat for species impacted by climate change.

Projects are primarily ranked based on whether they advance goals and objectives of this plan and their water supply benefits, but GHG emissions and climate change adaptation were added as considerations. Specifically, the following questions were added to the Project Review Process form:

1. Will this project result in reduced greenhouse gas emissions? If yes, explain how and quantify.
2. Will this project increase greenhouse gas emissions? If yes, explain how and quantify.
3. Will this project contribute to adaptation strategies to respond to climate change impacts?

The RWMG is also dedicated to helping the State meet GHG emission reduction goals. These goals, prescribed in the California Global Warming Solutions Act of 2006 (AB 32), include reaching 2000 emission levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050.

Beginning July 1, 2012, GHG emissions for California Environmental Quality Act (CEQA) studies are required to be calculated using the California Emissions Estimator Model (CalEEMod). CalEEMod quantifies potential criteria pollutant and GHG emissions from construction and operations for a variety projects. The RWMG will also require that this model be used on projects considered for funding.

15.8 - Climate Change in other IRWMP Chapters

Climate change is discussed in several other IRWMP sections including:

Table 15-4 Climate Change in other IRWMP Chapters

Chapter 5	**Goals and Objectives**	This chapter includes general goals related to climate change adaptation and mitigation.
Chapter 6	**Resource Management Strategies**	This chapter discusses the impacts of climate change on the efficacy of different strategies, and the ability of strategies to help adapt to climate change.
Chapter 7	**Project Review Process**	The project review process includes new questions related to GHG emissions (Section 15.8)
Chapter 13	**Relation to Local Land and Water Planning**	This chapter summarizes the climate change adaptation and mitigation strategies from local water plans, and evaluates their consistency with the goals of this IRWMP.

Chapter 16 - DISADVANTAGED COMMUNITIES

16.1 - Introduction

Disadvantaged communities (DACs) comprise approximately 50% the Southern Sierra Region's population and have many critical and unique water supply, water quality and wastewater issues and needs because of their economic disadvantages.

A central task of the Southern Sierra RWMG is to seek out DACs or EDAs in the Region, incorporate their issues and needs and projects, as many State grants now either give special consideration or preferences for projects that serve DACs or EDAs or have funding percentages set aside for projects that help meet the needs of DACs or EDAs. This is a financial opportunity for both DACs and the RWMG. Even communities that don't meet the statutory definition of a DAC or EDA can benefit if they are below the Median Household Income (MHI) level for the State.

Therefore, the purpose of this chapter is to identify the Disadvantaged Communities (DAC) and Economically Distressed Areas (EDA) within the Southern Sierra Region and highlight their needs. The desired result is that these communities be successful in applying for Proposition 1 technical assistance, grant and loan programs for projects that will benefit them.
Specific topics that are discussed in this chapter include:

- Identification of and locations of DACs and EDAs in the SS Region
- Social and Cultural Make-up of DACs and EDAs in the Region
- Tribal Government Involvement and Collaboration
- Economic Conditions/Trends of the Region
- Environmental Justice Concerns
- Long Term Outreach Plans
- Problems and Priorities for Disadvantaged Communities and Economically Distressed Areas

16.2 Definitions of Disadvantaged Communities and Economically Distressed Areas

The California Water Code (CWC) §79505.5(a) defines a “Disadvantaged Community” as being “a community with an annual median household income (MHI) that is less than 80 percent of the statewide annual MHI”. Relying on this definition and the most recently available American Community Survey Census data (2012-2016, for which there is corresponding MHI for California Communities from 2014) indicating the statewide annual MHI to be $63,783 means communities with MHI of less than 80 percent or $51,026, are considered a Disadvantaged Community.

Proposition 1, the Water Quality, Supply, and Infrastructure Improvement Act of 2014, (also referred to as the “2014 Water Bond”) includes a definition for an EDA that includes disadvantaged communities that have a state median household income (MHI) less than § 85 percent of the statewide annual MHI as a determining factor, but also including other factors such as financial hardship, unemployment and population density. This definition is based upon CWC §79702(k).

CWS §79702(k) “Economically distressed area” means a municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 20,000 persons or less, with an annual median household income that is less than 85 percent of the statewide median household income, and with one or more of the following conditions as determined by the department: (1) Financial hardship; (2) Unemployment rate at least 2 percent higher than the statewide average; and (3) Low population density.

The DWR developed the Economically Distressed Area (EDA) Instructions and Mapping Tool in response to Proposition 1. The EDA instructions[29] are intended for prospective applicants for Proposition 1 grant and loan programs that include a consideration for EDA, such as a waiver or reduction in the mandated local cost share. The applicant’s ability to demonstrate they meet all the EDA applicable criteria and grant-specific requirements determines success in obtaining grants.

Severely Disadvantaged Communities are defined in the California Water Code §13476(j) as those communities with a MHI less than 60% of the statewide MHI.[30] Based upon the census numbers noted above, the threshold income to qualify for Severely Disadvantaged Community designation for the Southern Sierra Region is $38,270.

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[29] Department of Water Resources, *Proposition 1 Economically Distressed Area Instructions*, and related information accessible at DWR website: https://www.water.ca.gov/LegacyFiles/irwm/grants/docs/Resources/EDA/Final_Proposition%201_Economically%20Distressed%20Area%20Instructions.pdf

[30] A Severely Disadvantaged Community is a community with a Median Household Income of less than 60% of the Statewide Median Household Income.

16.3 Disadvantaged Communities and Economically Distressed Areas in the Region

Figure 6.1 shows the general locations classified as Disadvantaged Communities (DACs) and Economically Distressed Areas by the State of California based upon data for Census Designated Places (CDP) within the Southern Sierra Region. A CDP is a concentration of population without legally-defined corporation limits. These are defined by the US Census Bureau for statistical purposes only and may not represent actual population centers. CDPs are populated areas that generally include one officially designated but currently unincorporated small community, for which the CDP is named, plus surrounding inhabited countryside of varying dimensions and, occasionally, other, smaller unincorporated communities as well.

Some large areas in the Region (white areas in Figure 6.1) are not classified as DACs or EDAs, but these are primarily National Park and National Forest lands that have very low population density.

The DACs and EDAs cover areas with a total population of 16,084. This represents 50.2% of the permanent regional population of 32,040. These areas are targets in outreach efforts as part of the Planning Grant and beyond. The Region has a low permanent population because of its rural and mountainous nature but the Region accommodates millions of seasonal and part-time visitors each year.

Historically, DWR has reduced the grant cost share requirement for areas that have DACs. For instance, IRWM Planning grant cost shares are normally 50%, but the SSRWMG had their cost share reduced to about 25%. Future cost share requirements may vary, but the RWMG may receive a similar reduction for IRWM Implementation Grants.

DACs have been an integral part of the planning and implementation process. Springville, an EDA and a Severely Disadvantaged Community (SDAC, as confirmed by a community survey) represented by the Springville Public Utilities District, has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential information in the initial IRWMP.

DACs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in DACs in the Region. Supporting and planning projects and adapting to drought and climate in DACs will be a major focus of the IRWMP update proposed herein. The RWMG seeks to continue to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties Overlay DAC efforts. The RWMG participates in both efforts and will apply information learned since 2008 about the needs in these communities as well as apply information from other DAC-active groups such as the Inyo-Mono RMWG's DAC work to the IRWMP update to best engage and partner with DACs.

EDAs have been an integral part of the planning and implementation process. Springville, an EDA and DAC, represented by the Springville Public Utilities District has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential information in the initial IRWMP.

EDAs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in EDAs in the Region. Supporting and planning projects and adapting to drought and climate in EDAs will be a major focus of the IRWMP update proposed herein. EDAs are a relatively new classification under Proposition 1. The RWMG seeks to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties Overlay DAC/EDA efforts. The RWMG participates in both efforts and will apply information learned since 2008 about the needs in these communities as well as apply information from other DAC-active groups such as the Inyo-Mono RMWG's DAC work.

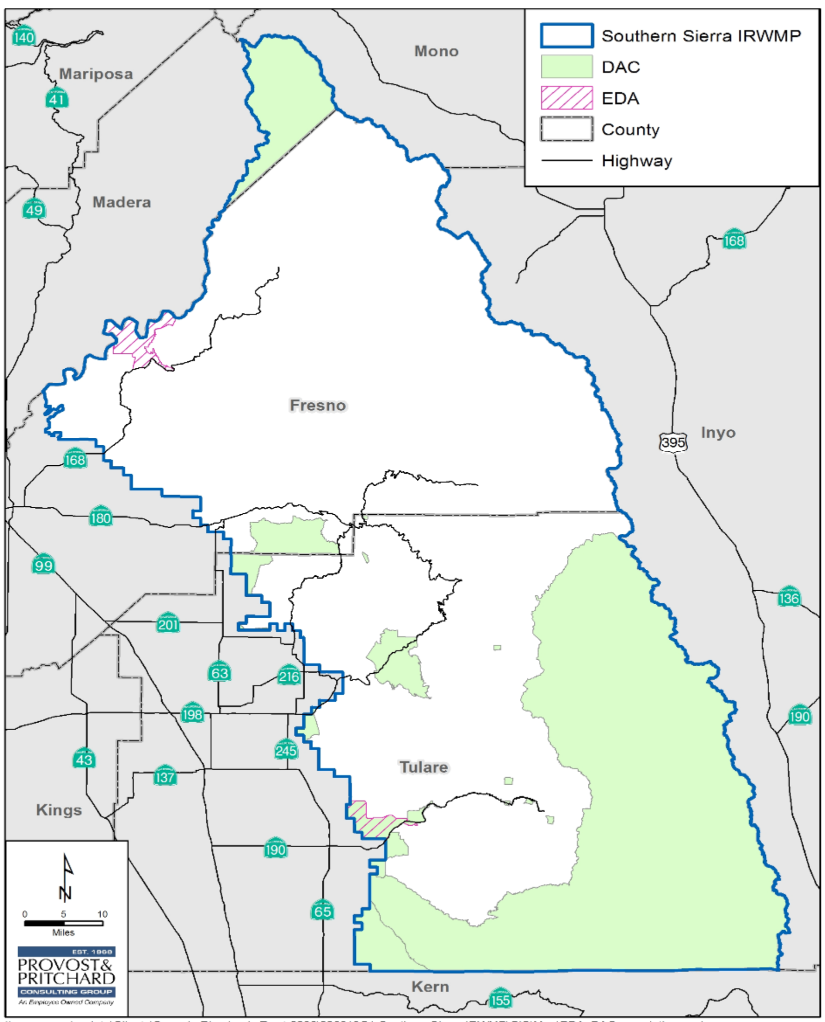

Figure 16-1 General Locations of Disadvantaged Communities and Economically Distressed Areas in the Southern Sierra Region

For IRWMP purposes, the primary data sources for the DAC determination were the Disadvantaged Community Place, Tract and Block Group shapefiles downloaded from the Disadvantaged Communities Mapping Tool established by DWR. This data telescopes down from the broad US Census CDP to smaller tract and block group geographies allowing a more precise identification/location of DACs. Similarly, the DWR EDA Mapping Tool web page was used to indicate which block groups were considered Economically Distressed. Care was taken to confirm that the newly identified EDA communities met the combinations of criteria for income, total population, and unemployment (EDD). Geographic areas were included if they met either the DAC or EDA criteria. DACs identified at the block group, tract and place levels were all combined as they did not overlap geographically (preventing double counting). Finally, the population estimates for DACs/EDAs were compared to those for the entire SSIRWMP boundary to obtain a percentage of approximately 50%.

The following areas were thought to potentially be DACs, but the RWMG was not able to verify this due to insufficient localized data and so were eliminated but should be verified if possible in the future:

- Biggers Ponderosa Trailer Park
- Driftwood Mobile home Park
- Kings Canyon Mobile Home Park
- Oak Knolls Trailer Park
- Trailer Isle Park

Due to finer grained evaluation conducted for the Tulare Lake Basin Disadvantaged Community Water Study[31], a few other communities thought to be DACs were able to be confirmed to *not* be DACs, as follows:

- Miramonte
- Sierra Masonic (Water Company)

Table 16.1 below identifies 14 communities/water companies that are likely DAC or EDA according to the definitions provided above and pursuant to DWR Mapping Tool, with some further refinement based upon data collected for the Tulare Lake Basin Disadvantaged Community Water Survey, and some local knowledge. Figure 6.2, immediately following Table 6.1, shows the locations of these communities.

[31] *Disadvantaged Community Water Study for the Tulare Lake Basin,* prepared for the County of Tulare under Department of Water Resources Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84) grant agreement. Prepared by Community Water Center, Provost & Pritchard Consulting Group, Self-Help Enterprises and Keller Wegley Consulting Engineers. August 2014.

Table 16-1 SS IRWMP Region Disadvantaged Communities with Less than 80% of Statewide Median Household Income and Economically Distressed Areas with Less than 85% of Statewide Median Household Income

Location Name	Population	Median Household Income (MHI) 2014	Percent of Statewide MHI ($63,783) 2014	Severely Disadvantaged < 60% of Statewide MHI ($38,270)
Doyle Mobile Home Park	22	NA	-	-
Lake Success Mobile Lodge	20	$38,393	60%	no
Tooleville Water Company	350	$29,354	43%	yes
Pine Flat Water Company	110	$23,558	37%	yes
Community of Posey	79	$23,558	37%	yes
Springville Public Utility District	1300	$35,682	57%	yes
Riverkern Mutual Water Company	336	$38,139	59%	yes
Sierra Glen Mobile Home Park	22	$35,341	55%	yes
California Hot Springs Water Company	75	$23,558	37%	yes
Community of Hartland	36	NA	-	-
Mary Lou Mobile Home Park	52	$41,379	65%	no
Mt. Ararat Mobile Home Park	41	$41,379	65%	no
New Auberry Water Association	200	$41,379	65%	no
Rio Vista Mobile Home Park	20	$42,188	66%	no

Source: U.S. Census, American Community Survey, 2014 (most recent data). Median income is for all households, regardless of household size.

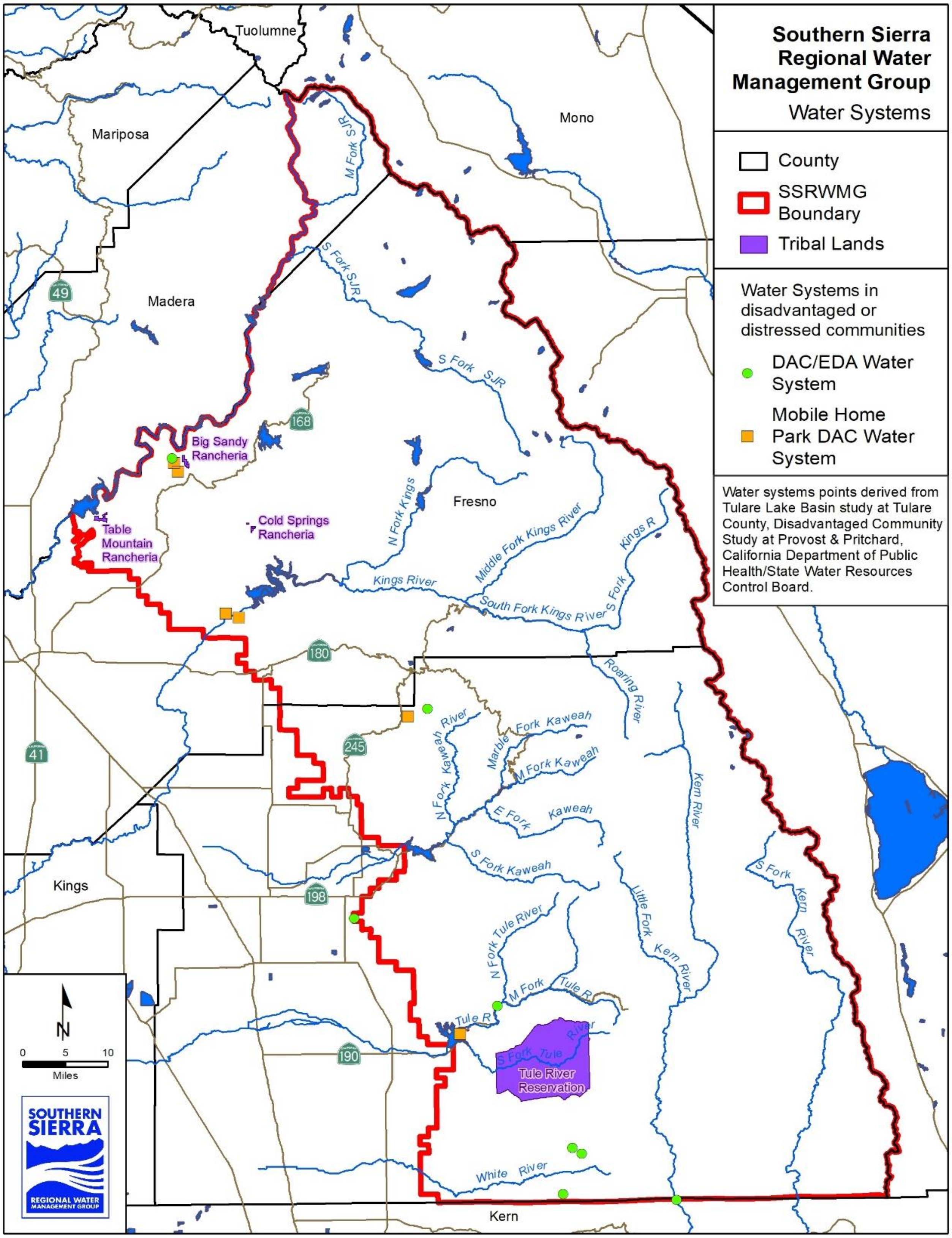
Southern Sierra Regional Water Management Group
Water Systems
County
SSRWMG Boundary
Tribal Lands
Water Systems in disadvantaged or distressed communities
DAC/EDA Water System
Mobile Home Park DAC Water System
Water systems points derived from Tulare Lake Basin study at Tulare County, Disadvantaged Community Study at Provost & Pritchard, California Department of Public Health/State Water Resources Control Board.
Tuolumne
Mariposa
Mono
Madera
Fresno
Kings
Kern
Big Sandy Rancheria
Table Mountain Rancheria
Cold Springs Rancheria
Tule River Reservation
M Fork SJR
S Fork SJR
N Fork Kings
Middle Fork Kings River
Kings River
South Fork Kings River
S Fork
Kings R
Roaring River
Kern River
Little Fork Kern River
S Fork Kern River
Kaweah River
N Fork Kaweah
Marble Fork Kaweah
M Fork Kaweah
E Fork Kaweah
S Fork Kaweah
N Fork Tule River
M Fork Tule R
Tule R
S Fork Tule River
White River
49
168
180
41
245
198
190
0 5 10
Miles
SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Figure 16-2 Locations of Identified Disadvantaged Communities and Economically Distressed Areas

Because of the lower income levels generally found in the permanently populated areas of the Southern Sierra Region, many communities meet the definition of a Disadvantaged Community. However, there is a significant difference in capacity between a (relatively) larger Disadvantaged Community such as the community of Springville with approximately 1300 people and a small or severely disadvantaged community such as Hartland (population of 32). All disadvantaged communities have needs that should be recognized, but smaller communities may have greater disadvantages in terms of their ability to prepare competitive grant applications, participate in regional efforts, and stay apprised of technology and regulations.

The San Joaquin Valley is traditionally rural by nature, and although Valley cities and unincorporated communities are growing, the agricultural nature of the region ensures that much of the population remains dispersed throughout the vast expanse of the Valley and foothills and private inholdings within public lands that dominate the Sierra Nevada mountains. The Southern Sierra region is peppered primarily with small and even tiny communities and private inholdings within federal lands, which can only continue to exist if their basic infrastructure needs can continue to be met and many of the communities aren't aware of the scope, nature or potential to solve problems they already have. Water is the most essential, and the most local, of these needs. While there are small special districts or mutual water companies that provide domestic water service to some of the rural communities, their capacity is very limited. Operating a well and maintaining a simple distribution system is one thing, but when water treatment plants or other sophisticated improvements are needed, these systems' small size and on-going operations and maintenance are crippling. They lack the economy of scale to spread costs over many users, and they often lack commercial or industrial users who could contribute revenues. The extremely low density, dispersed, rural, residential character of the rugged foothill and mountain areas within the Southern Sierra Region is therefore commonly served by individual wells and septic systems.

In addition to economy of scale, other unique challenges faced by small Disadvantaged Communities and Severely Disadvantaged Communities include:

- Geographic isolation, making consolidation challenging
- Low revenues and high delinquency rates
- Small or nonexistent reserve funds
- Dependence on a sole source of water
- Small pools of interested, informed individuals who can run the water systems and governing boards
- Lack of equipment and other resources
- Lack of access to technology in an increasingly technological world
- Limited ability to hire paid staff or consultants
- Isolation or exclusion from regional or state dialogue around water policy
- Lack of office space and record storage

16.4 Social and Cultural Characteristics of the Region

The Southern Sierra Region comprises the foothill areas of and the primarily western slope of the Sierra Nevada Mountain Range within the eastern roughly 50-60 percent of Fresno and Tulare Counties and the small portion of Madera County containing the upper SE aspects of the San Joaquin River Watershed. Following an unnamed tributary NE of Mammoth Pool Reservoir. The foothill areas are dominated by agricultural activities (primarily rangeland) with rural residences scattered on agricultural or other open space lands, numerous relatively small unincorporated communities and other pockets of residential and small-scale commercial development.

The rising slopes of the Sierra Nevada are largely held by the US National Forest Service or National Park Service, smaller federal holdings include the Bureau of Land Management and US Fish and Wildlife Service, with some scattered privately owned "in-holdings" of residential or recreation homes including mobile home parks and basic commercial support services. Individual private wells and septic systems are common, but small private water companies and water/wastewater districts are scattered throughout the Region, including Shaver Lake, Auberry/Prather, Three Rivers, and Springville. With high unemployment, lower earnings, and lower per capita income than California as a whole, the counties bordering the three national forests are facing challenges to their economic health. Thus, these communities are less able to adapt to forest management changes that would affect key economic sectors.1

The scenic and recreational resources of the Sierra Nevada and its foothills are attractive to those seeking less urban, agricultural or vacation/recreational life-styles and tourists. Relatively less expensive per-acre land cost in the Region contributes to its attractiveness. Limited public utility and other services does constrain development somewhat, and maintenance and repair of aging and strained water and wastewater treatment and delivery systems can be costly. Perpetual population growth in California and rising percentage of that growth occurring in the Central Valley and adjacent rural areas of the Southern Sierra region is expected to make this Region attractive with accompanying rise in growth rate over the next 20 years. This growth will test a Region already challenged by higher costs of hillside/mountain construction and delivery of adequate public utilities and services. The National Parks and Forests are expected to continue to attract growing numbers of travelers and companion demand for commercial and recreational support services.

Economic Diversity[2]

As noted above, stable and reliable water supply is needed to improve economic stability and diversity, accelerate the pace of job growth, maintain the quality of life for residents

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[2] US Department of Agriculture, Forest Service, *Volume 1 Draft Environmental Impact Statement,* Chapters 1-4. May 2016.
https://www.fs.usda.gov/detail/r5/landmanagement/planning/?cid=STELPRD3802842

in the region, and diversify the job base. Opportunities for diversification exist not only in the agricultural and recreational sectors, but in a limited way for both old and new industrial sectors. Industries such as metal fabrication and machinery that have emerged from the Region's historical agricultural economy are engaged in production of a wide range of components for the consumer economy. Newer business opportunities in areas such as information technology can also gain a foothold in the region as "clean" technology not requiring brick and mortar locations. Further, as the content, volume and variety of agricultural output increases, opportunities for industries supporting agriculture also increase for everything from baling wire, to motorized vehicles and equipment, to packaging products and related manufacturing. These types of economic opportunities are generally not as prevalent in the foothill and mountain areas due to their relative distance to the agricultural consumers, but they do exist.

The economies surrounding the Sierra National Forests are diversified with travel and tourism sectors accounting for more than half of all employment. The economies surrounding the Sequoia National Forest are diversified with low to no specialization across all Census County Divisions (Lin and Metcalfe 2013). National Forest System (NFS) land management planning recognizes that social, economic, and ecological systems are interdependent and as such, requires the consideration of social, economic, and ecological factors in all phases of the planning process. National forest management can influence social and economic conditions relevant to a planning area, but cannot ensure social and economic sustainability, because many factors are outside the control and authority of the responsible official. For that reason, the 2012 Planning Rule requires that plan components contribute to social and economic sustainability within Forest Service authority, and the inherent capability of the plan area. Every year, the Region plays hosts to millions of visitors, more than half of which come for recreation on public lands and waterways. As the Region's economy diversifies, demand for business- and recreation-related travel will increase, with the need to develop more and better accommodations, amenities, and services.

In addition to locally generated sales tax, the counties bordering all national forests receive revenues from sales taxes on timber products and on temporary lodging from visitors to the Region. Called payments in lieu of taxes (often known as PILT or the 25 Percent Fund) are also an important consideration for local county governments. Therefore, it is important to recognize that these smaller rural counties are reliant on visitors to the national forests to contribute tax revenues essential for providing key public services.

Jobs

Typically, unemployment rates are higher in Tulare, Fresno, and Madera Counties than statewide, and this holds true for the eastern portions of those counties in the Southern Sierra Region. Consequently, these counties are continually working to create jobs, expand and diversify the economic base, and prepare the labor force for the changing global economy. The rural areas of these counties tend to be more strongly based in agriculture and rural foothill/mountain areas based in part on tourism and recreation. Because there are often relatively few non-agricultural employment opportunities in the

rural unincorporated areas, proportionally higher income levels for agricultural and recreational/tourism employment is essential to reducing the economic disadvantages of the rural foothill and mountain communities. Therefore, one of the regional priorities is to strengthen the area's historical economic base of agriculture and recreation/tourism by expanding the Region's job base supporting these industries. Jobs related to recreation/tourism and land management activities in the mountainous areas are largely dependent on National Park and Forest land development/resources management policies while more minimal job opportunities may exist in essentially land-locked areas of private inholdings within the National Parks and Forests.
It is essential for the Region's agricultural and recreation/tourism economy to remain at the cutting edge in agronomic practices and hospitality-related commerce; this will require adequate water supply and quality.

Housing

Local governments must commit to providing appropriate programs to promote a variety of housing opportunities for all income groups, which is required to be codified in the Housing Element of their General Plan. This plan must contain policy to accommodate the Regional Housing Needs Allocation (RHNA) that is formulated at the State level and distributed to the Council of Governments for local allocation.

Essential components of housing affordability in the Southern Sierra Region and thus, the ability of the Counties of Madera, Tulare and Fresno to meet targeted RHNAs, are providing not only suitable quantity of water but also healthy quality of water. Development Impact Fees and monthly user fees are commonly the primary means of funding treatment and delivery/usage of suitable domestic water supplies by public or private water purveyors.

These water delivery and usage costs commonly constitute a higher percentage of the Disadvantaged Community household incomes and budgets. As a consequence, the ability of local governments to meet their housing goals is directly affected. Often the local government must subsidize the delivery/usage costs with local money or grant funds which are generally not permanent. This problem is exacerbated in those Disadvantaged Communities who do not have community water systems and must rely on private wells. When groundwater supplies are, or become contaminated, homeowners are then compelled to spend money on bottled water or household treatment, due to the inability to afford to drill deeper wells to reach clean water. This brings the sum total of water expenses to levels exceeding $200 per month in some case in the Southern Sierra Region. Some Disadvantaged Communities are unable to afford alternatives to drinking contaminated water.

16.5 Social and Cultural Make-up and Trends of DAC and EDA in the Region

Just as it has in the Central Valley regions of Madera, Fresno and Tulare Counties, chronic high and seasonal unemployment has plagued foothill and mountain areas of these counties, as well, for more than three decades. Low per capita income and isolation from the economic engines of the coastal metropolitan areas between San Francisco Bay Area and San Diego have led to clusters of poverty in many of the smaller incorporated and unincorporated communities in foothill/mountain areas of Central Valley counties, qualifying them as Disadvantaged Communities. Many can now also be identified as Economically Distressed Areas under provisions of Proposition 1 Water Bond of 2014.

Relevant social and economic data is presented below in **Table 16.2**

Table 16-2 Socio-Economic Information for Southern Sierra Region IRWMP

	Southern Sierra Region	California
Estimated Population 2014[1]	32,030	38,066,920
Estimated Population 2016[2]	31,353	38,654,206
Median Age[1] (weighted average)	46	36
Median Household Income (MHI, weighted average)	$63,695	$63,783
MHI as % of State MHI)	99%	100%
Estimated Population 2014[1]	32,030	38,066,920
Estimated Population 2016[2]	31,353	38,654,206
Median Age[1] (weighted average)	46	36

17 Sources: [1] American Fact Finder, United States Census Bureau. American Community Survey *Notes: Median Age and Median Household Income are normalized to population estimate for block groups. More populated block groups have a larger influence on the resulting estimate.

18 Population for block groups that are only partially within the IRWMP boundary is estimated by multiplying the portion of the block group inside the IRWMP by the ACS population. Populations are not evenly distributed in space, so this is a simplification that results in a rough population estimate.

The economy of the Southern Sierra Region has been largely driven by agriculture, and recreation-related commercial businesses since the second half of the twentieth century. Despite the relative success of the agricultural economies and urban/suburban growth, the foothill region's unemployment rate has remained among the highest in California. Average wage levels in the Southern Sierra Region are substantially lower that statewide averages.

A stable and reliable long-term water supply of appropriate quality in the Region and downstream of it will need to be sustained into the future to allow both the recreation and agricultural-based economy to continue to thrive and to invigorate more economic diversity within the Region and State as a whole. Water supply reliability and water quality in the State depends on snow-pack and related headwater conditions within the Sierra Nevada. Thus, water management in regions of the State like the Southern Sierra Region are critical to maintaining downstream local economies in several primary sectors: job creation, economic diversification, housing, agriculture and food security, air quality, and water treatment. Water districts, counties, cities, private sector, and other organizations will need to create good jobs at a faster rate than population growth and at proportionately higher average wage levels than in the past to help the Region recover from the past mid-century and early current century recessions.

In the meantime, the State has legislated that the watersheds and headwaters of Sierra and other mountain streams form a critical “green” infrastructure which deserves to be recognized and treated as such, with associated funding allocations and attention.

In addition, some federal land managers have recognized how humans and natural resources interconnect in watersheds.

16.6 Tribal Government Involvement and Collaboration

Within the Southern Sierra IRWM Plan boundary there are four Federally recognized Native American tribes: Big Sandy Rancheria Band of Western Mono Indian Tribe, Table Mountain Rancheria of the Chukchansi band of Yokuts and the Monache Tribe, Cold Springs Rancheria of Mono Indians of California, and the Tule River Indian Tribe. The Big Sandy Rancheria Western Mono Indian Tribe is a signatory member of the Southern Sierra RWMG and the Tribal Council adopted the 2014 IRWMP. Income data for these Indian Tribes is not readily available from US Census or CA Department of Finance or other publicly available data bases. Many indicators, including the extent of water-based issues, including supply, quality and sustainability all indicate that the tribal areas may be EDA/DAC. A community survey in the Big Sandy Rancheria indicated that the area is Severely Disadvantaged. Therefore, all Tribes were included in this IRWMP’s Disadvantaged Community Outreach Program.

16.7 Environmental Justice Concerns

DACs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in DACs in the Region. Supporting and planning projects and adapting to drought and climate in DACs will be a major focus of the IRWMP update. The RWMG seeks to continue to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties regional DAC efforts. The RWMG participates in both efforts and will apply information learned since 2008 and the 2014 IRWMP to focus resources in these communities and their surrounding watersheds to provide a sustainable resource and assistance base. These efforts can provide technical service, planning and implementation services, grants and loans.

The RWMG continually identifies the communities in the Region which are priorities for outreach and engagement and prescribes actions based on overall and specific outreach strategies. The overall goal is to identify all possible communities, and contact points, including those communities adjacent or on the regional boundary. Once these communities are identified with appropriate contacts, materials are regularly sent to stakeholders, the materials relate to meetings, programs, projects or funding and are posted and linked/cross-linked to website and also cross-referenced and linked via social media. Then, social media visits, views and website visits and views can be tracked. Meeting participation, briefings and other items are also utilized to track responses, engagement and refine future actions (see Appendix N).

Direct engagement is very important in the Region, in particular to address social justice considerations. Direct engagement in the many locations in remote areas in the Region includes:

- Flyers, materials and articles posted and written in relevant communities;
- Presentations and discussions at chambers of commerce mixers, community events and town halls;
- Incidental contacts and discussions in communities;
- Discussions with landowners and agencies;
- Formal and informal briefings;
- Responses to agency or other outreach efforts.

During direct engagement and contact activities, participants will be asked to respond to some simple questions which may be standardized into a questionnaire. These data will be utilized to encourage, facilitate and track issues, needs and engagement from the communities.
Aside from the general watershed education and IRWMP information, the RWMG developed and distributed the following materials for work with project proponents, DACs and tribal entities:

- Regional Projects handout;
- Integrated Projects Handout;
- Climate Change Handout;
- Funding and proposal-specific materials.

The objectives for the material distribution include:

A. Distribute materials to the public and stakeholders in a variety of formats during and after the IRWMP-update process;
B. Develop standardized tracking, data, and outreach forms and tracking 2018-19 to track locations, responses and numbers.

The RWMG has compiled the communities, tribal entities, the majority of their reported incomes and their DAC status, where possible.

The locations without previous contact, or those with a change in staff, leadership or status indicate the need for engagement and feedback during outreach activities. The larger entities, servicing the most people, with lowest capacities are the highest priorities, generally. Feedback from these entities and others who were already contacted will form the basis for additional outreach, funding, projects, programs and future IRWMP updates.

16.8 Long Term Outreach Plans - Strategies to Overcome Barriers and Promote Increased Involvement

The Southern Sierra RWMG and Southern Sierra Region IRWMP plans to focus on continued outreach to the Disadvantaged Communities and encourage participation in the IRWM process, as well as support project development and implementation to accomplish water quality Goals and Objectives as part of the Southern Sierra Region plan. The Southern Sierra RWMG will produce an annual report, when deemed necessary, with an updated list of proposed projects in the region, which will include Disadvantaged Community projects that meet regional Goals and Objectives. To support this goal the Southern Sierra RWMG will be committed to continuing to encourage them to join the RWMG, fostering relationships with the Disadvantaged Communities, and maintaining an updated list of the Disadvantaged Communities within the region and their primary contact information.

16.9 Problems and Priorities for Disadvantaged Communities and Economically Distressed Areas

Aside from income level, the Disadvantaged Communities of the Southern Sierra Region have several significant obstacles to surmount to obtain sustainable safe drinking water supplies, provide sewer services and plan for flooding/stormwater related issues. Those obstacles include water quality, Technical, Managerial and Financial (TMF) Capacity, economies of scale, aging or inadequate infrastructure, and geographical location. Informal canvassing of Disadvantaged Community members also revealed the following concerns affecting participation in the IRWM process:

1.) Lack of computer technology to receive info. Disadvantaged Communities often prefer direct mailings and postings at Churches, Community Centers (Self Help has some at their multi-family developments, for example) and printed messages coming home with their kids from school. Those that have access to the internet will commonly spread information they receive by word of mouth.

2.) Method of presentation of information. Print material should not be overly technical, or overly wordy…keep it simple, use lay terms and graphical illustrations to help convey essential message. Notices should be colorful or in other ways "attention grabbing". Water related notices, surveys, etc. should state boldly the material is IMPORTANT INFORMATION ABOUT WATER. Encouragement in the printed materials and verbal prompts from kids should read "Important: be sure and read!" (Otherwise they won't read it or will just throw it away.)

3.) Meetings are preferable following notices. Residents of Disadvantaged Communities prefer face-to-face contact rather than more impersonal written material. They prefer to attend meetings to ask questions and get additional detail. Being able to meet and build relationships with regulators and consultants face-to-face also builds more trust and helps them to feel less disenfranchised.

4.) Need known points of contact. Residents of Disadvantaged Communities like to have identified community leaders or agency representatives to whom they can express concerns, issues and questions about water by phone or personal contact; not by email, and from whom they can receive regular updates or information from.

5.) There's a lack of meaningful information on the drought reaching the Disadvantaged Communities. Residents of Disadvantaged Communities hear there's a drought, but they don't really understand what that means to them or how or in what ways it may be actually affecting their little community, and more importantly what can or will be done about it to help them. Good imagery that tells the story of how much groundwater levels are dropping, specifically in their community, not just averages county- or state-wide is more useful to them than lots of numbers or statistics. They are hungry to be educated but not with too much technical-speak that is over their heads.

6.) Not as concerned about quality as for availability of water. They know they should be concerned about quality if they get a notice that their water is bad or bordering bad. But they're not sure what to do when they experience declining quantities.

7.) Borderline Disadvantaged Communities still need help. There are many foothill communities in the Madera IRWM Region where average incomes are just above the threshold to be designated as DACs, but who need help with water issues nonetheless.

Water Quality

Occasionally (in some cases, regularly), Disadvantaged Communities are issued "unsafe to drink" or "boil water" orders requiring the use of bottled water exclusively for consumption purposes. Many Disadvantaged Communities with small water supply systems in the Region have a long and documented history of water quality issues including nitrate, uranium, arsenic, volatile organics and a variety of other constituents.

Some of the origins of contamination are naturally occurring, such as arsenic or uranium, which are common by-products related to the geology of the area and may become unsafe with deeper wells in some areas. In other cases, origins of the contaminants are related to land use: point source and nonpoint source discharges from agricultural operations, food processing, dairies, and human wastes from failing or improperly maintained septic systems. The potential solutions are as varied as the contamination sources and are difficult to standardize across multiple communities due to variables such as geographic location, local hydrologic conditions and chemistry, water system size, water source, and local preference. However, the Three Rivers Water Supply Study [insert reference] provides a relatively comprehensive analysis of the wells, their contaminants and some possible solutions. Solutions often include the following: drilling new or deeper wells or modifying existing wells to access different parts of the aquifer; treatment facilities; source blending; consolidation in a variety of forms; or conversions to either community water or sewer services. Occasionally, cease-and-desist orders may be issued to individual polluters, but typically this is not an immediate solution because many types of pollution tends to persist long after the discharge stops.

Consumer Confidence Reports for County-operated drinking water systems (Maintenance Districts and Service Areas) and complete assessments for these systems can be found at the Division of Drinking Water website1 These reports contain data from sampling results for detection of coliform bacteria, lead, copper, sodium and hardness, and contaminates with a primary drinking water standard and with a secondary drinking water standard.

Technical, Managerial and Financial Capacity & Economies of Scale

Technical, Managerial, and Financial (TMF) capacity is an obstacle that Disadvantaged Communities across the country struggle with on a continual basis. TMF refers to the ability of a community to have Board leadership and personnel with the necessary technical and managerial skills to run the facilities, as well as community-wide financial wherewithal to afford the necessary steps required to obtain safe drinking water, provide sewer service or prevent flooding.

Due to financial constraints, it is often difficult, if not impossible, for a Disadvantaged Community to offer the competitive salaries required to maintain a skilled staff. However, due to the income levels within a Disadvantaged Community, water providers are extremely restricted in their ability to raise rates in order to provide for higher salaries. The result is a perpetual downward spiral where the Disadvantaged Community citizens continue to pay for services that can be substandard or virtually non-existent, and the water provider struggles to meet basic expenses; systems go into disrepair, often, ultimately failing, and then requiring an even greater magnitude of financial assistance to restore.

Economies of scale refer to the cost advantages that an enterprise obtains due to its relatively large size. Small Disadvantaged Communities often come out on the losing side of the economy of scale ratio. Some communities lack water systems altogether or are too small to strategically plan and therefore may compete with adjacent interests. They shoulder many of the same costs for maintenance, permitting, pumping and staffing as any other water system would, but with a smaller, poorer customer base over which to spread the cost. In this situation, the smaller Disadvantaged Communities would often benefit from operating jointly with one or more other small Disadvantaged Communities or being absorbed into a larger nearby purveyor. Each Disadvantaged Community would then only be responsible for a smaller pro-rata portion of the staffs' salaries, operating costs, consultants cost, etc. By consolidating with other nearby Disadvantaged Communities or non-Disadvantaged Communities, they could potentially hire more skilled staff and solve a portion of the TMF capacity deficiencies.

Other TMF challenges for Disadvantaged Communities can include the inability to afford to hire an adequately skilled manager. Consequently, system management often falls by default to volunteer Board members, or to an administrative person that lacks proper technical training or experience. Staff turnover, poor management and technical

[1] http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/publicwatersystems.shtml.

deficiencies can result from this situation. A small rate base also makes accumulation of reserves difficult. Small water systems often find themselves stuck in a "reactionary" operations cycle, continually focused on crises and putting out fires rather than planning ahead for capital improvements to the system. Some systems operate on a month-to-month basis like a family living from paycheck to paycheck.

These are only a few examples of the TMF challenges that Disadvantaged Communities cope with. Closer scrutiny of individual communities reveals unique situations that carry unique problems and unique solutions.

Geographical Location

As discussed previously, several of the issues associated with the Disadvantaged Communities can be solved by collaboration or consolidation with other nearby communities. However, many of the Disadvantaged Communities are geographically isolated or lack the "political mass" to negotiate with a larger nearby community, or several districts, associations or companies exist in a small area. There needs to be a motivation and adequate funding for collaboration or consolidation with all parties.

The efforts of the Southern Sierra RWMG are intended to provide a forum where Disadvantaged Communities and non-Disadvantaged Communities can come together to seek and implement solutions to the regional water supply and quality issues, regardless of geography.

Aging or Inadequate Infrastructure

The water and wastewater infrastructure of many Disadvantaged Communities is substandard, poorly-functioning or aging. The communities often lack public drinking water infrastructure and rely on shallow, inadequately constructed or sealed private wells or have old and severely leaking distribution systems that result in poor water pressure, bacterial contamination, and other drinking water challenges. Frequently, small Disadvantaged Communities lack meters and are therefore unable to monitor water use or implement conservation policies effectively. Many small Disadvantaged Communities also have inadequate or failing septic systems. A future detailed community survey to determine the infrastructure and water quality conditions and needs of the Region's disadvantaged communities and economically distressed areas would be a valuable and desirable project for the RWMG to pursue.

Chapter 17 - References

Note: This list of references does not include the numerous land and water planning documents discussed in Chapter 12 – Relation to Local Land Use Planning & Water Planning. Details of those documents are already provided in Chapter 12. In addition, other resources used in developing this study, but not necessarily referenced in the text or the list below, are found in Appendix K – Resource Database.

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Appendix A

Memorandum of Understanding

Memorandum of Understanding
Southern Sierra Regional Entity
(Date of Signing) 2009

This Memorandum of Understanding (MOU) is entered into by and among the members of the Planning Committee with regard to the formation of the Southern Sierra Integrated Regional Water Management Plan (IRWMP). The overarching vision of the IRWMP is to meet the integrated water needs of the people and watersheds of the South Sierra IRWMP region now and into the future. The IRWMP will be developed in three phases: 1) a formation (launch) phase to develop and submit an application to the California Department of Water Resources (DWR) for a Planning Grant; 2) a planning phase to develop the Southern Sierra IRWMP and; 3) an implementation phase to implement the plan. The Southern Sierra Regional Water Management Group (hereinafter referred to as the "Southern Sierra Planning Committee" or "Planning Committee") will be realized through this MOU for the purpose of phases one and two of the IRWMP.

1 Purpose

This MOU is a statement of mutual understanding among the Planning Committee members to acknowledge the intentions of the parties and provide for cooperative action regarding:

- The roles and responsibilities of the parties in IRWMP formation, including the sources of funds and in-kind technical assistance
- The structure that will be used to exchange information with the Southern Sierra Planning Committee, Coordinating Committee, and other interested parties, and the public to provide for technical review and public support for formation of the IRWMP.
- The general work plan that Southern Sierra stakeholders will complete to form the IRWMP.

1.1 Duration of this Memorandum of Understanding

This MOU will remain in effect from the date of signing for 3 years or until replaced by another form of agreement by the Southern Sierra IRWMP Planning Committee.

1.2 Southern Sierra Preamble from the IRWMP

This IRWMP is not intended to, and it does not, impose legally binding requirements on the entities that adopt or participate in the IRWMP. The IRWMP's purpose is to summarize the process and the plan developed by the Southern Sierra Region stakeholders to meet their common goals of achieving sustainable water supplies and uses, improved water quality, environmental stewardship, efficient urban development, protection of agriculture, and a strong economy.

Although the IRWMP refers to many legally binding statutory and regulatory provisions—such as general plans, zoning ordinances, water quality plans, and various permits, licenses, and approvals; its purpose in doing so is to ensure that the IRWMP is consistent and compatible with those existing legal obligations. Rather than adding to or modifying the present legal and regulatory environment, the IRWMP is intended to streamline and improve the stakeholders' ability to operate and succeed within that environment. Thus, the IRWMP provides guidance to, but does not impose any mandates upon, the water agencies, land use agencies, local governments, watershed organizations and others who adopt the IRWMP.

2 Background

2.1 IRWMP Formation

The Southern Sierra Planning Committee intends to launch an IRWMP Planning process, which will culminate in submitting a Planning Grant Proposal to DWR soon after final guidelines are released.

2.2 IRWMP Adoption

Any organizations, agencies or individuals that support the Southern Sierra IRWM Plan may adopt it. These include such organizations as water agencies, conservation groups, agriculture representatives, businesses, tribal groups, land use entities, and local, state, federal agencies and private entities with an interest in the Southern Sierra.

Southern Sierra IRWMP Geographic Boundaries

The Southern Sierra IRWMP boundaries will include the foothills and mountain headwaters regions of the Kern, Tule, Kaweah, Kings, and San Joaquin watersheds. These watersheds cover the Sierra Nevada portion of Madera, Fresno, Tulare, and Kern Counties. The primary boundary includes the Sierra Nevada Ecosystem Project (SNEP) boundaries, but is adapted to sync with neighboring IRWMP efforts.

- To the east, the Southern Sierra IRWMP boundary is defined by the Sierra Nevada crest.
  - Rationale: Waters flowing to the west from the Sierra crest are source waters for foothill uses and management. Precipitation falling west of the crest drain the western slope of the mountain range and are connected hydrologically with the Tulare and San Joaquin basins.
- To the north, the Southern Sierra IRWMP is defined by the Upper San Joaquin watershed.
  - Rationale: The upper San Joaquin River basin is split between Fresno and Madera Counties, but the river is managed across counties. The issues on either side of the county line are similar, but contrast sharply with downstream users in intensive agricultural areas outside of the Sierra Nevada Region. The San Joaquin watershed shares many of the same issues with watersheds further south in the region.
- To the west, the Southern Sierra IRWMP is considering a boundary including the foothill areas of the region's watersheds.
  - In the Kings River Area, the SSIRWMP boundary extends the District boundaries of the Tri Valley, Orange Cove, Hills Valley Water Districts east of the towns of Orange Cove, Orosi and East Orosi. East of the City of Fresno, the boundary extends to the boundaries of the Fresno Metropolitan Flood Control District, the International Water District and the Garfield Water District.
    - Rationale: This boundary was negotiated with the Upper Kings River Forum Regional Water Management Group to match UKRF boundaries.

- In the Kaweah Delta area, the SSIRWMP boundary extends to the Kaweah reservoir or the 600-foot contour in the Kaweah River Drainage. Further, the boundary follows the RWQCB Irrigated Lands Program and generally follows surface water-ground water usage boundaries. In the aquaculture/Lewis/Avocado area, the boundary will be the 600' elevation contour and squared to section lines; the agriculture north of Elderwood will be in the KDRWMG. In Davis Valley, the Westside has small, irrigated lands while the east and the north are rangeland. The boundary will follow section lines in these areas. In Dry Creek, the boundary will follow land use: irrigated lands will be part of the KDWMG and grazing land will be in the SSIRWMP. In Mehrten Valley, the 600' contour will be the guide, most of the valley will be in KDRWMG. In Yokohl Valley, most of the western valley will be in the KDRWMG while the eastern portion of the valley will be in the SSIRWMP. In Round Valley, east of Lindsay, the KDRWMG will include a few small areas east of the ILP, the boundary will again be based on land use and squared to the section lines.
    - Rationale: This boundary was negotiated with the Kaweah Delta Water Conservation District Regional Water Management Group to match KDWCD boundaries.
- In the Tule River Area, the SSIRWMP boundary includes the Tule River Indian Reservation and down to approximately the 600-foot contour in all forks of the Tule and squared to section lines. The Deer Creek Tule River Authority planning area will follow irrigated lands while the SSIRWMP will follow rangeland.
    - Rationale: This boundary was negotiated with the Deer Creek-Tule River Authority Regional Water Management Group to match that region's planning boundaries.

- To the south, the Southern Sierra IRWMP boundary is defined by the Tulare-Kern County line.
    - Rationale: the Kern watershed's water resources will be managed by both SSIRWMP and Kern County Water Agency IRWMP. The two entities will work collaboratively in the watershed across the county boundary.

2.3 Planning Horizon

The Southern Sierra planning and implementation horizon is approximately thirty years into the future, in the range of 2038-2040. However, many Southern Sierra discussions and actions will be guided by a longer time horizon of up to fifty years into the future.

2.4 Joining and Leaving the Southern Sierra IRWMP Planning Committee

Any water stakeholder organization may join the Southern Sierra IRWMP as part of the Planning Committee (see below for description). Water stakeholders could include, but are not limited to such organizations as: water agencies, conservation groups, agriculture representatives, businesses, tribal groups, land use entities, and local, state, federal agencies and private entities with an interest in the Southern Sierra. A group who wants to join the Southern Sierra IRWMP should notify the Planning Committee of their intent to join and sign this MOU to signify their good faith effort to join.

Any entity who would like to discontinue their participation in the Southern Sierra IRWMP may do so at any time. This MOU is non-binding and non-regulatory. The Southern Sierra IRWMP Planning Committee only asks that any member who wants to leave, notify the rest of the Planning Committee at which point they will no longer be a member of the Planning Committee of the Southern Sierra IRWMP.

3 Program Management Structure

3.1 Planning Committee

The Planning Committee is the decision-making body during the SSIRWMP formation process. In that context it will oversee and approve major programmatic decisions such as funding applications and performance measures. The Planning Committee will set the overall strategic direction for formation of the IRWMP. During the planning phase, the Planning Committee or its designated Work Groups will meet at least every other month.

3.1.1 Membership

The first Planning Committee membership will be comprised of those who sign this Memorandum of Understanding. These members will commit to approximately three years on the Planning Committee or until the SSIRWMP is complete.

The Planning Committee strives to ensure its membership represents a broad range of interests, including: water supply, water quality, environment/habitat, recreation, agriculture and ranching, resource management, hydropower, cities/counties, sanitation, other water resource management areas, economically disadvantaged local communities and individual local stakeholders interested and willing to participate. In order to cover these interests, members may include, but are not limited to: water agencies, resource agencies, conservation groups, tribes, agricultural and ranching interests, cities, counties, education organizations, disadvantaged community representatives, private landowners, and businesses.

Planning Committee membership will be comprised of those who sign this MOU before submission of the planning grant proposal. Planning Committee members must be committed to ensuring long-term ecosystem health of the areas watersheds, water supply, water quality, involvement of the local communities, especially disadvantaged communities; and the protection, preservation and restoration of natural resources of the Southern Sierra region; and agree to work constructively with others.

The Project Manager will check in with Planning Committee members on regular basis to reconfirm their intent to actively participate and their primary representative. This will not be binding or require the member to re-sign the MOU. This activity is merely intended to give the Project Manager and Planning Committee the most updated list of active Planning Committee members and primary and alternate representatives. Membership in the Planning Committee may change to accommodate evolving circumstances, such as changes in individual organizational capacity or participation.

Planning Committee members agree they will strive to support the Southern Sierra IRWMP through a variety of supporting activities, which may include in-kind contributions and/or funding.

3.1.2 Representation

Each member organization will identify their lead representative for the Planning Committee and will make their best effort to attend Planning Committee meetings to make decisions. Planning Committee members may choose to identify alternates but they are encouraged to have one representative attend the IRWMP Planning Committee meetings for consistency.

3.2 Coordinating Committee

The Coordinating Committee, appointed by the Planning Committee, is a smaller, representative group of the Planning Committee that meets between Planning Committee meetings to assist staff with process planning, recommendations for process modifications, communications, and other issues for which staff needs advice. The Coordinating Committee may also provide more consistent fiscal oversight in helping to manage the IRWMP with the fiscal sponsor. Ultimate decision-making still resides with the Planning Committee. Membership in the Coordinating Committee may change to accommodate evolving circumstances (such as changes in individual organizational capacity or participation history) by consensus of the Planning Committee. The Coordinating Committee meets every month during planning stages and then every other month thereafter. This schedule could change again during implementation planning.

The Coordinating Committee may play a role in developing substantive proposals and policy, at the request and subject to the approval of the Planning Committee, but has no decision-making authority.

4 Formation Funding

4.1 Funding

Funding for the launch and planning phases will come from grants. Southern Sierra IRWMP anticipates that financial support for the regional entity will ultimately come from projects funded through the Southern Sierra IRWMP, but during the formation period (the formation period will end with a planning grant from DWR or other organization) will come from a portion of the launch and planning grants.

The Planning Committee agrees they will strive to support the Southern Sierra IRWMP through variety of supporting activities during the formation period.

4.2 Fiscal Agent

Fiscal Agent for IRWMP Launch

Sequoia Riverlands Trust shall serve as Fiscal Agent for the Southern Sierra IRWMP Launch phase. Duties include administering grant funds, coordinating meetings for the Coordinating Committee and Planning Committee, making meeting notes and notices publicly available, maintaining a webpage where IRWMP documents can be accessed.

Fiscal Agent for Planning Grant

The Planning Committee will choose a Fiscal Agent for the Southern Sierra Planning Grant Proposal to DWR and the Planning Phase. This entity will have custody and responsibility for administering all funds of the Southern Sierra regional entity, including without limitation deposit and disbursement of said funds and accounting of all business transactions of the regional entity. Fiscal oversight will still be performed by the Planning Committee and Coordinating Committee.

Any budget line item change over $1,000 should be considered by the Coordinating Committee, as the fiscal oversight of the IRWMP.

Any budget line item change over $10,000 must be reviewed and approved by the Planning Committee

Annual Financial Reporting
At the close of each calendar (or fiscal) year, the fiscal agent(s) and individual project partners shall provide a complete accounting of fiscal activity related to Southern Sierra IRWMP and associated projects to the Planning Committee.

5 Public Outreach and Participation

5.1 Planning Committee Meetings

The Planning Committee will meet at least every other month and schedule additional meetings if necessary to ensure effective planning of the SSIRWMP. All Planning Committee meetings are open to the public. Interested parties are welcome and encouraged to attend to share concerns about the Plan and learn about the IRWMP. Highlights from the Planning Committee meetings shall be distributed to the Southern Sierra Planning Committee and posted on the web for public viewing.

5.2 Public Forum / Interested Parties

The public forum refers to the general public and broad range of organizations interested in the Southern Sierra process that seek information about Southern Sierra activities either by attendance at meetings or through other means of communication. The Southern Sierra IRWMP maintains an interested party or stakeholder email list. Email list participants receive notice of all Southern Sierra meetings and all other announcements about the Southern Sierra planning process.

5.3 Public Noticing and Transparency

Southern Sierra meetings are noticed via an inclusive email list discussed above. In addition, Southern Sierra IRWMP will begin sending meeting announcements to all the public agencies involved in the process and encourage them to post Southern Sierra Planning Committee meetings on their web pages and to announce through agency noticing procedures. Planning Committee member entities are not responsible for compliance by Southern Sierra with public agency noticing requirements. The Southern Sierra IRWMP shall maintain a publicly accessible website displaying a calendar of meetings, agendas, meeting notes, list of participants, and when appropriate, a brief description of accomplishments, partners and overall mission of the IRWMP.

In preparation for Planning Committee meetings, which will involve decision-making, the Planning Committee will be noticed that there is a decision-making meeting 2 weeks in advance of the meeting. This notice can be by email with the agenda if available at that time.

5.4 Briefings and Outreach

Southern Sierra IRWMP stakeholders representing their own organizations regularly conduct briefings with local elected officials and other organizations interested in Southern Sierra or in which Southern Sierra IRWMP would like to extend its reach. Southern Sierra IRWMP periodically prepares briefings materials and makes presentations at conferences and meetings. Only the Project Manager or a designated representative may make public statements on behalf of the Southern Sierra IRMWP as an entity.

6 Planning Committee Decision Making

6.1 Decision Making Rule

6.1.1 Consensus as the Fundamental Principle

The Planning Committee shall base its decision-making on consensus (agreement among all members) in all of its decision-making. Working toward consensus is a fundamental principle of the Southern Sierra IRWMP process.

6.1.1.1 Definition of "Consensus"

In reaching consensus, some Planning Committee members may strongly endorse a particular proposal while others may accept it as "workable." Others may be only able to "live with it." Still others may choose to "stand aside" by verbally noting a disagreement, yet allowing the group to reach a consensus without them if the decision does not affect them or compromise their interests. Any of these actions still constitutes consensus.

Since the IRWMP has no regulatory authority, any decisions it makes cannot regulate or force another entity against its will to take an action not in its interest. All decisions and projects will be made and developed under the consensus rule except as noted in Section 6.1.1.2 below.

6.1.1.2 Workgroups

Workgroups give input and recommendations to the Planning Committee. But all decisions will be approved by the Planning Committee as a whole.

6.1.1.2 Less than 100% Consensus Decision Making

The Planning Committee shall not limit itself to strict consensus if 100% agreement among all participants cannot be reached after all interests and options have been thoroughl*y* identified, explored, discussed and considered. Less-than-consensus decision-making shall not be undertaken lightly. If, after full exploration and discussion, the Planning Committee cannot come to 100% agreement, it will use the less-than-consensus decision-making protocols as described below. For proposals or the Plan to be endorsed by the Planning Committee, it must pass the test identified in (a) below.

a) Broad Support of the Planning Committee Membership

The Plan or proposal must be endorsed by 75% of the total number of *active* members of the Planning Committee. (In other words, the Plan cannot be opposed by more than 25% of the total number of *active* members of the Planning Committee.) *Active* participation is defined in Section 6.1.1.3.

6.1.1.3 Definition of Active Participation by Planning Committee Members

Active participation means regular attendance at Planning Committee meetings; regular participation in at least one Work Group or ensuring that a designee of the Planning Committee member's organization participates in a Work Group under the Planning Committee member's close guidance; and reviewing planning and other written documents before discussions or decisions will be made. It is understood that occasionally Planning Committee members may need to miss a Planning Committee or Work Group meeting, or both meetings. If there is a question as to whether a Planning Committee member should be considered "active" for purposes of decision-making, the Coordinating Committee will make that determination by communicating with the member or determining whether the stakeholder is active or not based on recent participation.

7 Revisions to the MOU

Any revisions to this MOU must be made through the decision-making process outlined in the section above on decision-making.

Signature Page

Date: ______________________

_________________________ ____

Name (Signature) Print Name

____

Organization

Primary Representative:
Email: ____
Telephone: ____
Address: ____

Alternative Representative:
Email: ____
Telephone: ____
Address: ____

REFINEMENTS TO THE SSIRWMP M.O.U.
SOUTHERN SIERRA IRWMP
Adopted on May 10, 2012

The following materials are refinements and clarifications to the existing "Memorandum of Understanding, Southern Sierra Regional Entity," originally dated 2009. The materials do not replace the M.O.U., they merely provide additional details to eliminate ambiguity, and additional protocols on a few important topics that were not yet addressed. Together they form the governing documents of the Southern Sierra IRWMP's Regional Water Management Group.

1. Program Management Structure (Section 3)

3.3 Change of "Planning Committee" term to "Regional Water Management Group"
As of July 2012, the "Planning Committee" will be referred to as the "Regional Water Management Group" (RWMG). Per IRWM guidelines (August 2010, Section 4-A-1, Governance, page 19), the RWMG includes three or more local agencies, at least two of which have statutory authority over water supply or water management. These two agencies share decision-making authority with the other members of the RWMG. All other aspects of the Memorandum of Understanding apply.

3.4 Change of "fiscal agent" term to "grantee"
As of July 2012, the term "fiscal agent" will be replaced with "grantee," for consistency with IRWM guidelines (August 2010), which defines "grantee" as the grant recipient (page 32).

3.5 Additional RWMG Roles and Responsibilities
Per the existing M.O.U., the RWMG will continue to oversee and approve major programmatic decisions, such as funding applications and performance measures, and will continue to set the overall strategic direction for formation of the IRWMP. Additionally, members of the RWMG will (1) review in advance of meetings and provide feedback on draft work products; (2) adopt final work products; (3) contribute expertise, data, and information to clarify discussions, eliminate false assumptions, and advance innovation; (4) communicate information to and from their agencies, organizations, and/or constituencies; and (5) act in a manner that will enhance trust among all participants.

3.6 Additional Coordinating Committee Roles and Responsibilities
Per the existing M.O.U., the Coordinating Committee will continue to assist staff with

process planning, recommendations for process modifications, communications, and other issues for which staff needs advice; may also continue to provide more consistent fiscal oversight; and may also play a role in developing substantive proposals and policy, at the request and subject to the approval of the Planning Committee. Additionally, the Coordinating Committee will help to prepare for RWMG meetings by reviewing and helping to develop meeting materials, and by reviewing draft work products, as needed.

3.7 Additional Membership Requirement

Members of the RWMG must be part of a public agency, an organization, a business, a California Native American Tribe, or other group that represents a public interest and has signed the M.O.U. The M.O.U. identifies the primary representative and alternate; to keep information up to date, members are required to submit a letter written on letterhead indicating if their primary representative or alternate changes. Alternates are encouraged to attend as much as possible to maintain continuity of the discussions. A single person may represent more than one agency, organization, business, Tribe, or other group, so long as they have documentation of their role from each entity they represent. The RWMG does not include individual members of the public. Individual members of the public who are interested in and concerned about the Southern Sierra IRWMP are requested to join the list of interested parties (see section 5.2.1).

5.2.1 Additional Information on Public Forum / Interested Parties

[This section augments the existing 5.2 Public Forum / Interested Parties]

All interested parties are welcome to attend and participate in RWMG meetings and other Southern Sierra IRWMP events. As specified in the existing M.O.U., the RWMG maintains a list of interested parties for the purpose of noticing meetings and other public events, and sharing news and information. The list may also be used to solicit feedback to the RWMG at appropriate times. The list includes individual members of the public, as well as members of agencies, organizations, businesses, Tribes, or other groups that have an interested in or are concerned about the Southern Sierra IRWMP but do not sign the Memorandum of Understanding.

3.8 Work Group Designation

The RWMG may choose to create work groups to advance specific tasks outside of RWMG meetings. The RWMG will specific a clear purpose for any work group and, as applicable, also specify the tasks or work products and corresponding timeline for the work group. All work groups will provide a status update on their activities at the RWMG meetings. All work products will be submitted in draft to the RWMG for adoption. While the work groups may make day-to-day decisions to advance their efforts, the work groups have no final decision-making authority (see Section 6.1.1.2).

3.9 Roles and Responsibilities of the Facilitators

The facilitators will provide impartial guidance regarding the planning and implementation process, and will manage meetings on behalf of the RWMG. The facilitators are content-neutral, which means they will not advocate for particular policy or technical outcomes; the facilitators will, however, advocate for a fair, transparent, effective, and credible dialog and decision-making process, including helping the RWMG uphold the elements of the M.O.U. Specific duties include (1) designing the work plan and meeting agendas in partnership with the Project Manager, Coordinating Committee, and other RWMG members as needed; (2) providing guidance on process options and decisions; (3) reviewing and providing feedback on draft meeting materials; (4) overseeing the preparation of meeting summaries, including action items, key points of discussion, and agreements and decisions; (5) serving as a confidant for members who wish to express concerns about content or process privately. The facilitator is in service of the RWMG and will provide equal support to all its members.

2. Public Outreach and Participation (section 5)

5.5 Media Protocol

Per the existing M.O.U., the Project Manager or other designated representatives may make public statements on behalf of the Southern Sierra IRWMP as an entity. The first point of contact for media or external inquiries should be the Project Manager or other designated representatives. Additionally, if contacted by the media or an external party, or in other sessions outside the meeting, members will:

a. Clarify that they are speaking only for themselves, not on behalf of the RWMG.
b. Express concerns and support in ways that are consistent with their expressions in RWMG meetings.
c. Represent other comments made in these meetings as general group concerns and support, rather than attributing statements to other people or characterizing the views of others.
d. Avoid using the press as a vehicle for negotiation.

Members reserve the right to express their own opinion to the media, but not the opinions of others. Members can refer media inquiries to other group members, who then can speak for themselves. The RWMG may periodically develop and approve lengthier consensus statements to keep the public and media informed of its work and progress, and associated decisions and agreements.

3. RWMG Decision-Making (Section 6)

6.1.1.4 Clarification of Less than 100% Consensus Decision-Making

Decision-making in the absence of consensus will follow the protocol in the existing M.O.U. For clarification of section 6.1.1.2 (a), decisions or agreements must be endorsed by 75% of the total number of active members of the RMWG who are present at the meeting (including via telephone) when a decision is made. Per the existing M.O.U., meetings that include decisions will be noticed two weeks in advance of the meeting. For clarification of section 6.1.1.3, "regular attendance" means that the member has attended at least half of the RWMG meetings in the past year, or in the case of new members, that the member has attended at least half of the RMWG meetings since signing the M.O.U. The RWMG will maintain a current list of RWMG members, including their primary representative and alternate, and track meeting attendance. The requirement for participation in a work group is only applicable insofar as three or more work groups are active.

6.2 Protocol for Notifying Members of an Upcoming Decision

Per section 5.3, Public Noticing and Transparency, meetings that involve decision-making will be noticed two weeks in advance of the meeting. Members will be requested to acknowledge receipt of the email notifying them of the upcoming decision. If no acknowledgment is received, the facilitator(s) will follow-up by telephone to ensure the member is aware of the upcoming decision.

6.3 Multiple Entities Represented by a Single Individual

In some cases a single individual serves as the designated representative of more than one member entity. In order for the RWMG to have consensus on a decision, each of the member entities represented by the single individual must be in consensus.

If less than 100% consensus decision-making is involved, the single individual must choose a single entity to represent; any additional entity represented by that individual must send their alternate representative to take part in decision-making. All alternates are required to be fully briefed on the group's historical deliberations and information and issues involved in the decision, to ensure continuity of the group's discussions and a timely decision-making process. All decisions will be noticed in advance as specified in sections 5.3 and 6.2.

If less than 100% consensus decision-making is involved, and one of the entities represented by the single individual has a financial interest in the outcome (e.g., one of the entities represented by the single individual is applying to be the grantee for a planning or implementation grant), the single individual will be permitted to participate in discussions and decisions regarding the steps, criteria, and information used for making the decision (e.g., selection of a grantee). In this regard, they help to shape the decision-making process as a whole. During the deliberation of the decision and final less than 100% decision-making, however, this individual will be requested to leave the room, and the entity that has a financial interest in the outcome will not be part of the less than 100% consensus decision-making. Additionally, none of the other entities represented by the single individual will be permitted to be part of the deliberation of the decision and final less than 100% decision-making. This is to avoid a situation where a secondary entity, even though it has no financial interest in the outcome, sends an alternate representative to support the selection of the single individual that typically represents them out of solidarity. To ensure that it has a voice in such a circumstance, any member entity typically represented by a single individual can decide to regularly send their alternate to the series of meetings leading up to a financial decision, and thus avoid relying on the single individual to represent them during that period of the RWMG's work. The RWMG will identify the appropriate number of meetings to attend early enough in the process to allow such participation.

4. Joint Fact-Finding (new section – section 8)

8 Joint Fact-Finding Protocol

The RWMG may choose to conduct joint fact-finding when it needs to make a decision regarding a complex scientific or technical issue, but cannot readily reach agreement on how best to proceed. Joint fact-finding provides an approach to building consensus and making informed decisions in the face of uncertainty. It involves a subset of RWMG members working with the consultant and subject-matter experts to frame the questions to be answered, interpret existing information, and generate recommendations. Joint fact-finding conducted by the RWMG will include the following steps:

1. The facilitator or RWMG member develops a short Issue Summary that identifies key issues and questions in enough detail to clearly communicate concerns to all members.
2. The RWMG identifies a few members to form a joint fact-finding work group on the designated topic. The work group identifies additional expertise needed to understand and address the topic, and invites mutually agreed-upon individual subject-matter experts to support the work group.
3. At its first meeting, the work group discusses how existing information applies to the issues and questions identified in the Issue Summary. Members identify areas where they are in consensus, and if possible, recommend to the RWMG how to move forward on the issues and questions identified. If the work group desires more information, it identifies the immediate next steps for gathering this. If the

desired information does not exist, the work group decides whether it can be generated in a timeframe that is consistent with the RWMG's work plan; if not, the work group agrees to continue its joint fact-finding effort and ultimately make a recommendation the absence of ideal information.

4. At its second or subsequent meetings, the work group reviews new information and seeks consensus on what to recommend to the RWMG. If the work group makes a sincere effort but cannot reach consensus, it may provide more than one set of recommendations to the RWMG.
5. When recommendations are ready, the work group presents these to the RWMG and answers any substantive or procedural questions from RWMG members. The intent is to provide recommendations in an open, transparent, and educative way that supports informed decision-making. The RWMG in turn seeks consensus on what recommendation(s) to adopt. The RWMG may request the work group to conduct additional fact-finding and report back.
6. The final recommendation adopted by the RWMG is recorded in the Issue Summary, as well as the standard meeting summary that is made publicly available on the website.

During the joint fact-finding process, the work group will update the RWMG as to its progress during the RWMG's regular meetings.

Regional Water Management Group/Planning Committee

- IRWMP decision-making body
- Membership: water agencies, resource agencies, conservation groups, Counties, Tribes, etc. from geographic scope of IRWMP (open to those interested in water resources management)
- Decision-making: consensus-based with a default for supermajority vote with representation from major interests.
- Meetings open to the public

Coordinating Committee

- Provides recommendations and guidance to IRWMP staff and consultants for managing IRWMP, preparation for meetings, drafting proposed policies, and planning tools
- Membership: representation from major interests and geographic area of IRWMP. Must also be members of Planning Committee.
- Size: Keep this Committee at a small workable number. Suggest 8.
- Frequency of Meetings: Meets every month during Planning stages and every other month thereafter.
- Decision-making: No decision-making authority. Proposes ideas to the Planning Committee for decision-making.

Grantee (1 entity)

(DWR eligibility: Non-profit or public institution)

- Administration of grants and funds including contracting, reporting, invoicing
- Grants awarded to fiscal sponsor on behalf of the IRWMP
- Leader in region and for IRWMP
- Contractor with DWR

Legal Authority (3 entities)

(DWR criteria: 3 public agencies, 2 with authority over water.)

- One of three entities will be fiscal sponsor for DWR Planning Grant
- Members of Planning Committee/members of Coordinating Committee
- Decision-making: none, these entities will make consensus decisions as part of the Planning Committee.
- Frequency of meetings: none. Group members may be part of the Coordinating Committee to engage in IRWMP coordination.

Appendix B

Regional Water Management Group Resolution of Adoption

Regional Water Management Group
RESOLUTION TO ADOPT
SOUTHERN SIERRA INTEGRATED REGIONAL WATER MANGEMENT PLAN

This resolution establishes and affirms that the Southern Sierra Regional Water Management Group (RWMG) adopts by consensus the Southern Sierra Integrated Regional Water Management Plan (Plan). Formal RWMG adoption is required for the Plan to become a framework for implementation and be eligible for project funding.

This RWMG resolution is voluntary and non-binding in nature, and does not commit RWMG members to any specific course of action. Individual agencies and organizations will sign a formal resolution of adoption.

WHEREAS, the RWMG has developed the Plan for the Southern Sierra region, and pursuant thereto, published notice of intent to adopt such a plan in accordance with the requirements of the California Integrated Regional Water Management Planning Act; and

WHEREAS, the Plan includes chapters regarding water supply, water quality, a description of the Region, regional goals and objectives, data management, resource management strategies and others; and

WHEREAS, the Plan was developed through an inclusive process of stakeholder collaboration; and

WHEREAS, the Plan is not a "project" as defined by the California Environmental Quality Act (CEQA) because the plan is not likely to cause any significant physical change to the environment, given that it is simply a planning tool. The Plan is therefore exempt from CEQA pursuant to Section 15262 and Section 15306 of the CEQA Guidelines. The Plan is also exempt under Section 15262 because it involves planning studies for possible future actions that participating agencies have not yet approved. The Plan only consists of basic data collection that will not result in disturbance of any environmental resource.

NOW, THEREFORE, BE IT RESOLVED that the RWMG does hereby adopt the Plan.

ADOPTED this 13th day of November 2014.

Chris Moi

Chris Moi, Project Manager

ATTEST:

Note taker

APPROVED AS TO FORM AND PROCEDURE:

Facilitator

Appendix C

Dams and Reservoirs in the Southern Sierra

Southern Sierra Regional Water Management Group
Dams and Reservoirs in the Southern Sierra

Watershed	Dam	Reservoir	Owner	Power Capacity (MW)
Kaweah River	Terminus Dam	Lake Kaweah	Corps of Engineers	
	Upper Monarch Lake Dam	Upper Monarch Lake	Southern CA. Edison	
	Lady Franklin Lake Dam	Franklin Lakes	Southern CA. Edison	
	Crystal Lake Dam	Crystal Lake	Southern CA. Edison	
	Sand Creek Dam		Tulare Co. Resource Management Agency	
Kings River	Giffen Reservoir Dam		Harris Farms Inc.	
	Pine Flat Dam	Pine Flat Lake	Corps of Engineers	165
	Sequoia Dam	Sequoia Lake	YMCA Inc.	
	Balch Afterbay Dam		PG&E	
	Balch Diversion Dam	Black Rock Reservoir	PG&E	
	Wishon Dam	Lake Wishon	PG&E	1,212
	Courtright Dam	Courtright Reservoir	PG&E	
	Hume Lake Dam	Hume Lake	United States Forrest Service	
San Joaquin River	Friant Dam	Millerton Lake	U.S. Bureau of Reclamation	25
	Shaver Lake Dam	Shaver Lake	Southern CA. Edison	
	Florence Dam	Florence Lake	Southern CA. Edison	
	Mammoth pool Dam	Mammoth Pool Reservoir	Southern CA. Edison	190
	Huntington Dams 1,2,3,&4	Huntington Lake	Southern CA. Edison	
	Balsam Meadow Dam	Balsam Forebay	Southern CA. Edison	11
	Vermilion Valley Dam	Lake Thomas A. Edison	Southern CA. Edison	
	Mono Creek Diversion	Mono Creek	Southern CA. Edison	
	Bear Creek Diversion	Bear Creek	Southern CA. Edison	
	Portal Powerhouse Forebay	Portal Forebay	Southern CA. Edison	
	Big Creek No. 4	Big Creek	Southern CA. Edison	100
	Big Creek No. 5	Dam 5	Southern CA. Edison	
	Big Creek No. 6	Dam Six Lake	Southern CA. Edison	
	Kerckhoff Diversion	Kerckhoff Lake	PG&E	
	Big Creek No. 7 Dam	Redinger Lake	Southern CA. Edison	
	Longley	Longley Lake	Southern CA. Edison	
	Bishop Creek Intake No. 2		Southern CA. Edison	
	Sabrina	Lake Sabrina	Southern CA. Edison	
South Western Creeks/Rivers	None			
Tule River	Larson Dam	Nativelands Lake	South Tule Independent Ditch Co.	
	Success Dam	Lake Success	Corps of Engineers	
Upper Kern River	None			
			Total	1703

Appendix D

Three Rivers Water Supply Study

PRELIMINARY EVALUATION OF WATER RESOURCES DEMAND AND AVAILABILITY THREE RIVERS, CA, AREA

SOUTHERN SIERRA
INTEGRATED REGIONAL WATER MANAGEMENT GROUP

AUGUST 15, 2014

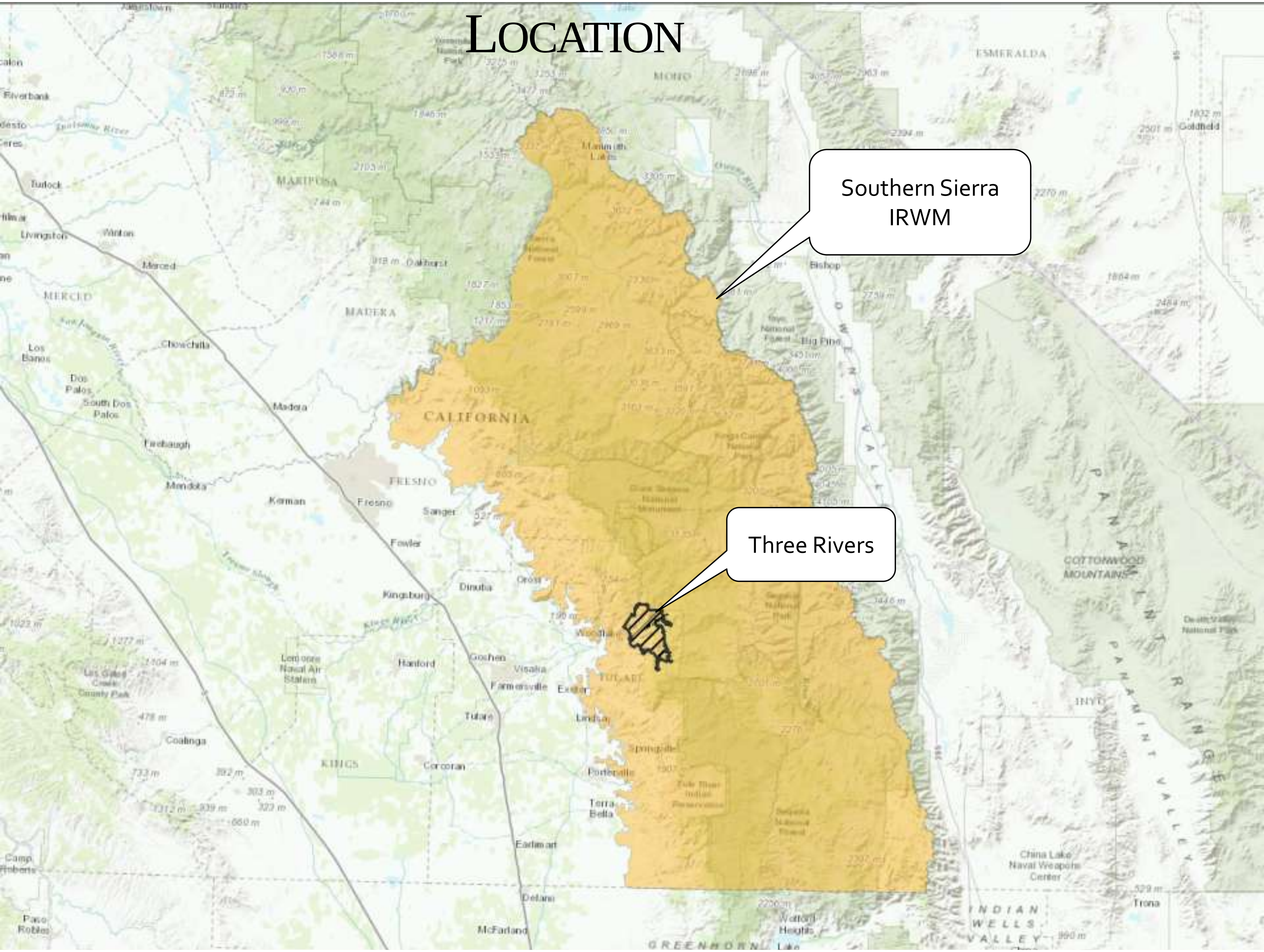
John Kirk
Department of Water Resources
Special Investigations and Planning Branch

Discussion Outline

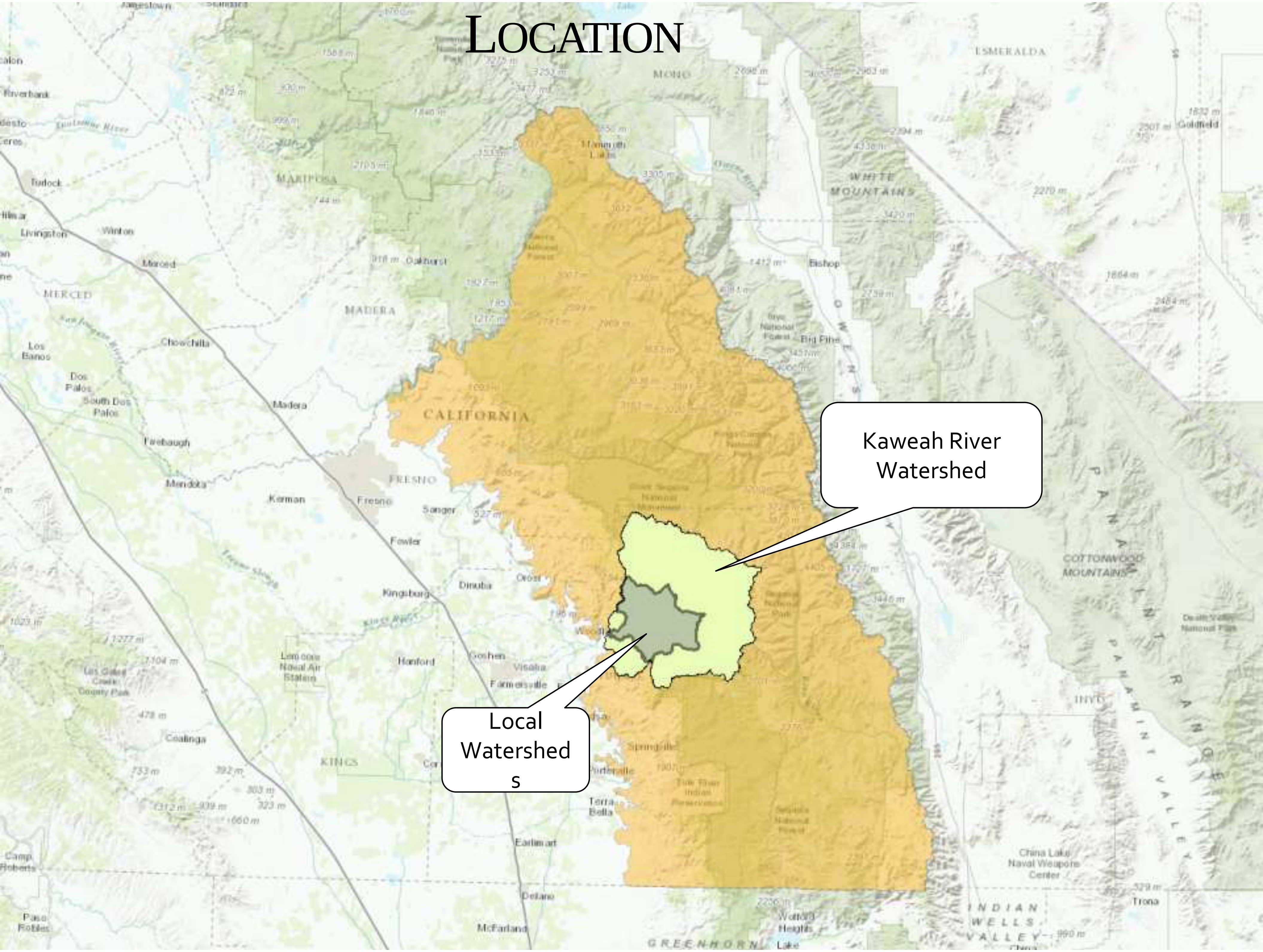
- Location and Land Use
- The Watersheds
  - Hydrology and Low Flow Conditions
- Water Demand
- Water Supply – Where does the water come from?
  - How much water is available?
  - What is the source of the supply?
- Aquifers – Nature of the aquifer(s) in the Three Rivers area
- Water Chemistry and Quality

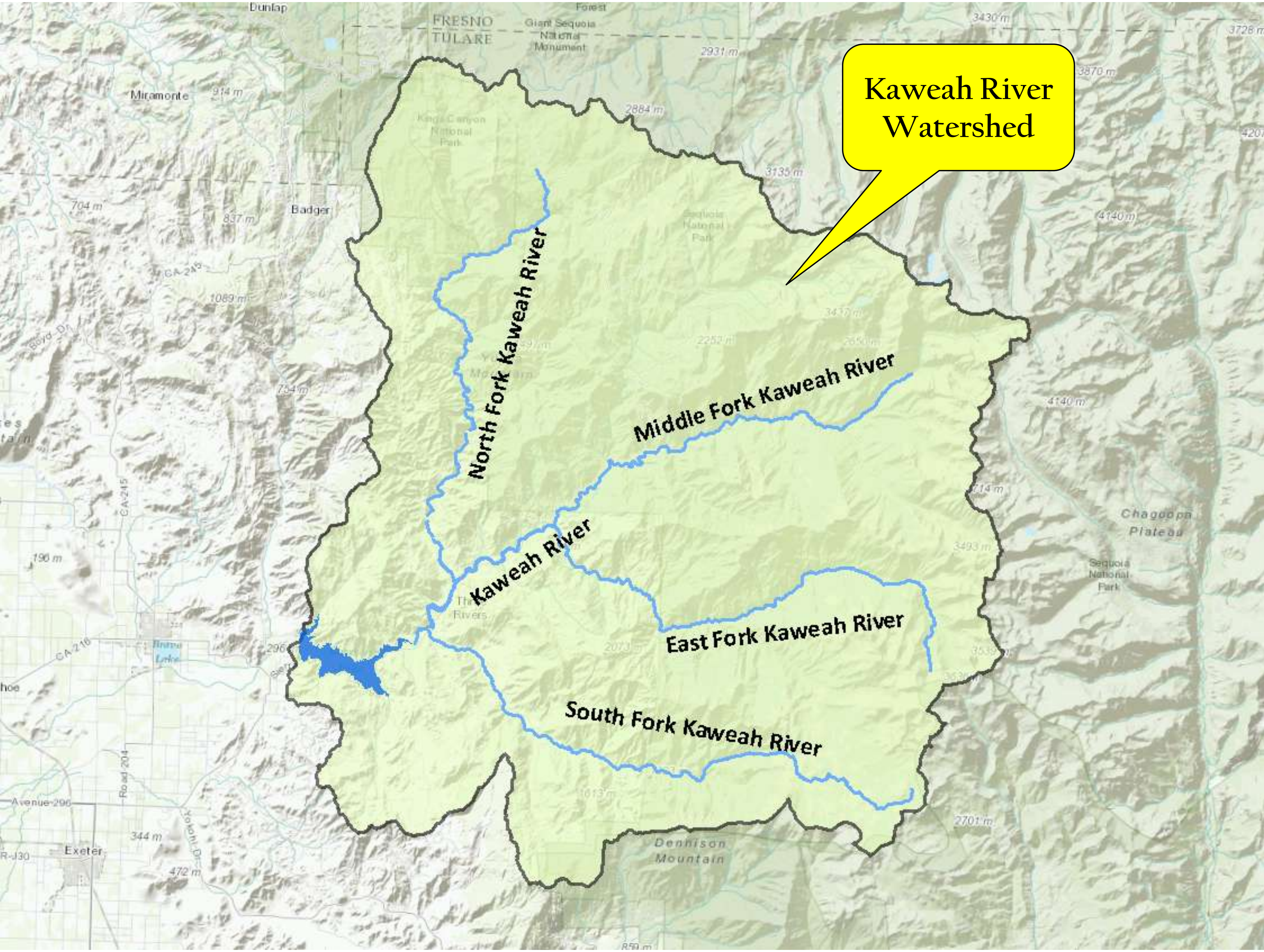
- LOCATION

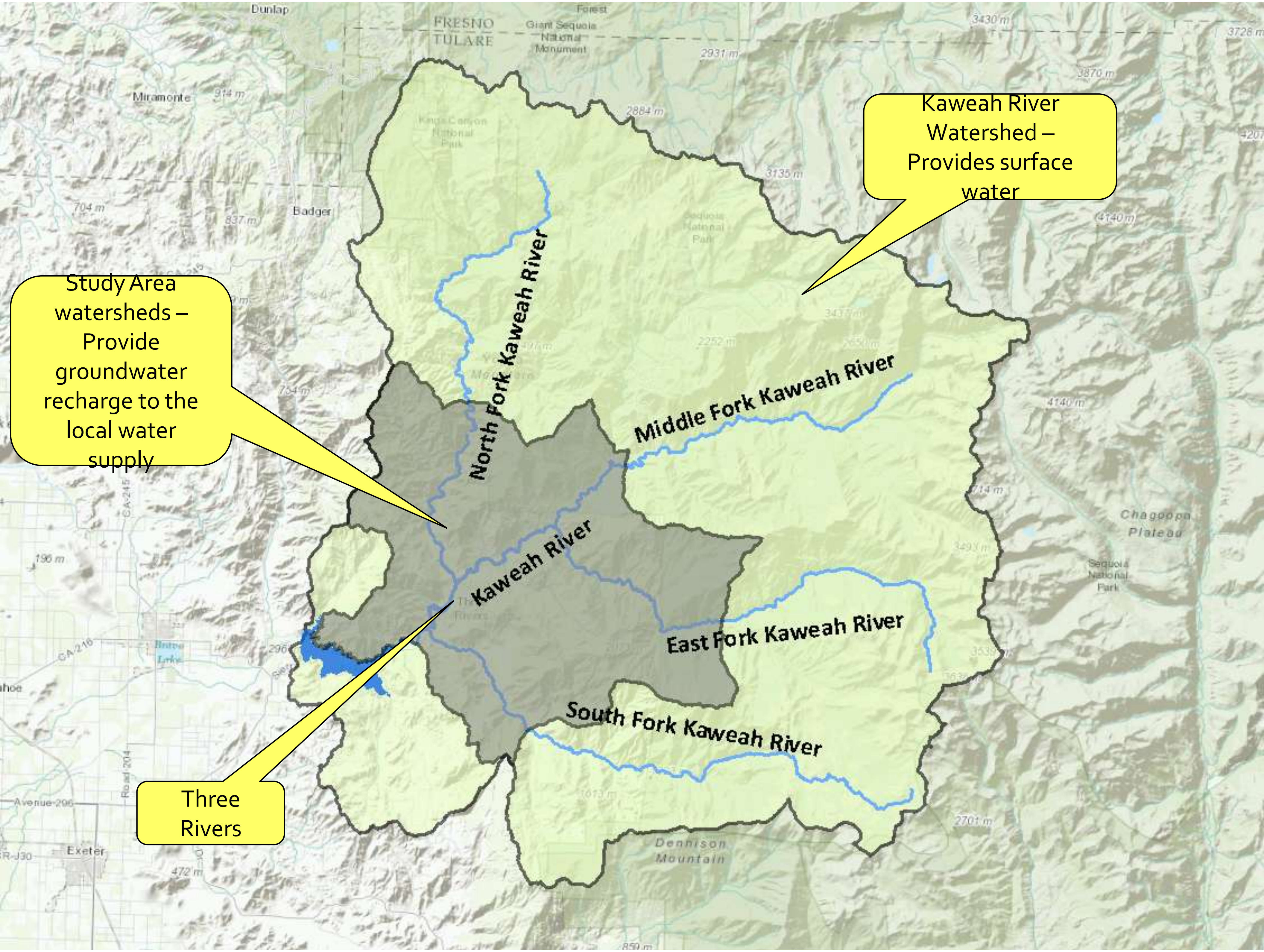
LOCATION


Southern Sierra
IRWM
Three Rivers
CALIFORNIA
FRESNO
MADERA
MARIPOSA
MERCED
TULARE
KINGS
INYO
MONO
ESMERALDA
COTTONWOOD MOUNTAINS

LOCATION


Kaweah River Watershed
Local Watershed s
CALIFORNIA
FRESNO
Fresno
Madera
Merced
Mammoth Lakes
Bishop
Sanger
Fowler
Kingsburg
Dinuba
Hanford
Goshen
Visalia
Farmersville
Springville
Porterville
Terra Bella
Earlimart
Delano
McFarland
Coalinga
Mendota
Kerman
Chowchilla
Turlock
Livingston
Winton
MERCED
MADERA
MARIPOSA
MONO
ESMERALDA
WHITE MOUNTAINS
COTTONWOOD MOUNTAINS
INDIAN WELLS VALLEY
China Lake Naval Weapons Center
Trona
Goldfield
KINGS
INYO

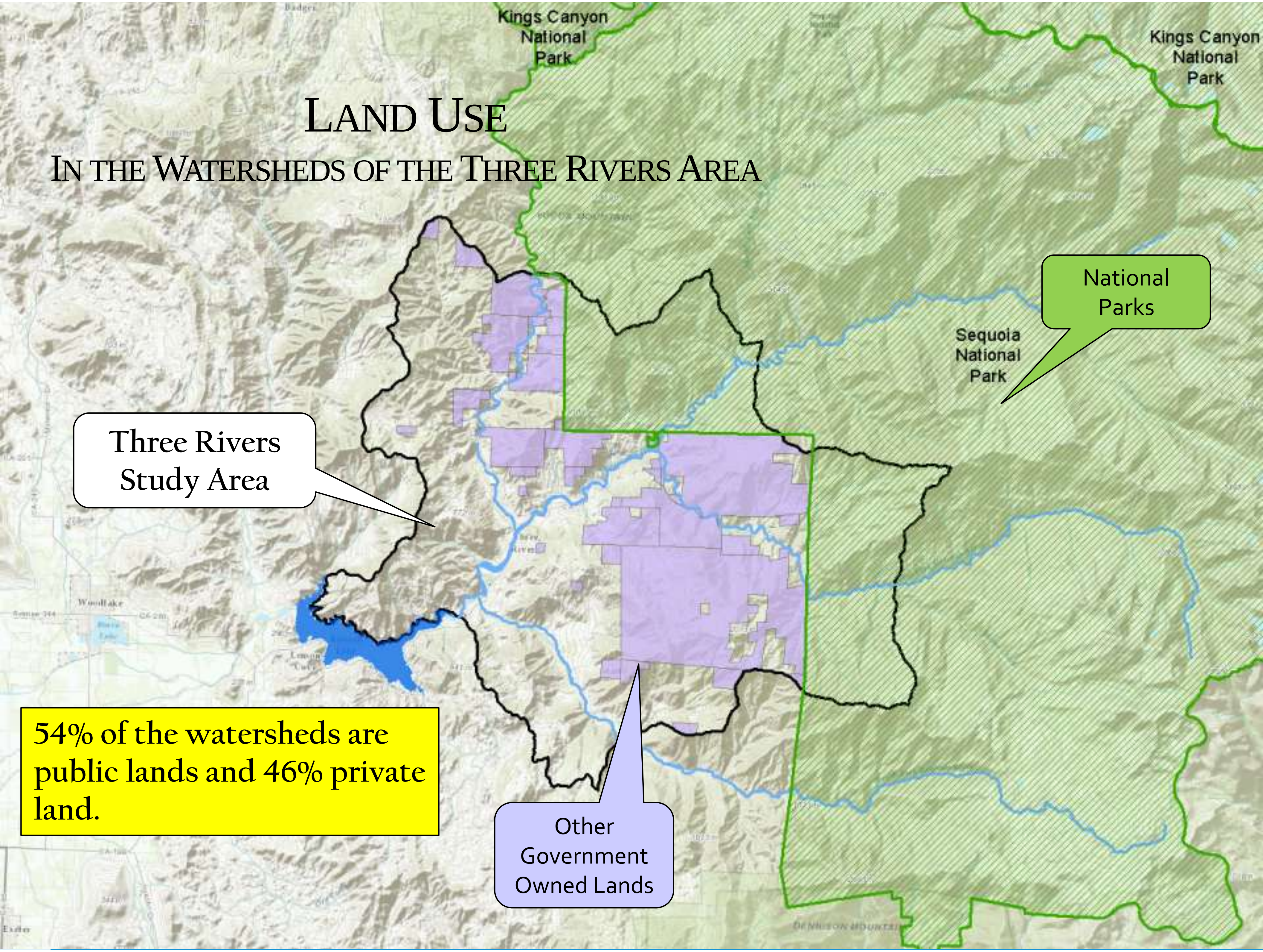

Kaweah River Watershed
North Fork Kaweah River
Middle Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River


Kaweah River Watershed – Provides surface water
Study Area watersheds – Provide groundwater recharge to the local water supply
Three Rivers
North Fork Kaweah River
Middle Fork Kaweah River
Kaweah River
East Fork Kaweah River
South Fork Kaweah River
FRESNO
TULARE
Dunlap
Miramonte
Badger
Exeter
Giant Sequoia National Monument
Chagoopa Plateau
Dennison Mountain

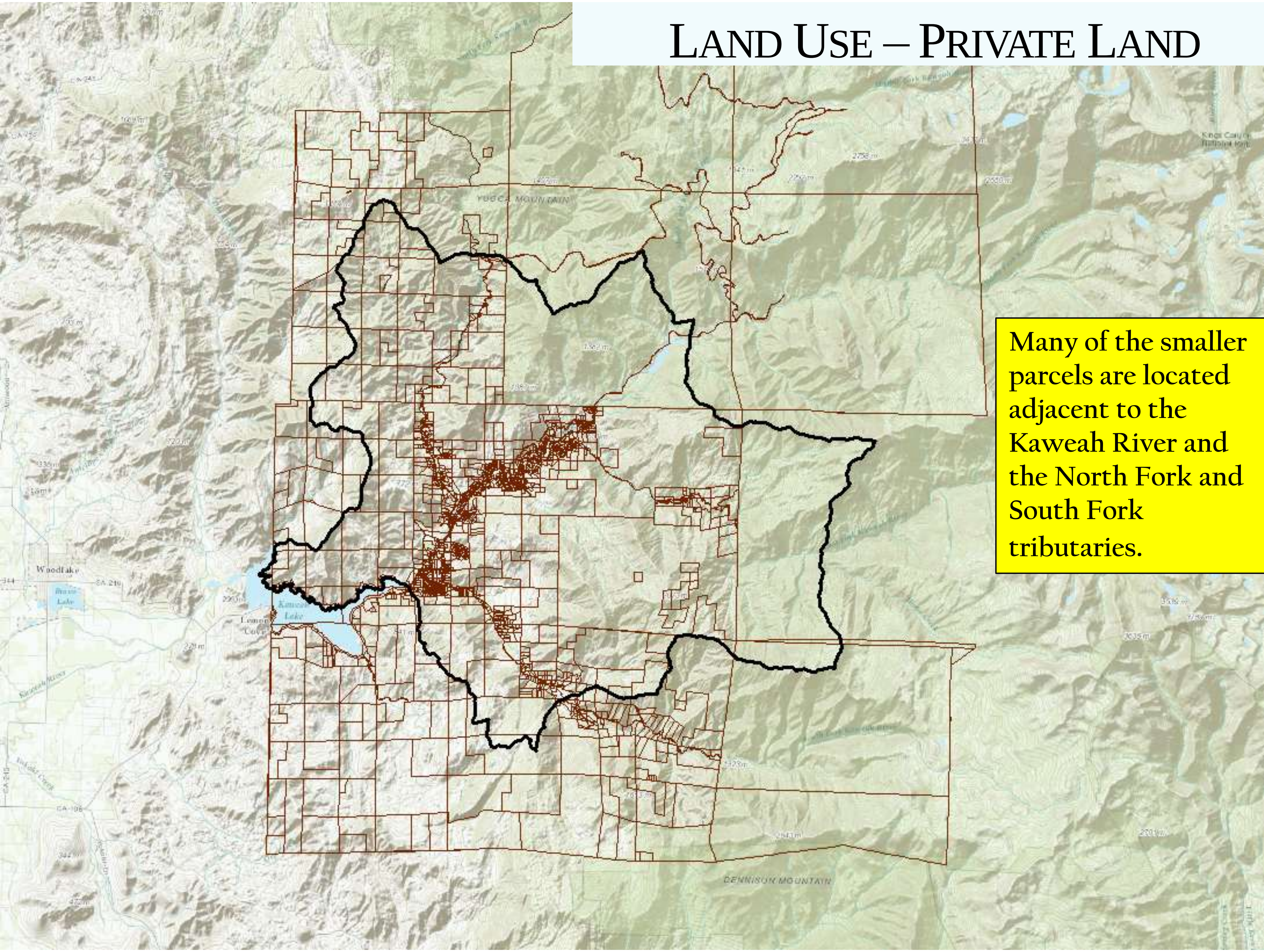
❖ Land Use

LAND USE

IN THE WATERSHEDS OF THE THREE RIVERS AREA

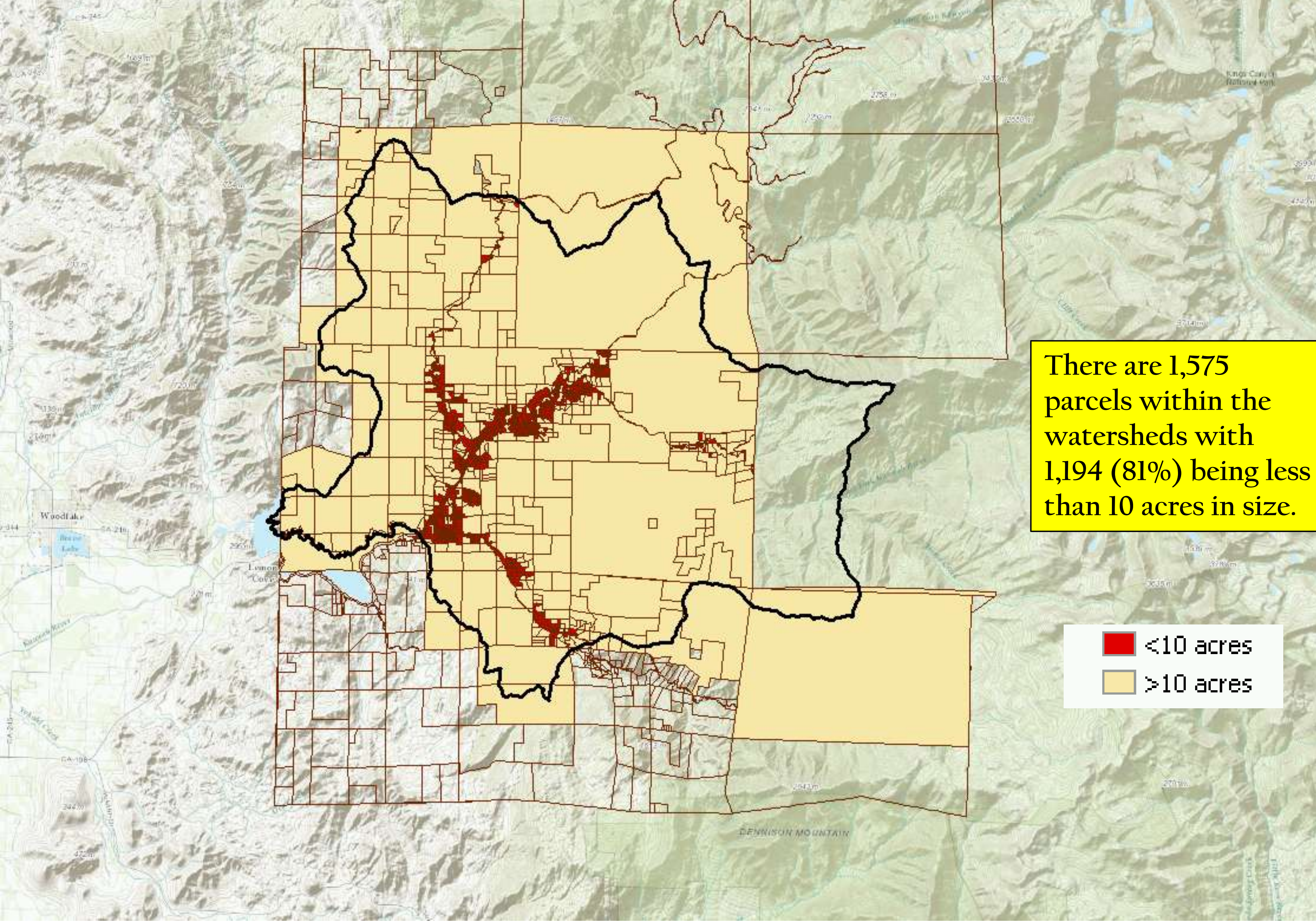


LAND USE – PRIVATE LAND



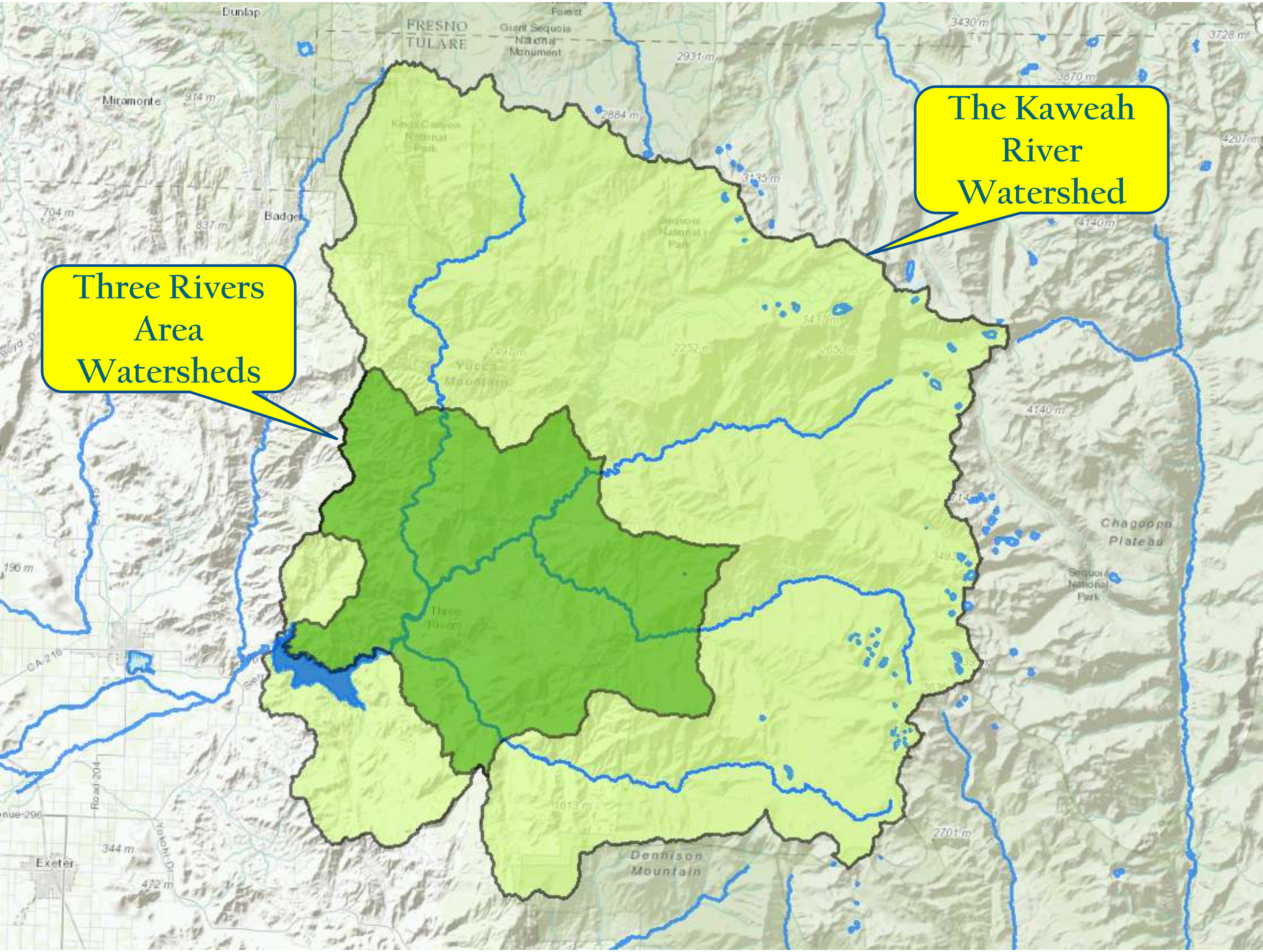
Many of the smaller parcels are located adjacent to the Kaweah River and the North Fork and South Fork tributaries.

Land Use – Private Land

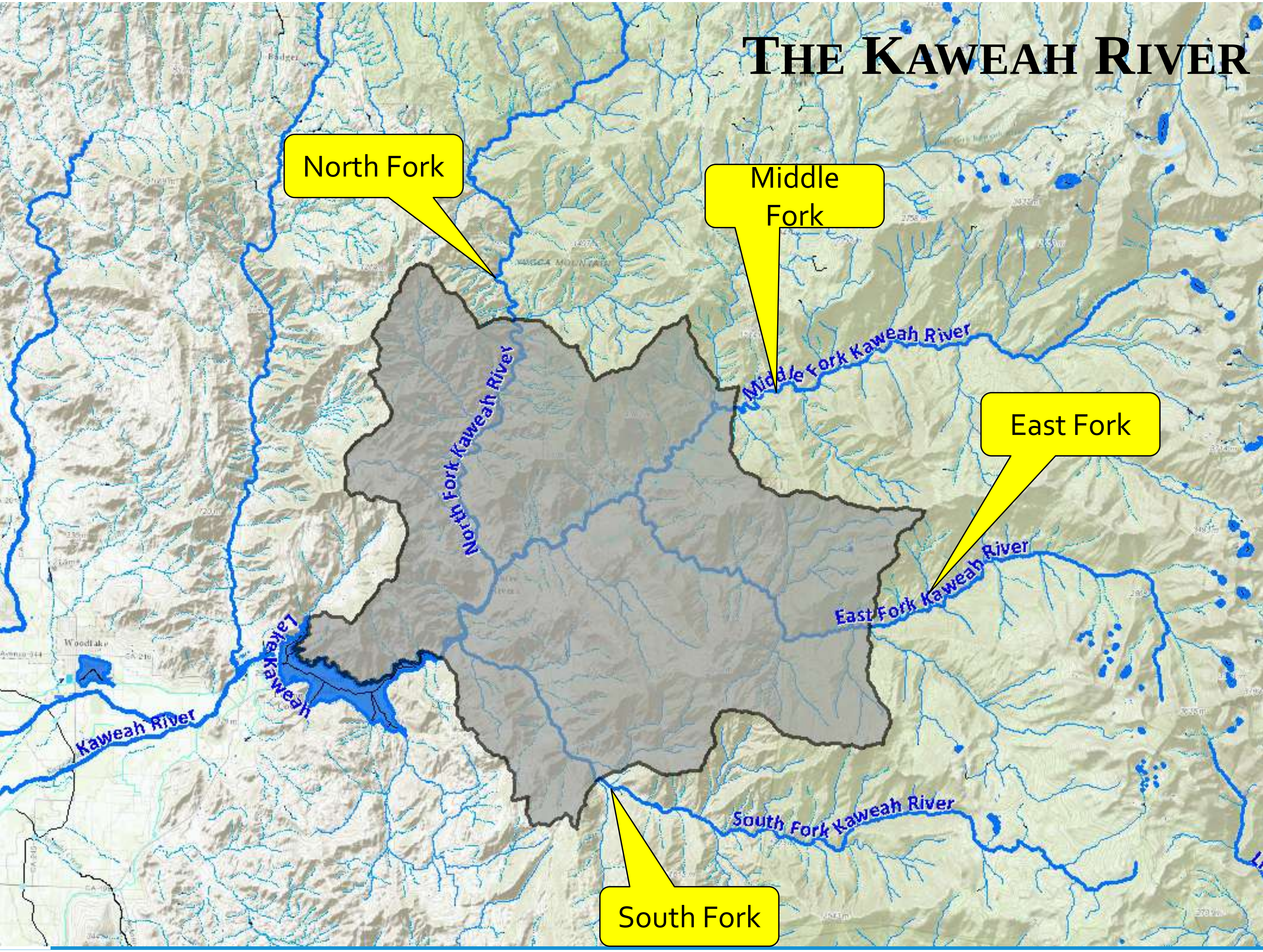


There are 1,575 parcels within the watersheds with 1,194 (81%) being less than 10 acres in size.

❖ THE WATERSHEDS

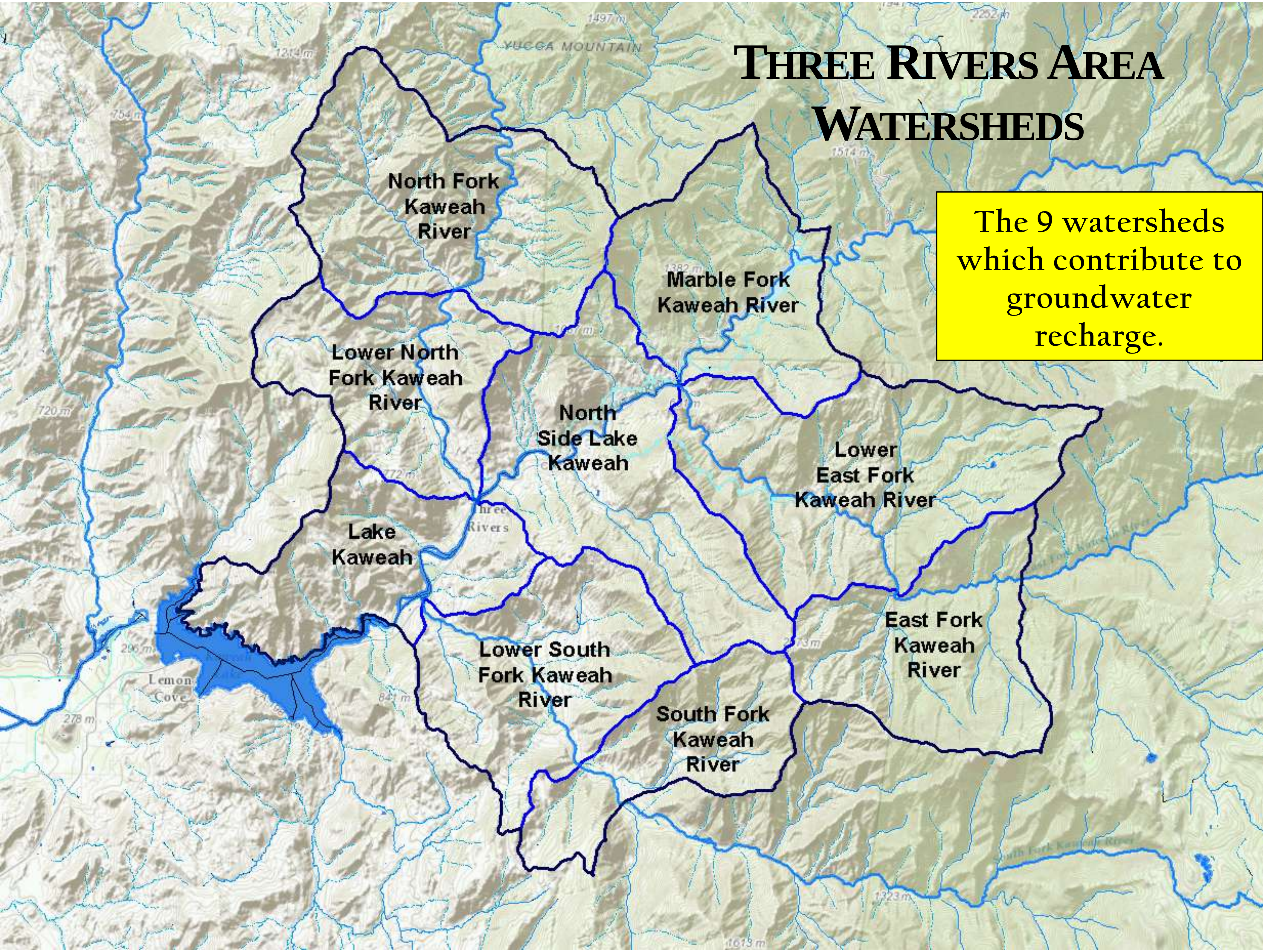

The Kaweah River Watershed
Three Rivers Area Watersheds

THE KAWEAH RIVER

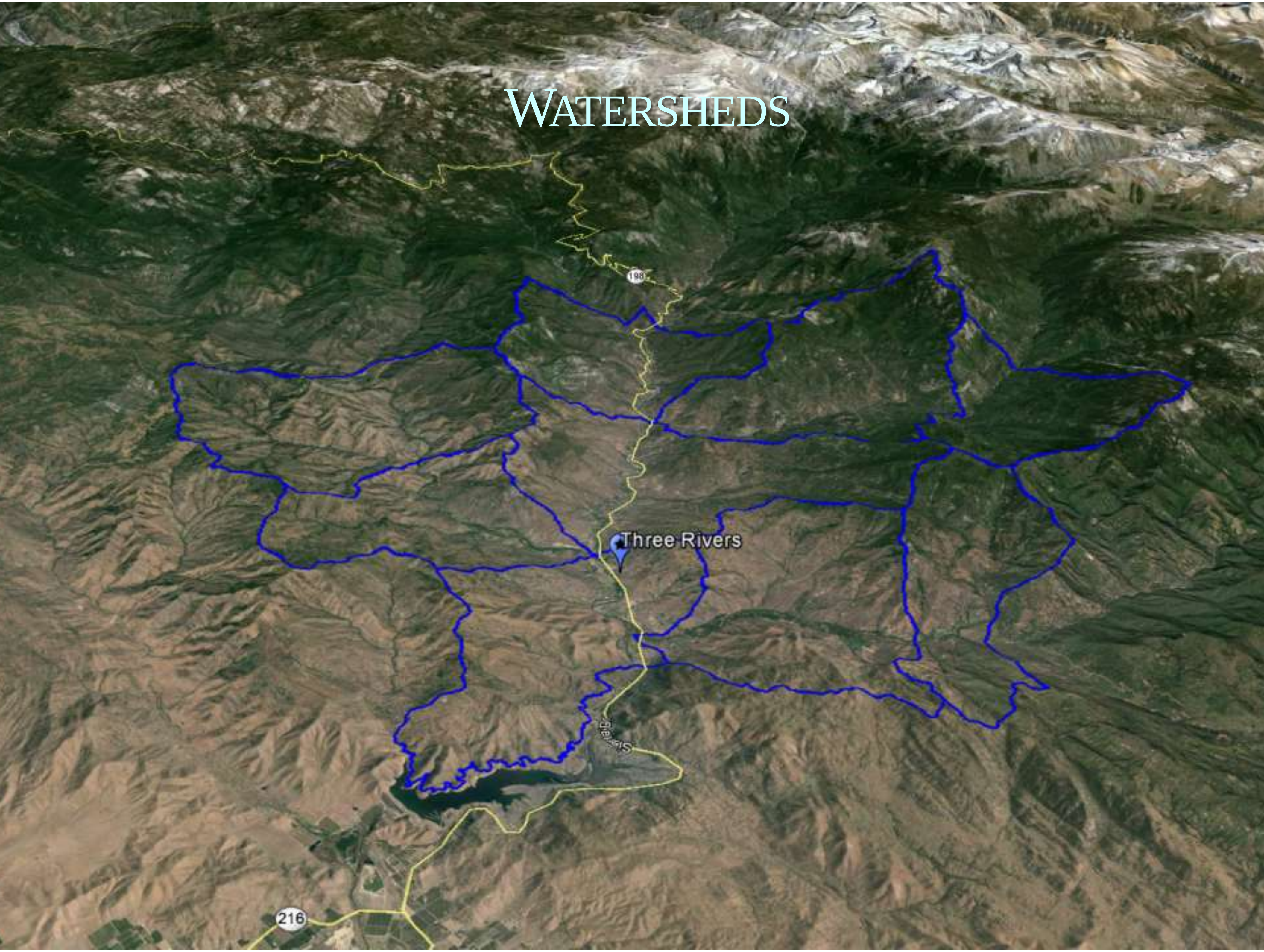


THREE RIVERS AREA WATERSHEDS

The 9 watersheds which contribute to groundwater recharge.

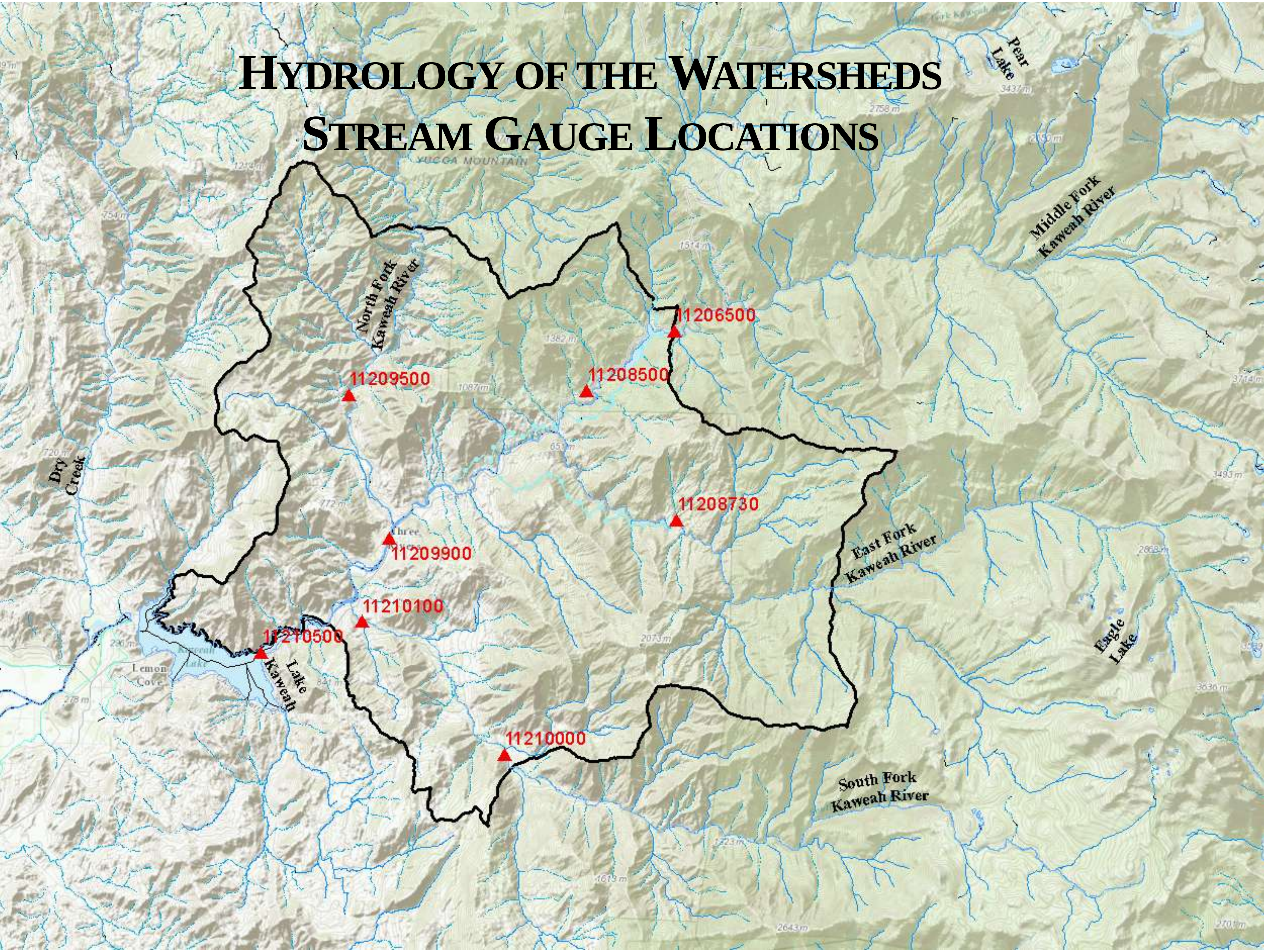


WATERSHEDS



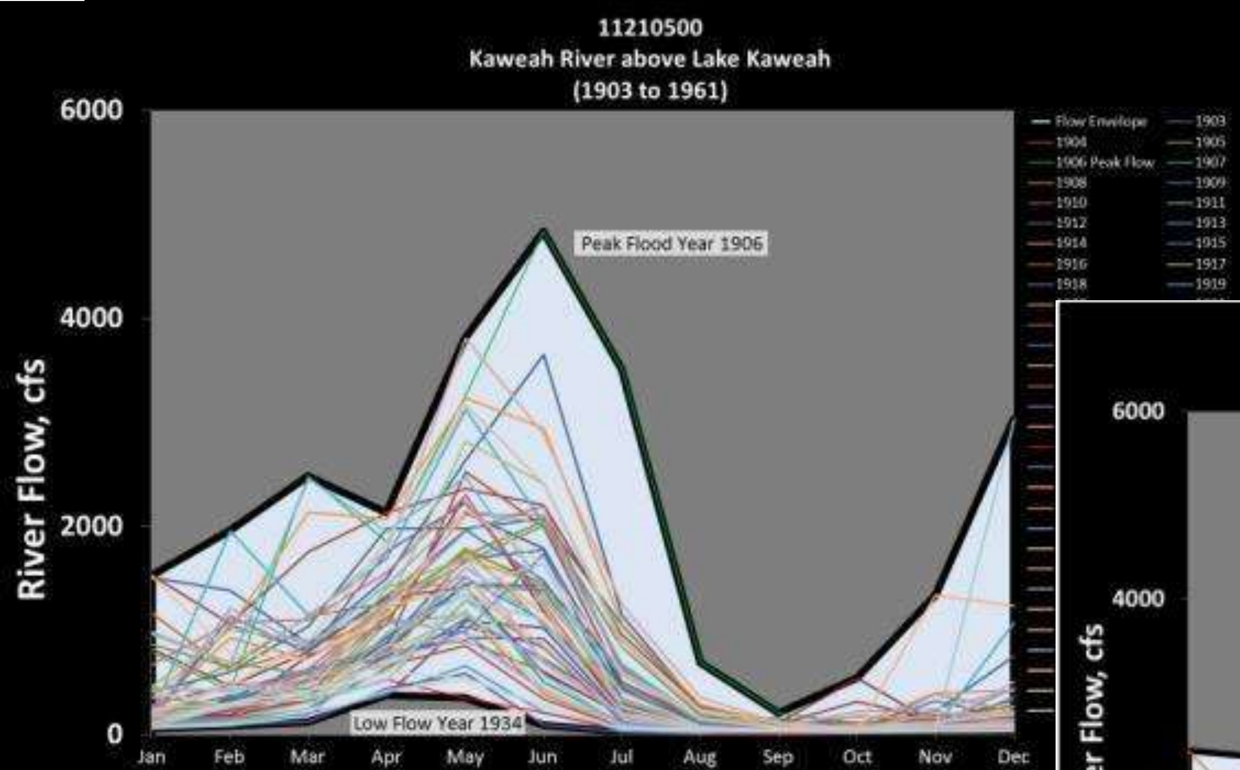
❖ HYDROLOGY OF THE WATERSHEDS

Hydrology of the Watersheds
Stream Gauge Locations

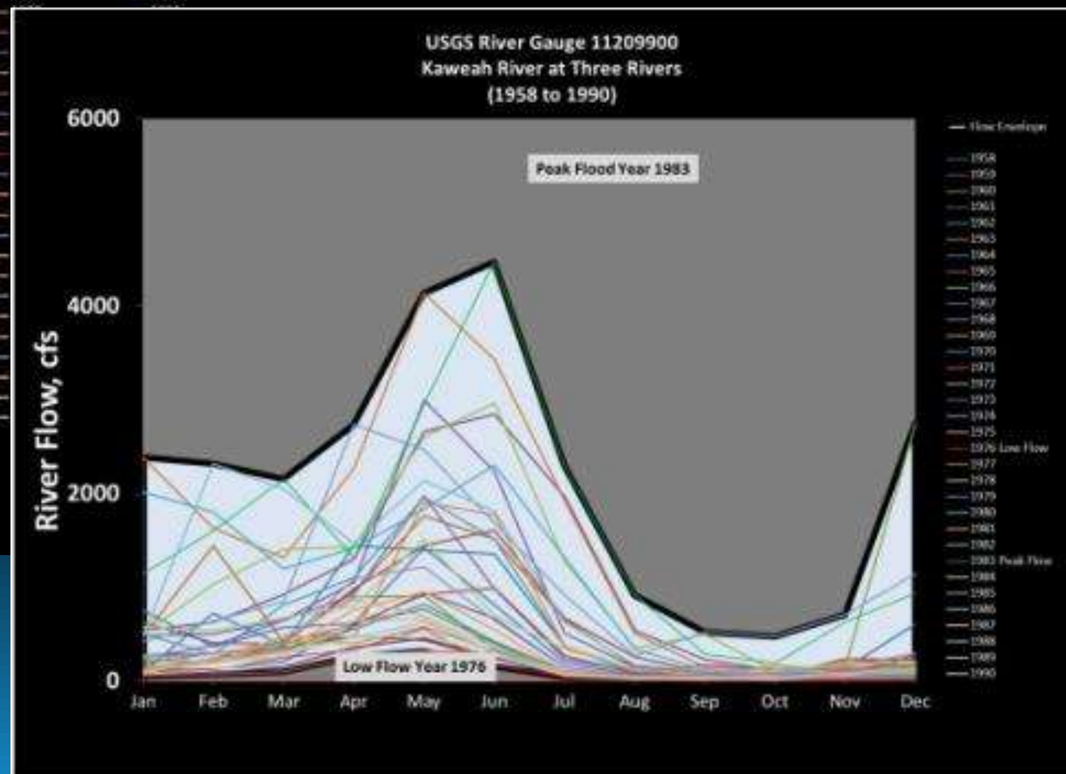


HYDROLOGY OF THE WATERSHEDS
RIVER FLOW FOR GAUGES AT THREE RIVERS

1903 TO 1961
(MISSING THE MAIN FLOOD YEARS)

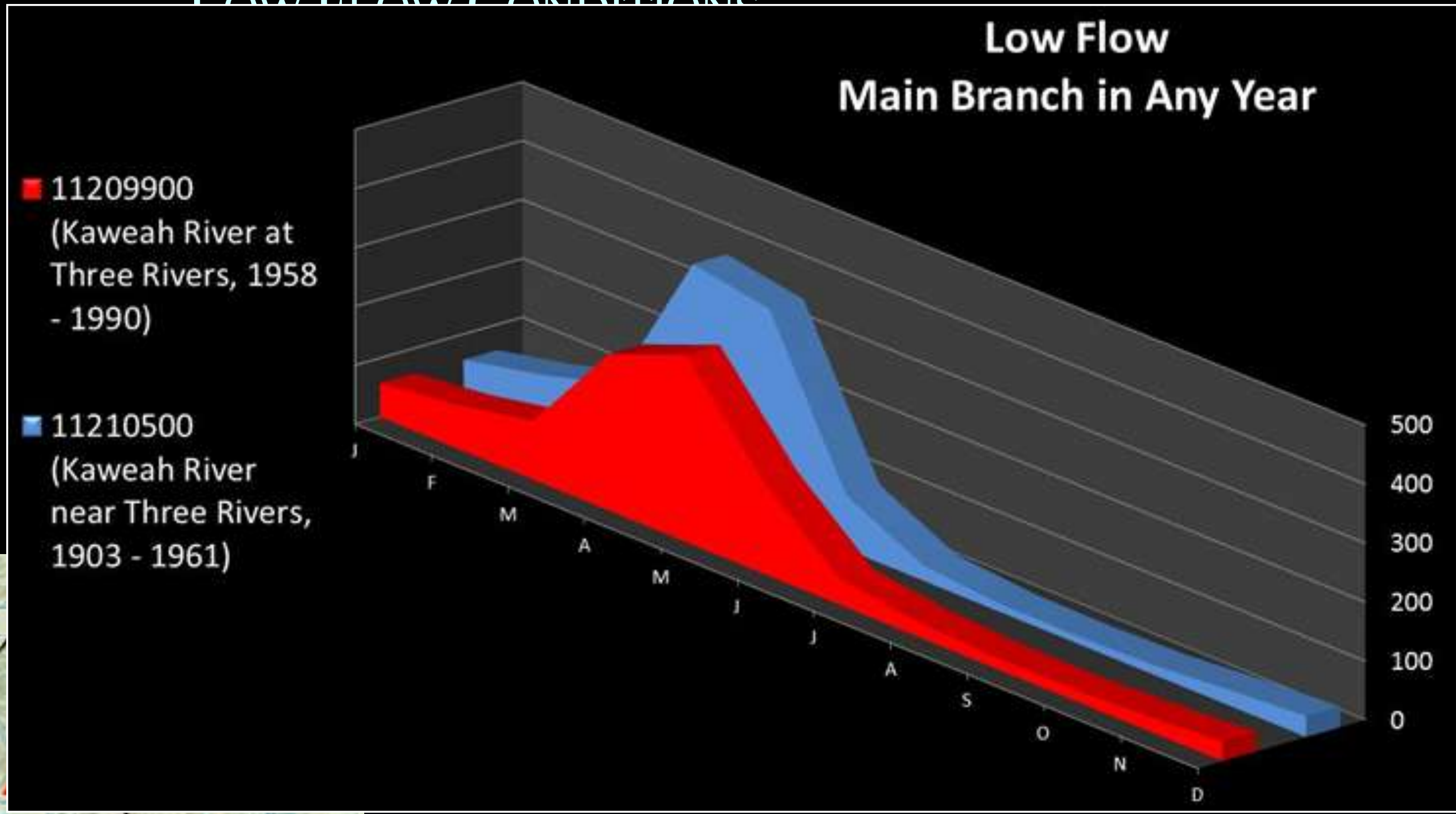


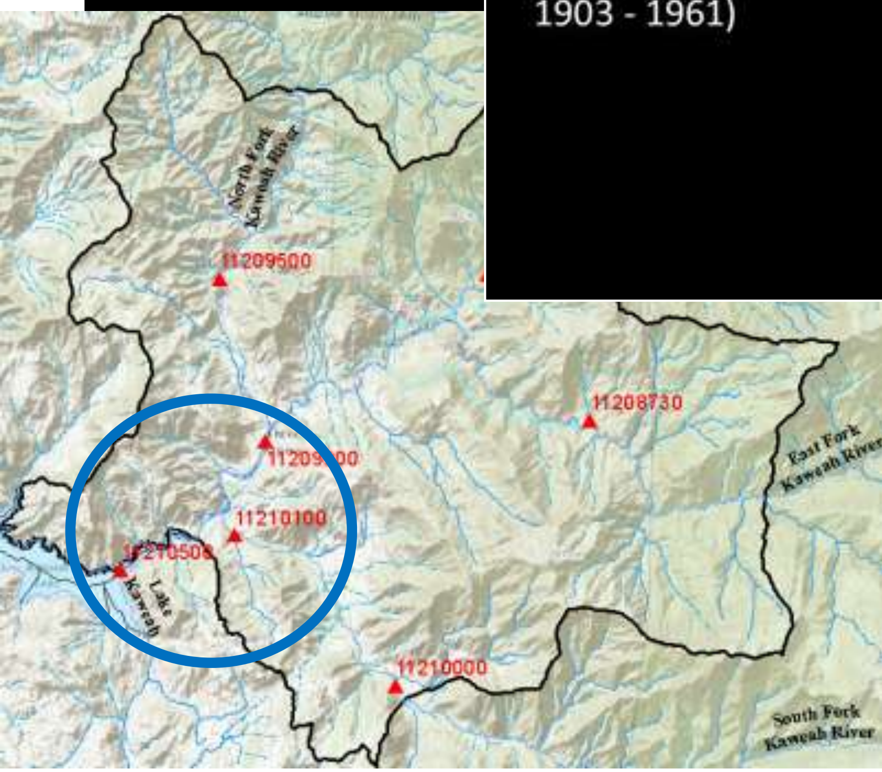
1958 TO 1990
(SHORT PERIOD OF RECORD)



HYDROLOGY OF THE WATERSHEDS

LOW FLOW CONDITIONS





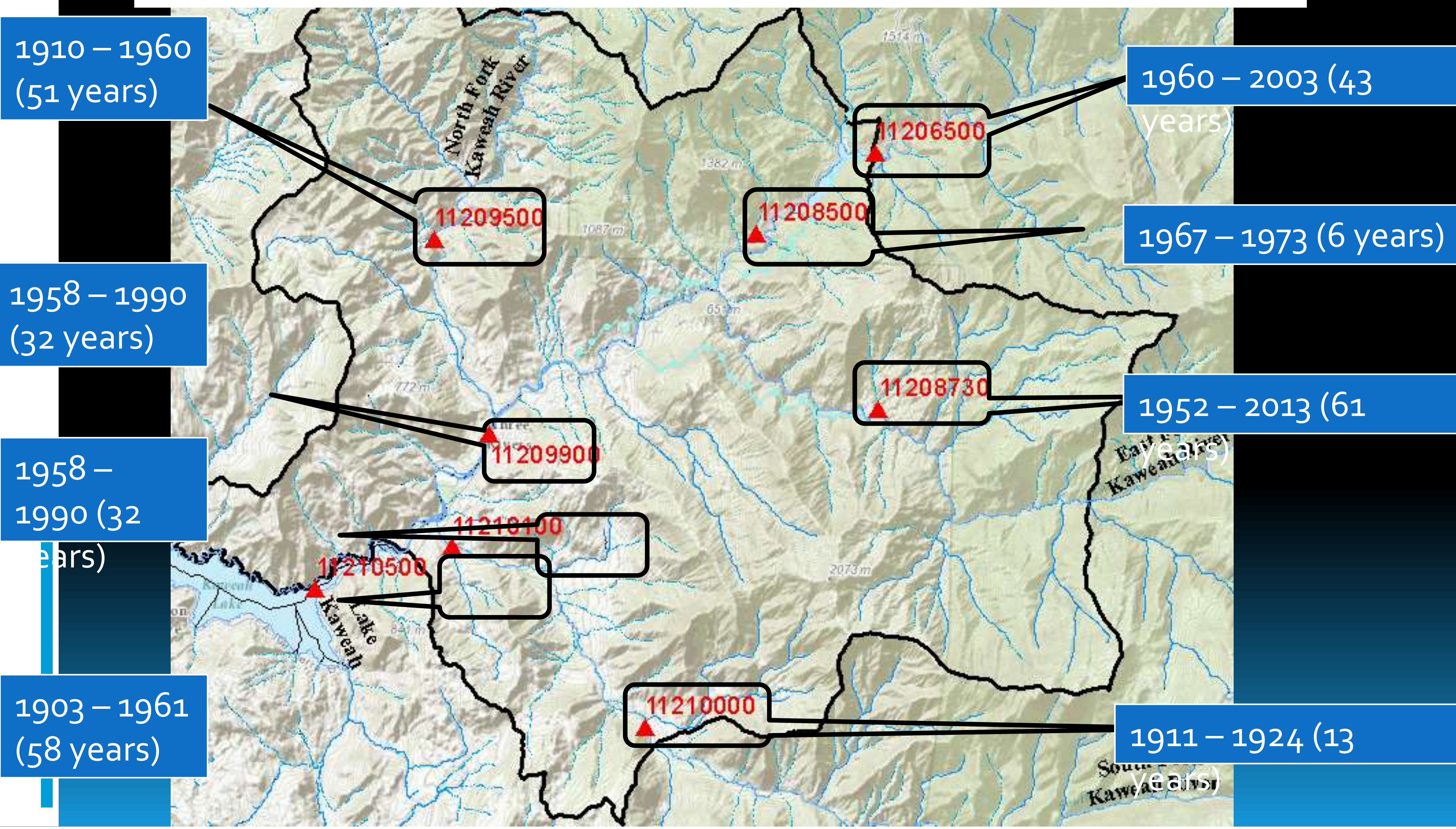
Low flow occurs in August and September and has a recorded minimum value of 14 cubic feet per second.

Hydrology of the Watersheds

River Flow Gauge Limitations

The periods of record are very short (6 to 61 years).

The records miss important drought and flood years.



❖ WATER DEMAND

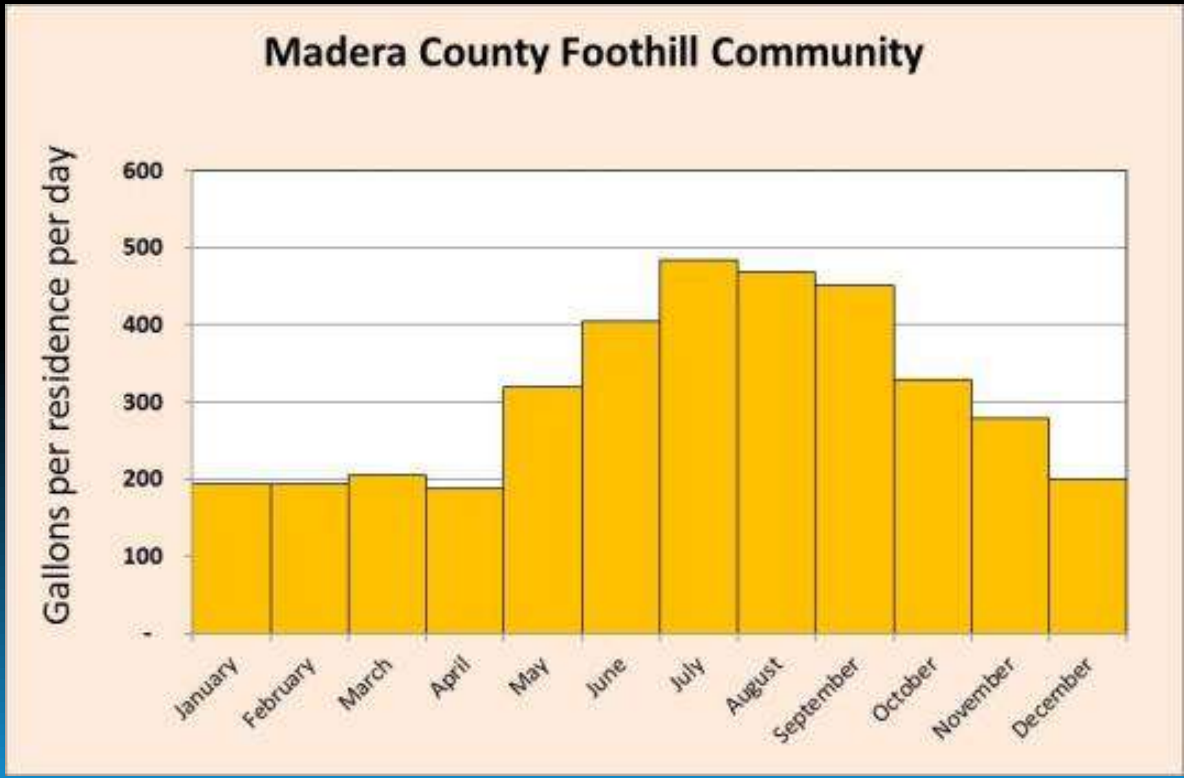
WATER DEMAND

Water Demand

- US EPA estimate: 300 gallons/day
- Similar foothill community (YLP): 310 gallons/day - average

Water Demand Varies by Season

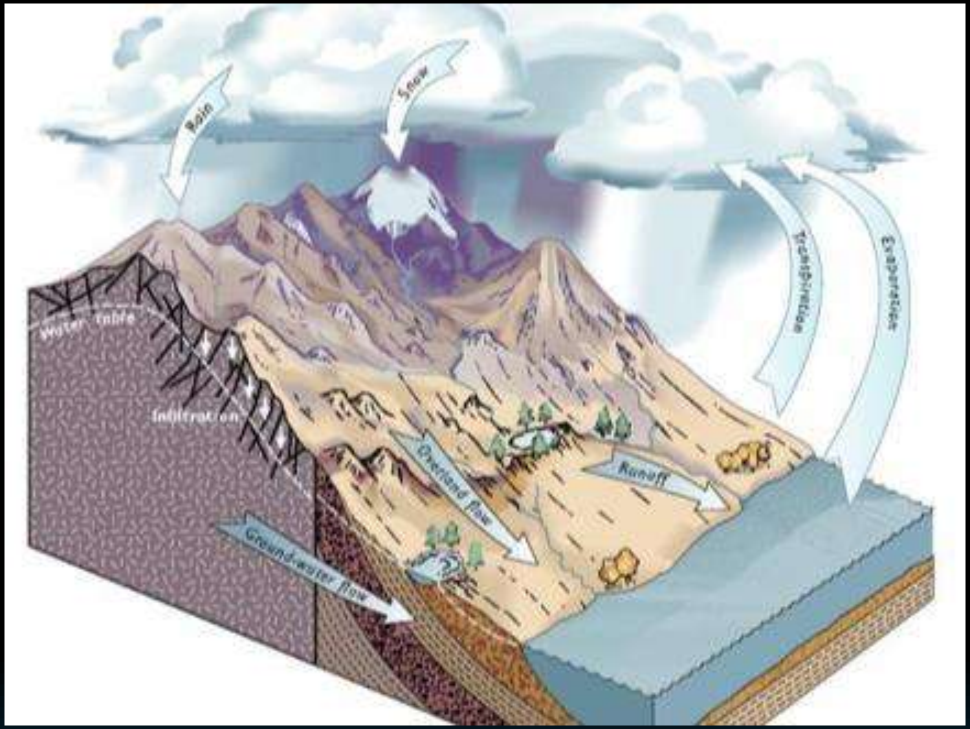
- Winter: 195 gallons/day
- Summer: 480 gallons/day



❖ Water Supply

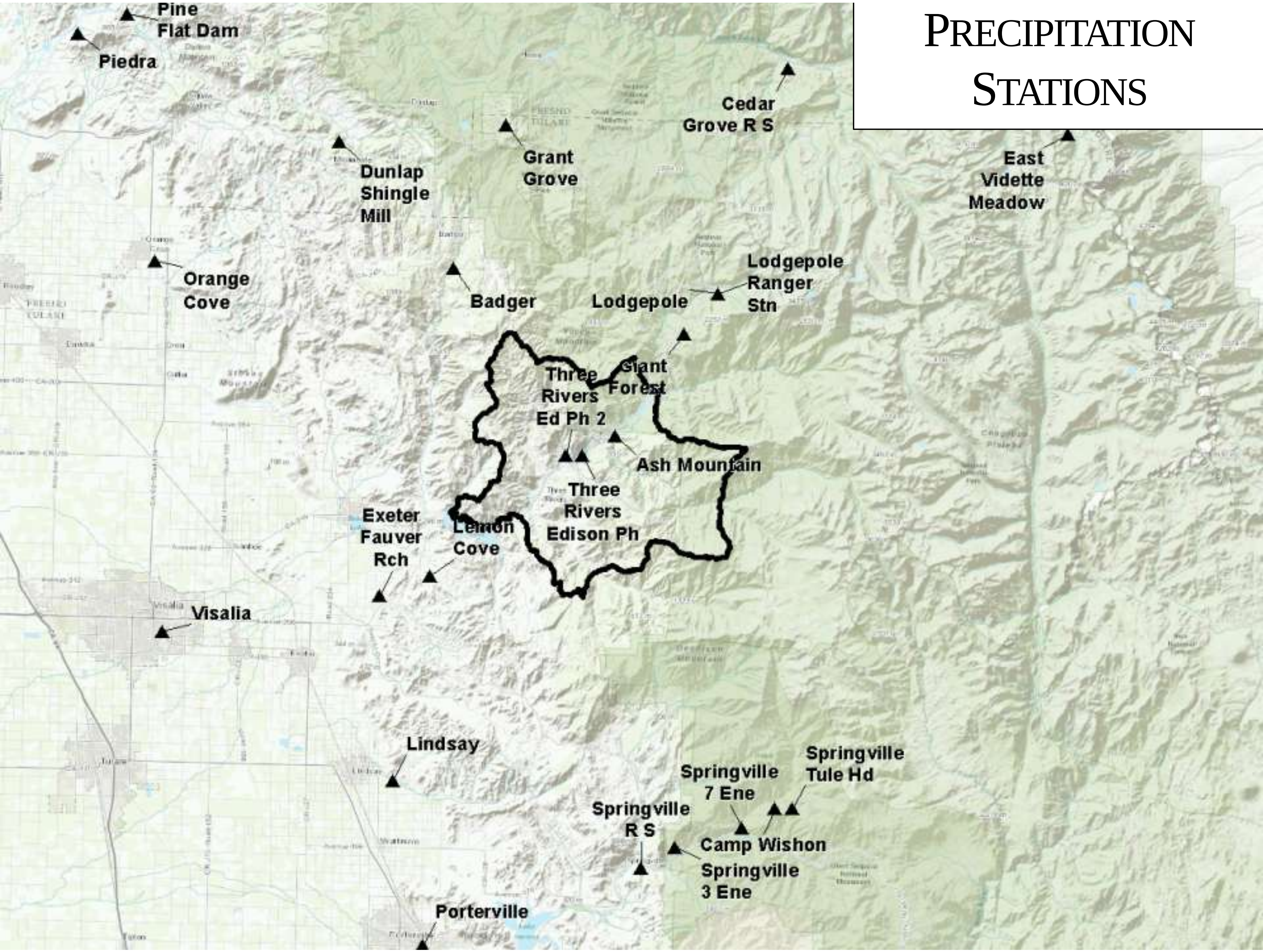
Water Supply

1. River flow from precipitation at high elevations.
2. Rain and snow falling within the local watersheds.

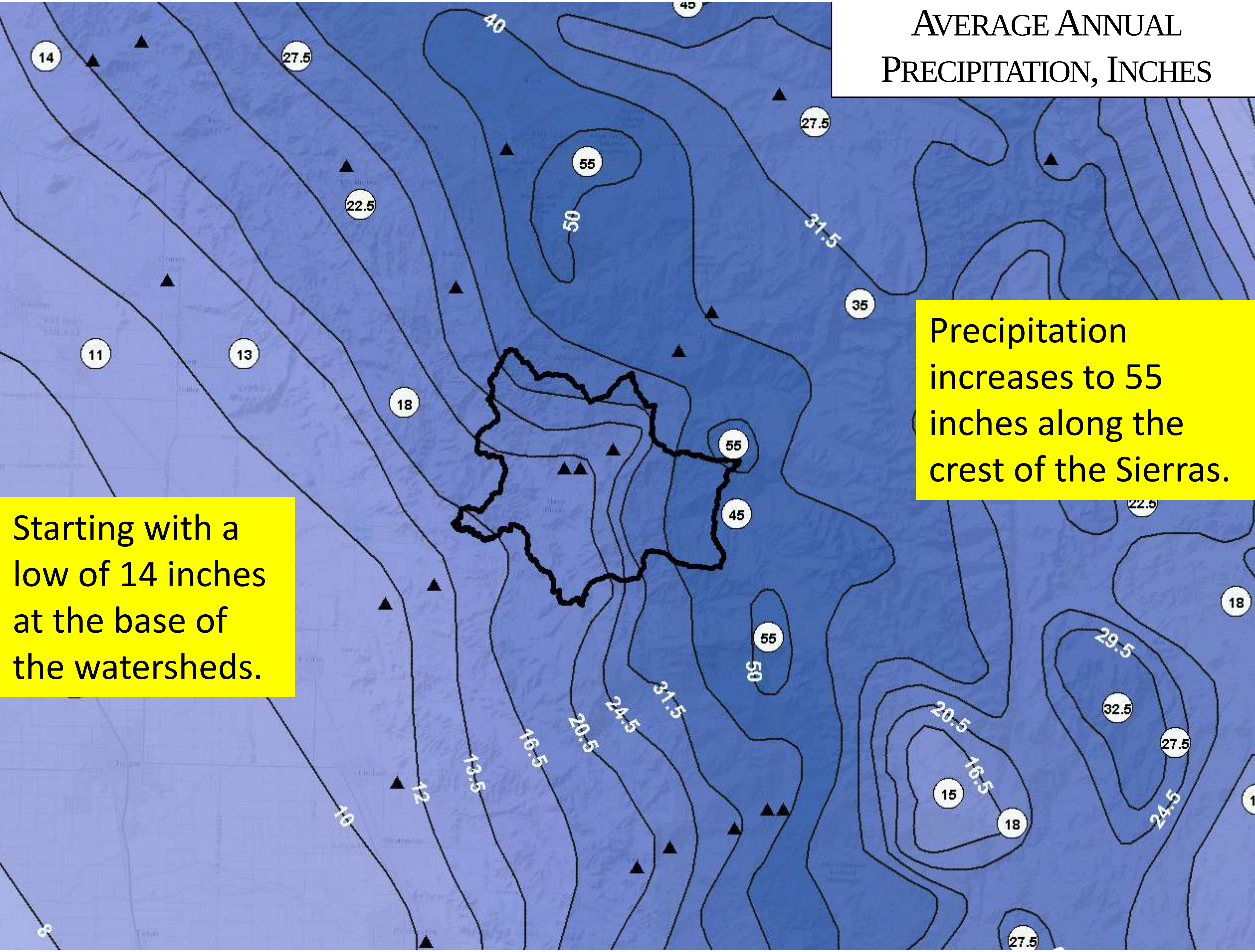


3. Groundwater in storage in the rock fractures.
4. Groundwater transported to the area via the rock fractures.

PRECIPITATION STATIONS



AVERAGE ANNUAL PRECIPITATION, INCHES



Precipitation increases to 55 inches along the crest of the Sierras.

Starting with a low of 14 inches at the base of the watersheds.

❖ Groundwater Recharge

Groundwater Recharge

Methodology

Natural Water Loss and Recoverable Water in Mountain Basins of Southern California

By JOHN R. CRIPPEN

CONTRIBUTIONS TO STREAM-BASIN HYDROLOGY

GEOLOGICAL SURVEY PROFESSIONAL PAPER 417-E

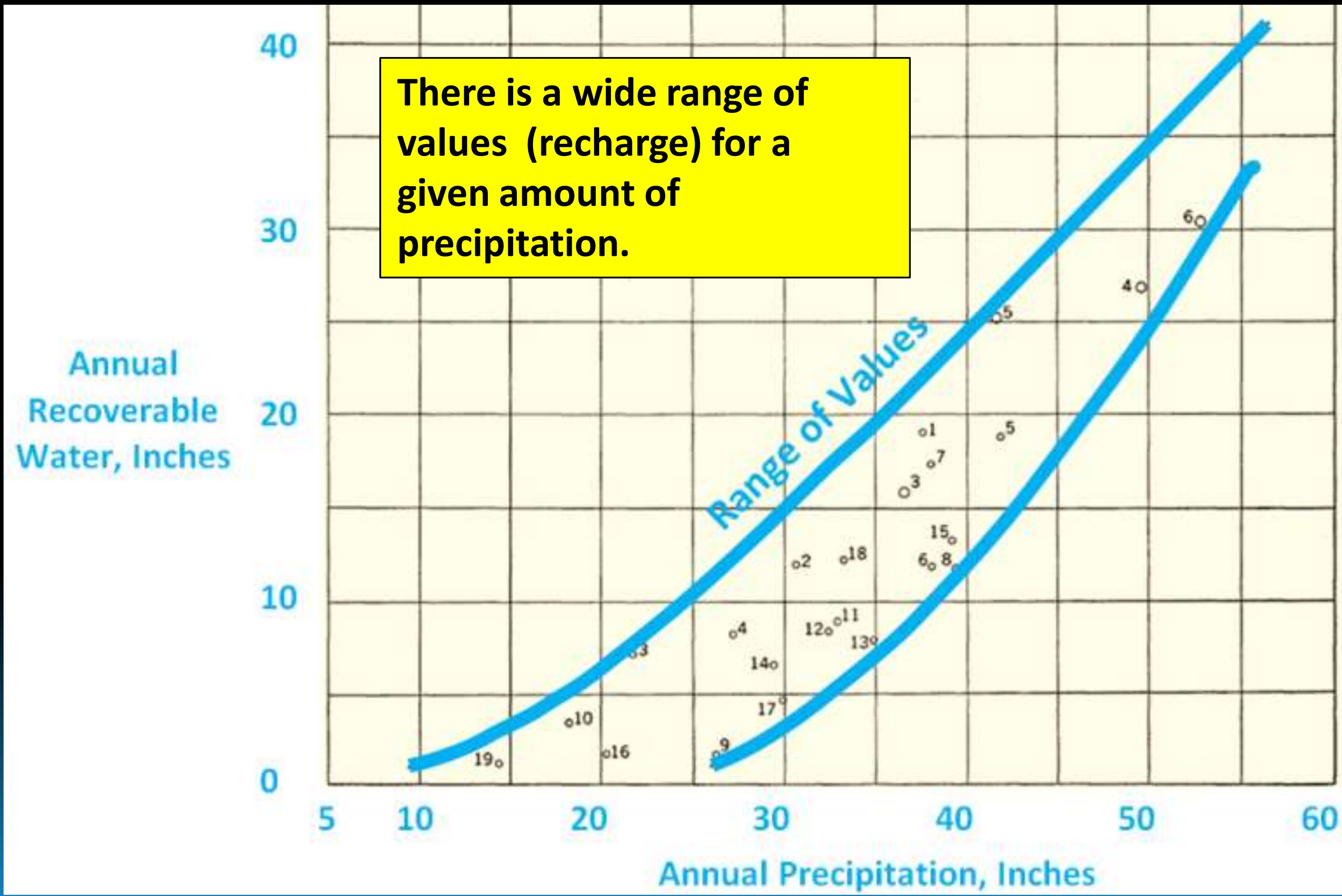
Prepared in cooperation with
California Department of Water Resources

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1965

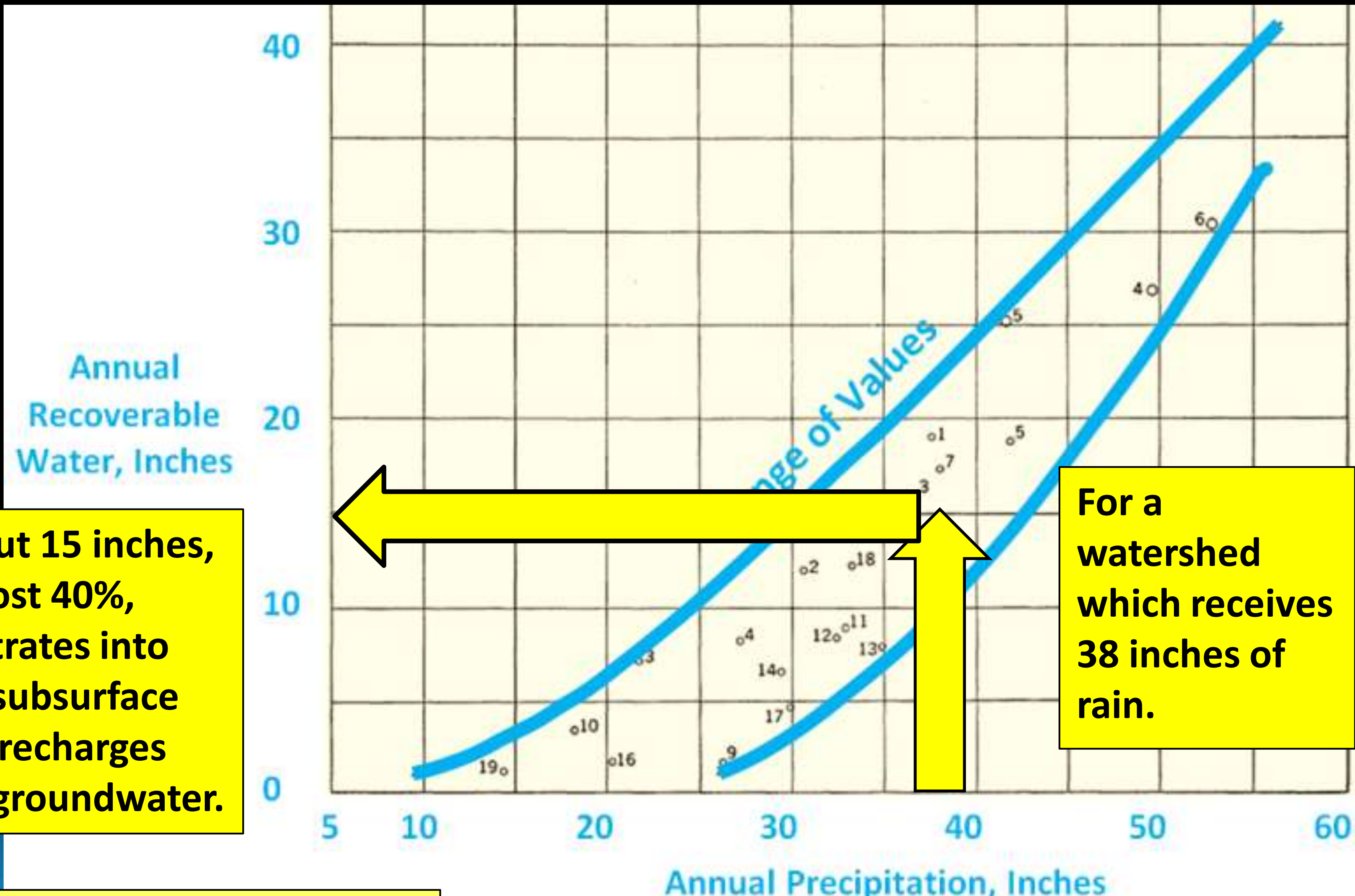
An older method that can be used to broadly estimate groundwater

Although the method has limitations, it can provide a simple and quick generalized estimate of regional recharge.

GROUNDWATER RECHARGE
METHODOLOGY



GROUNDWATER RECHARGE
METHODOLOGY

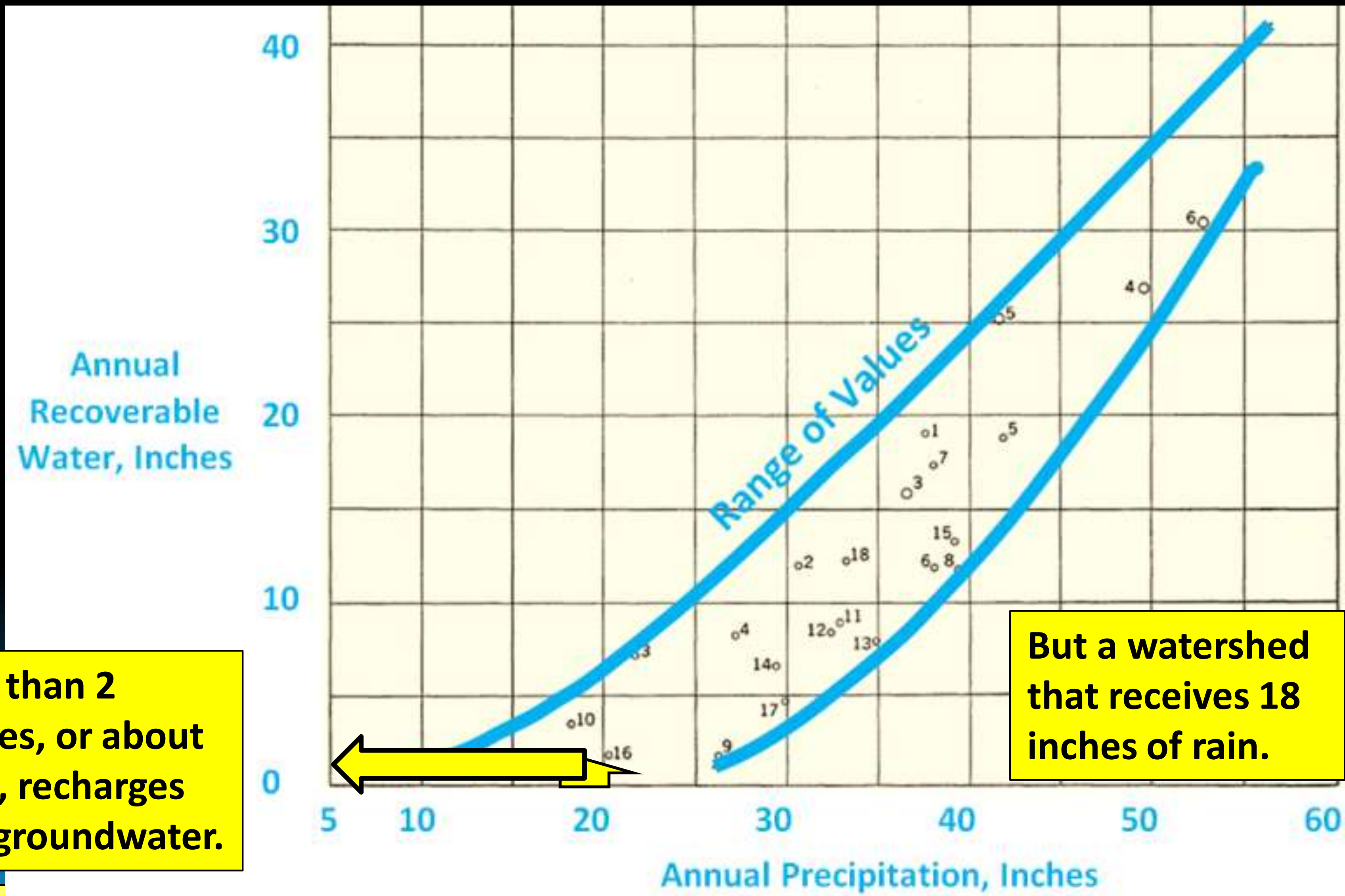


About 15 inches, almost 40%, infiltrates into the subsurface and recharges the groundwater.

For a watershed which receives 38 inches of rain.

But the range of values is 10 to 23 inches.

Groundwater Recharge
Methodology



Less than 2 inches, or about 10%, recharges the groundwater.

But a watershed that receives 18 inches of rain.

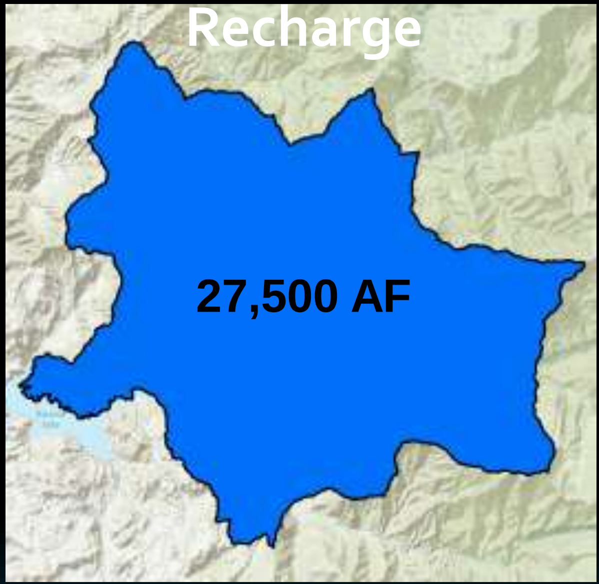
And the range of values is 0 to 5 inches.

WATER BALANCE

Average Precipitation Across the Entire Watershed = 22.5 inches.
Estimated groundwater recharge = 4 inches.

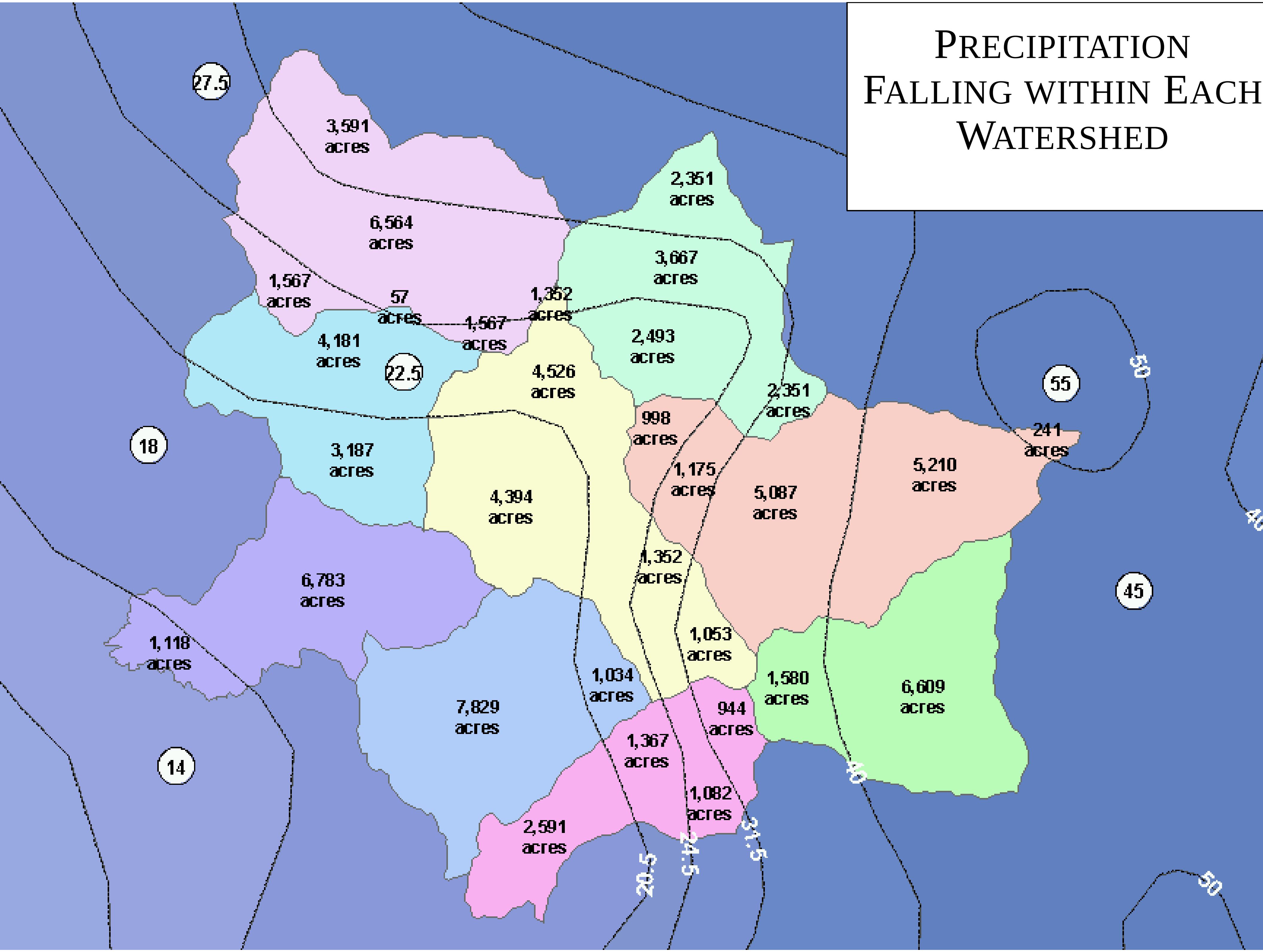
Area of the

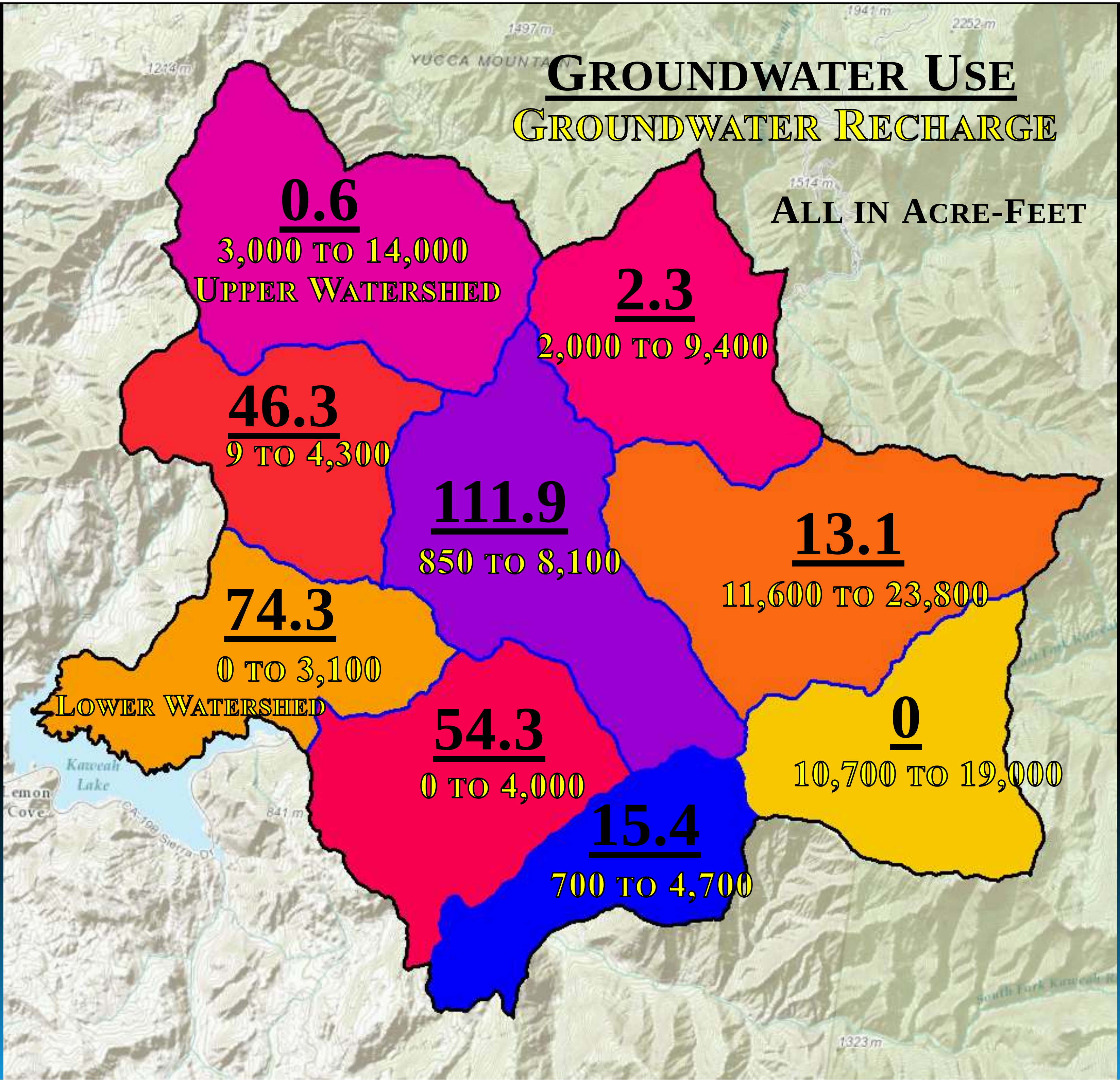
Groundwater Recharge



Groundwater Use

PRECIPITATION FALLING WITHIN EACH WATERSHED

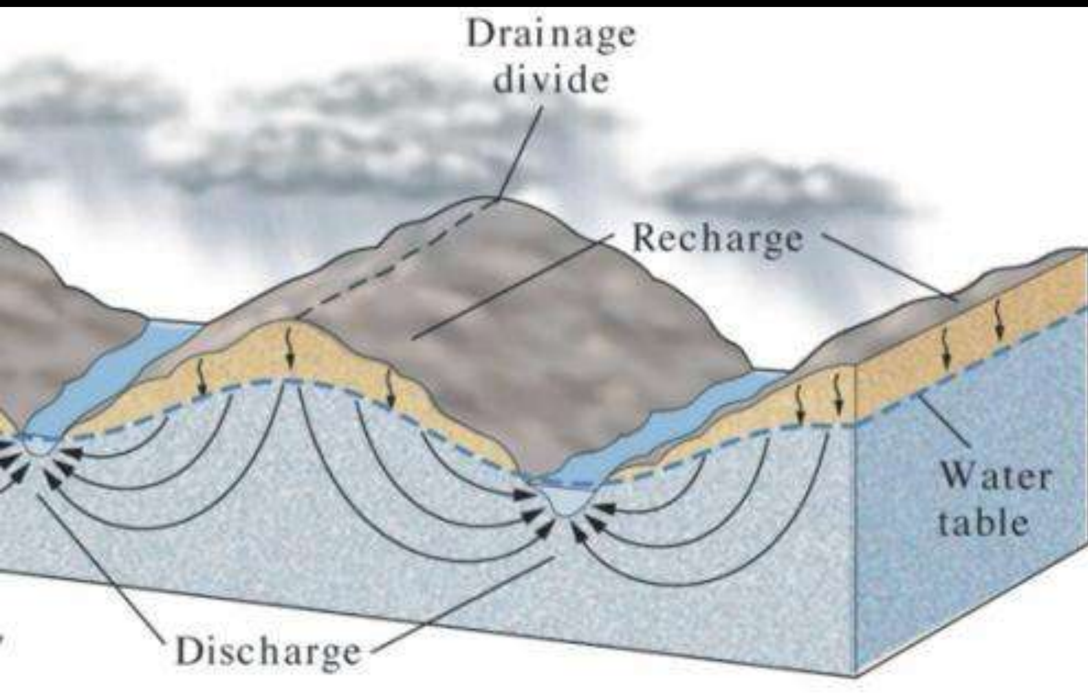


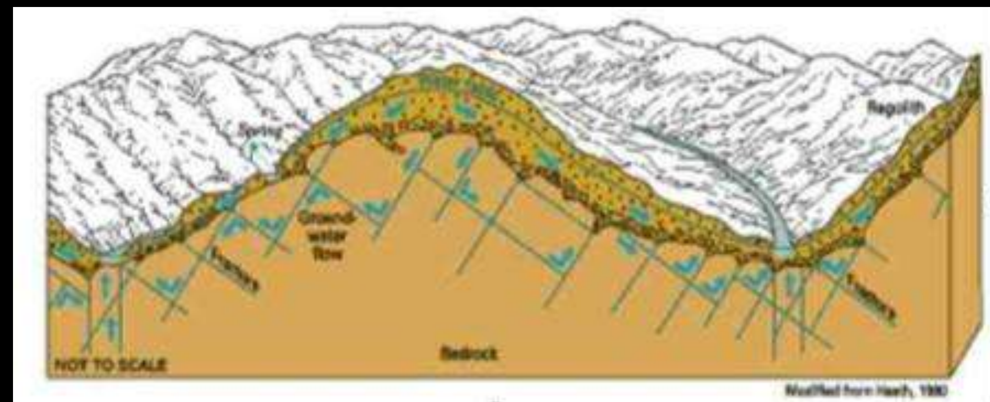

GROUNDWATER USE
GROUNDWATER RECHARGE
ALL IN ACRE-FEET
0.6
3,000 TO 14,000
UPPER WATERSHED
2.3
2,000 TO 9,400
46.3
9 TO 4,300
111.9
850 TO 8,100
13.1
11,600 TO 23,800
74.3
0 TO 3,100
LOWER WATERSHED
54.3
0 TO 4,000
0
10,700 TO 19,000
15.4
700 TO 4,700
YUCCA MOUNTAIN
Kaweah Lake
Lemon Cove

❖ AQUIFERS

THE AQUIFERS

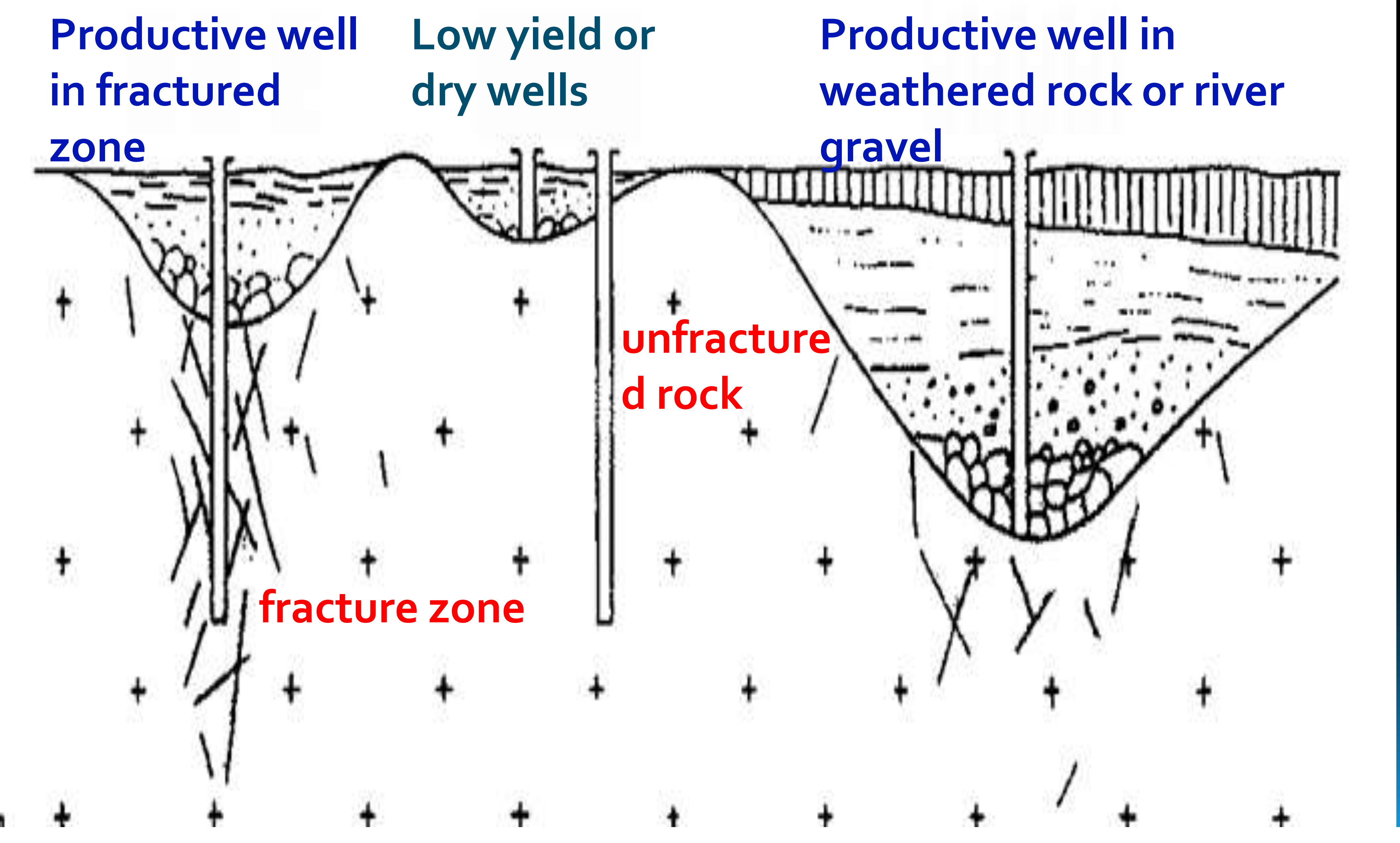
Alluvial and Fractured





Groundwater Movement is Downhill...
...from High to Low Elevation...
...from Recharge to Discharge area.

Fractured Rock Aquifers



Fractured Rock Aquifers

Fractured Rock Aquifers

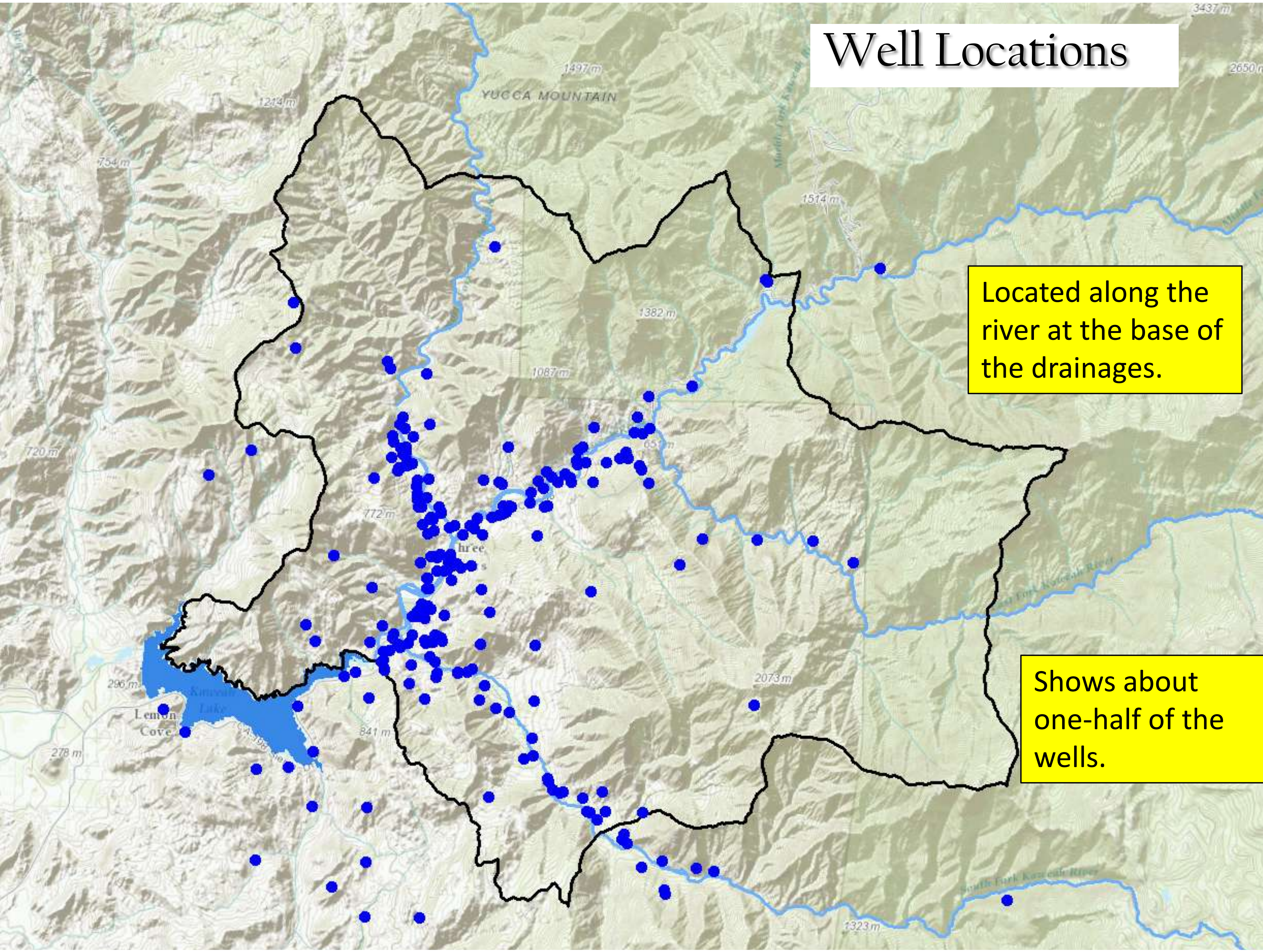
FRACTURED ROCK AQUIFERS


Northwest trending rock fractures, N. Fork of the Kaweah
Northeast trending fractures

❖ Water Supply

Wells in Fractured Rock

Well Locations



Located along the river at the base of the drainages.

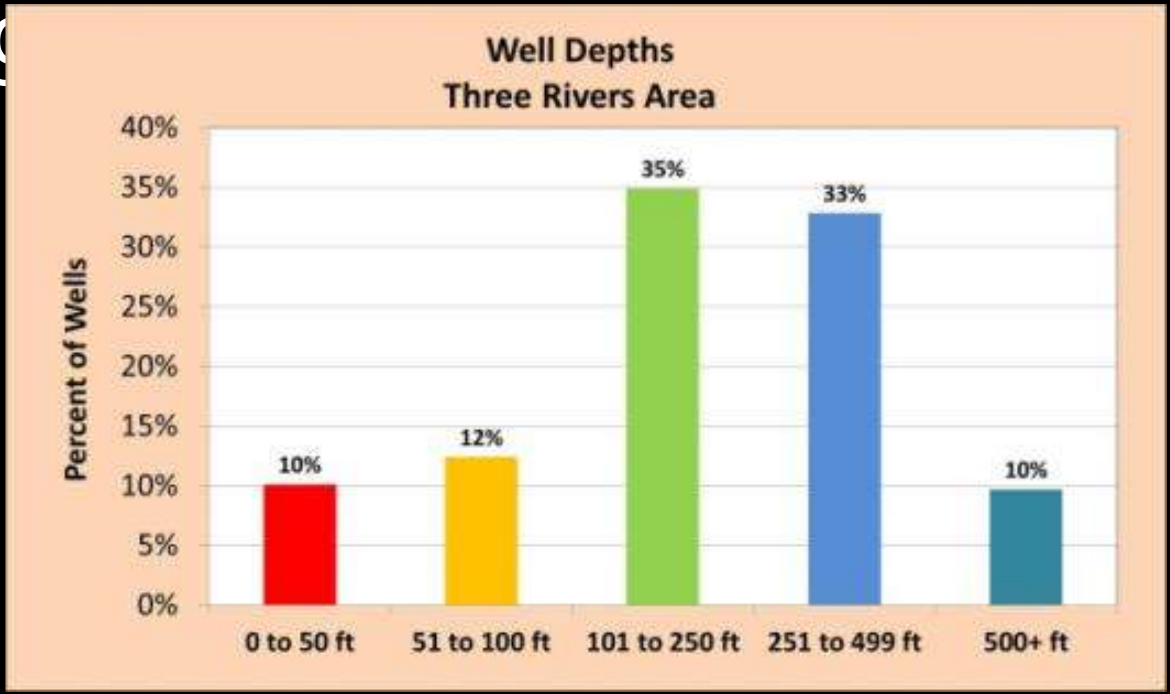
Shows about one-half of the wells.

Well Information from Well Driller's Logs

- Number of well logs reported to DWR: 486

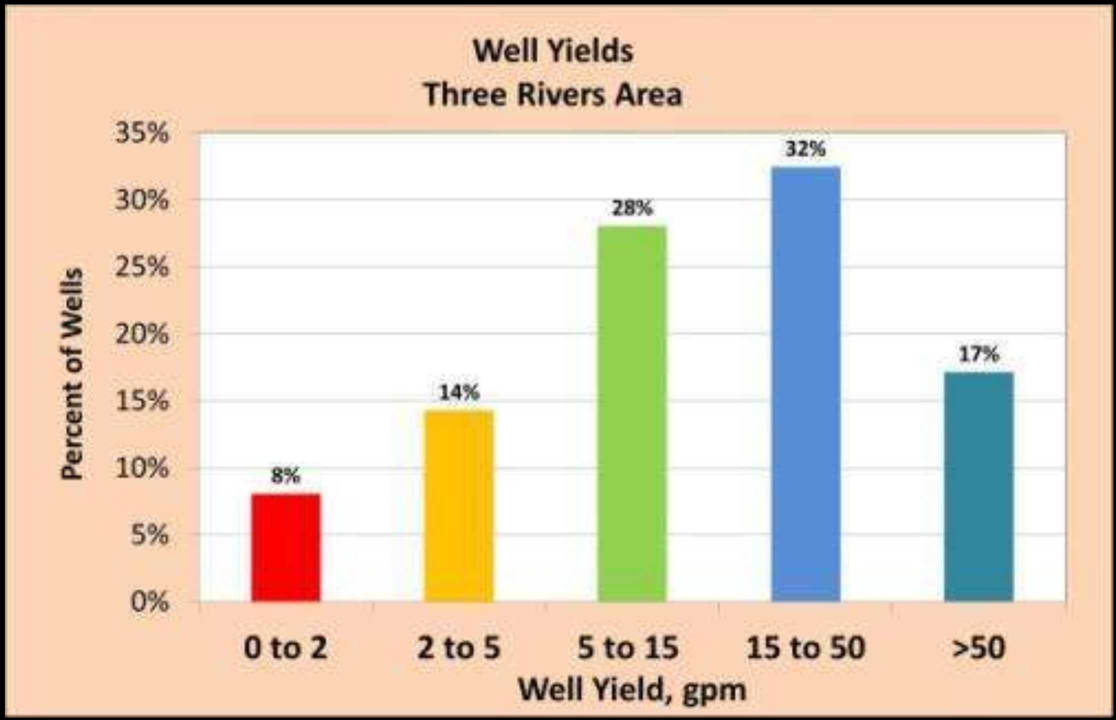
- 231 well logs with good location data and 255 located only to the nearest section.

Well Information from Well Driller's Log



- Well Depths
  - 68% of the wells had depths of 100 to 500 feet
  - 10% had depths less than 50 feet
  - 22% had depths less than 100 feet.

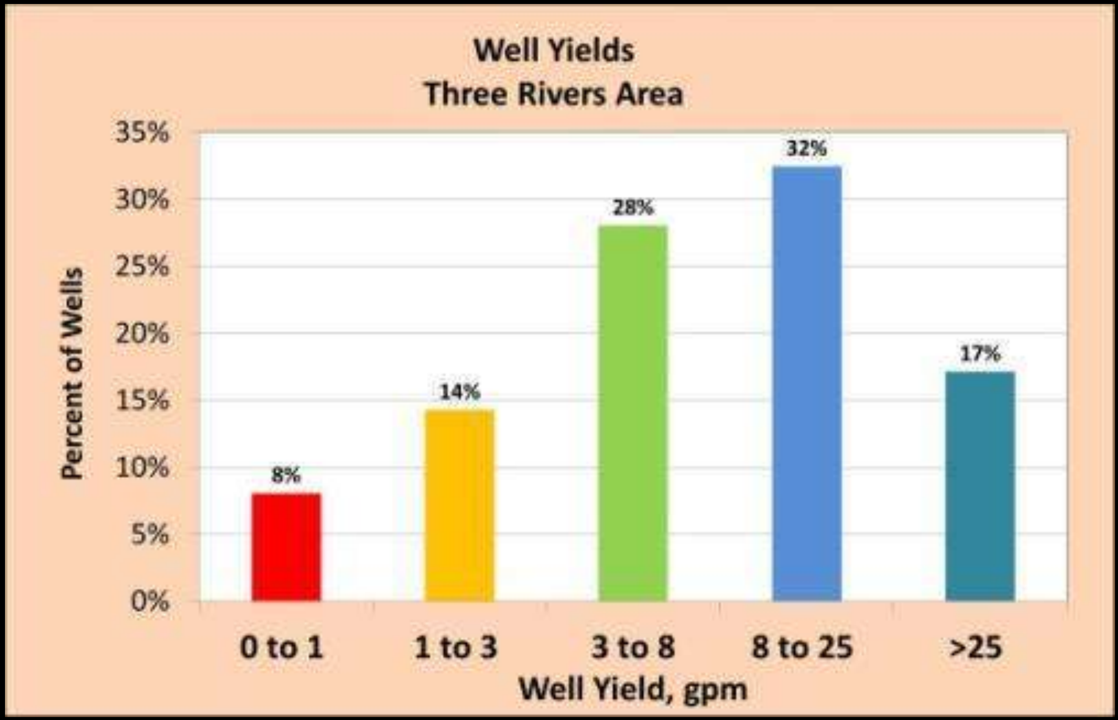
Well Information from Well Driller's Log



- <u>Well Yields</u> (*air lift test at time of drilling)
  - 8% of the wells had yields less than 2 gpm
  - 42% of the wells had yields between 2 and 15 gpm
  - 50% of the wells had yields greater than 15 gpm

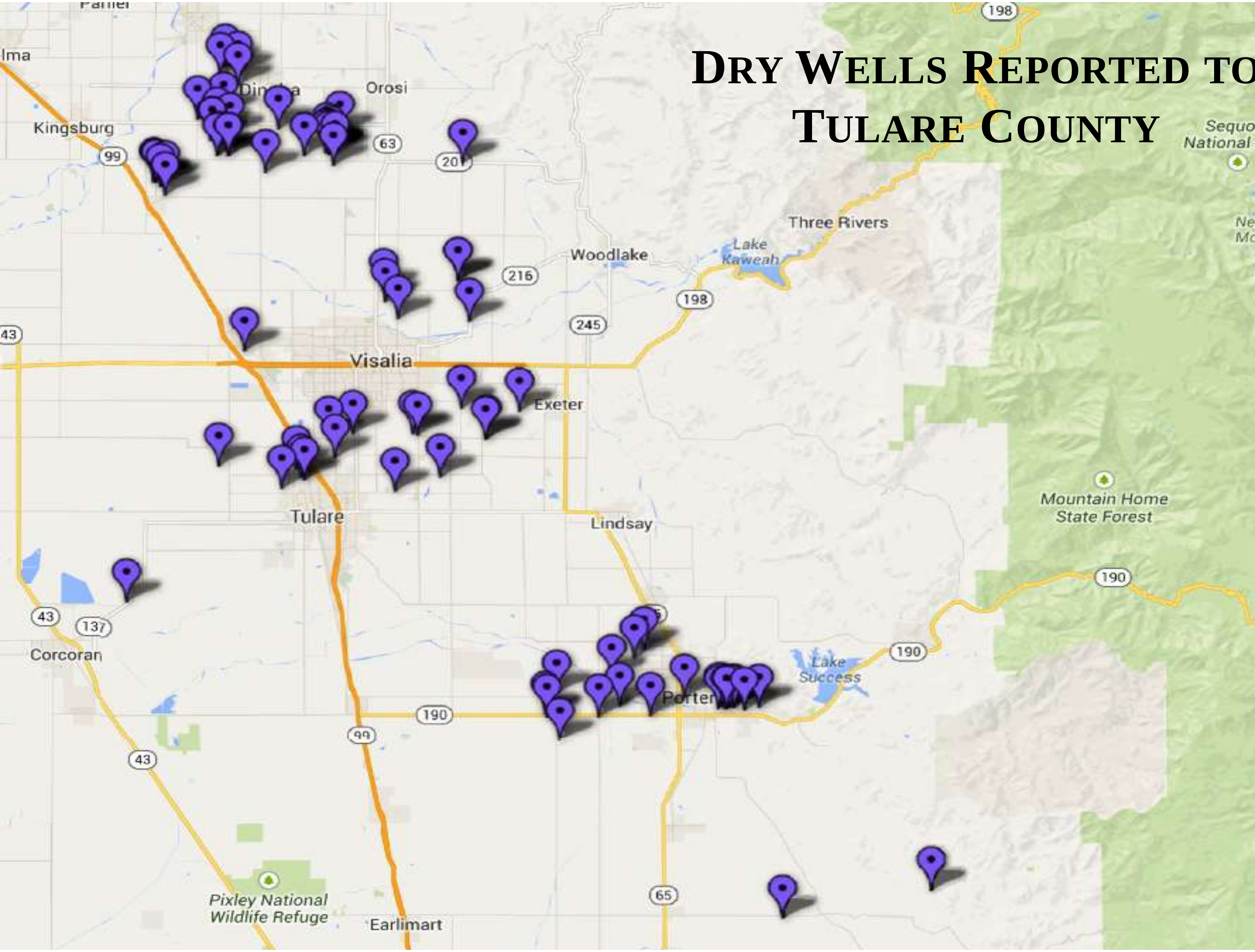
*Well yields by air lift are only rough estimates of the wells long-term pumping capacity. A rule of thumb to estimate in-use pumping capacity is take 1/4th to 1/2 of the air lift test estimate.

Well Information from Well Driller's Log



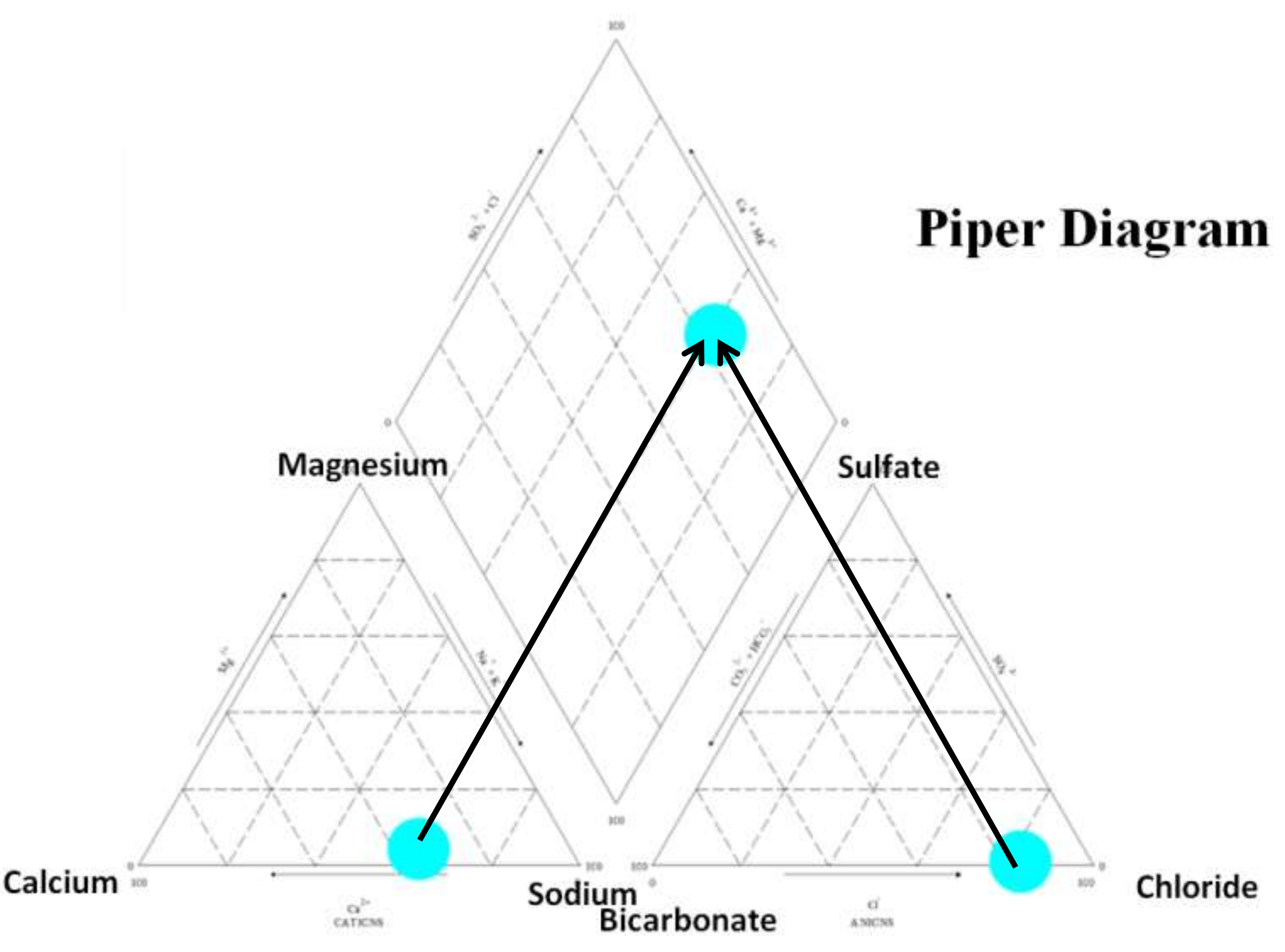
- <u>Well Yields</u> (estimated from ½ of the air lift test)
  - 8% of the wells had yields less than 1 gpm
  - 42% of the wells had yields between 1 and 8 gpm
  - 50% of the wells had yields greater than 8 gpm

Dry Wells Reported to Tulare County



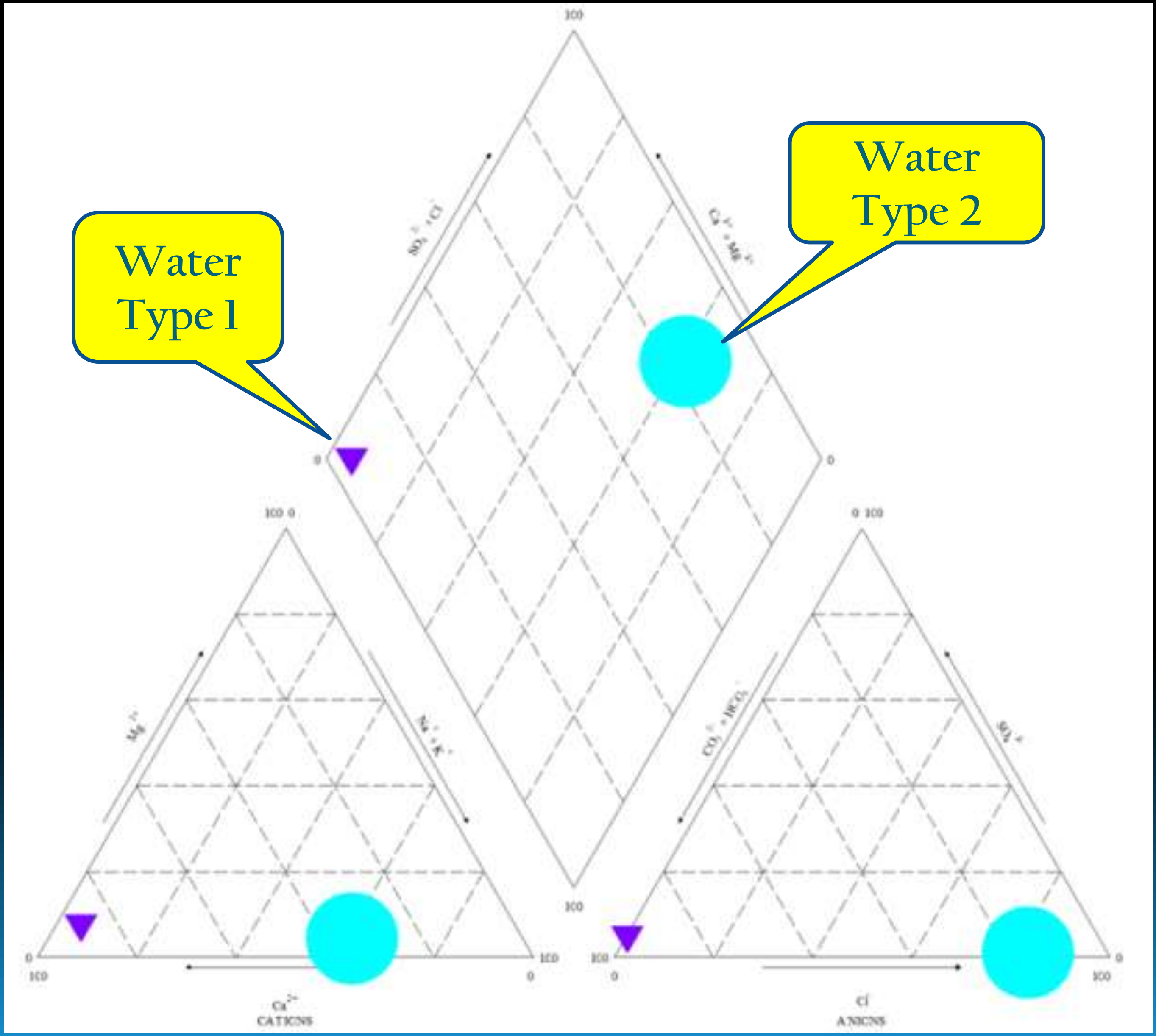
❖ WATER SOURCE DETERMINED BY WATER CHEMISTRY

WATER CHEMISTRY



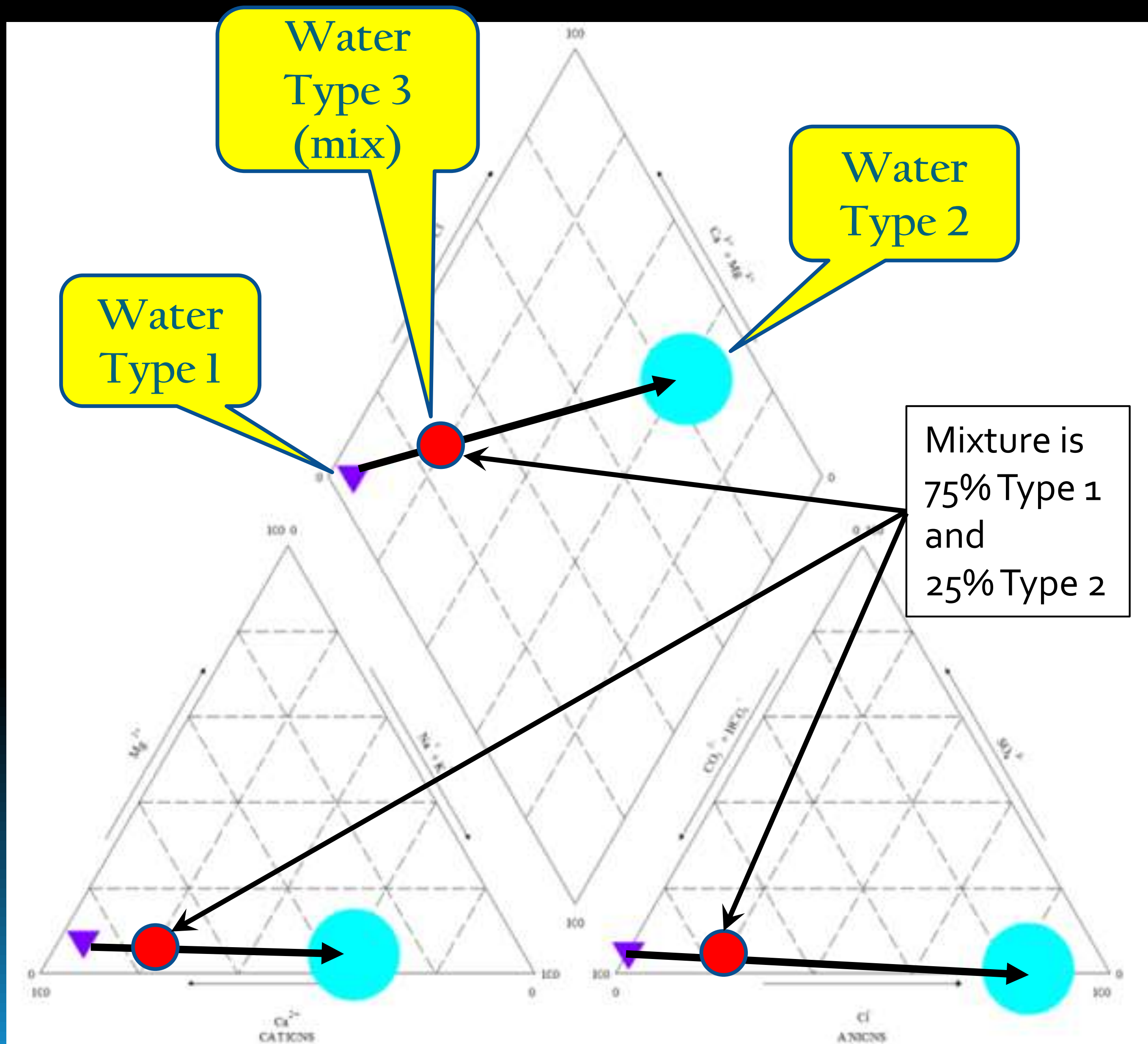
Chemistry from the cation and anion triangles are projected onto the central diamond

WATER CHEMISTRY



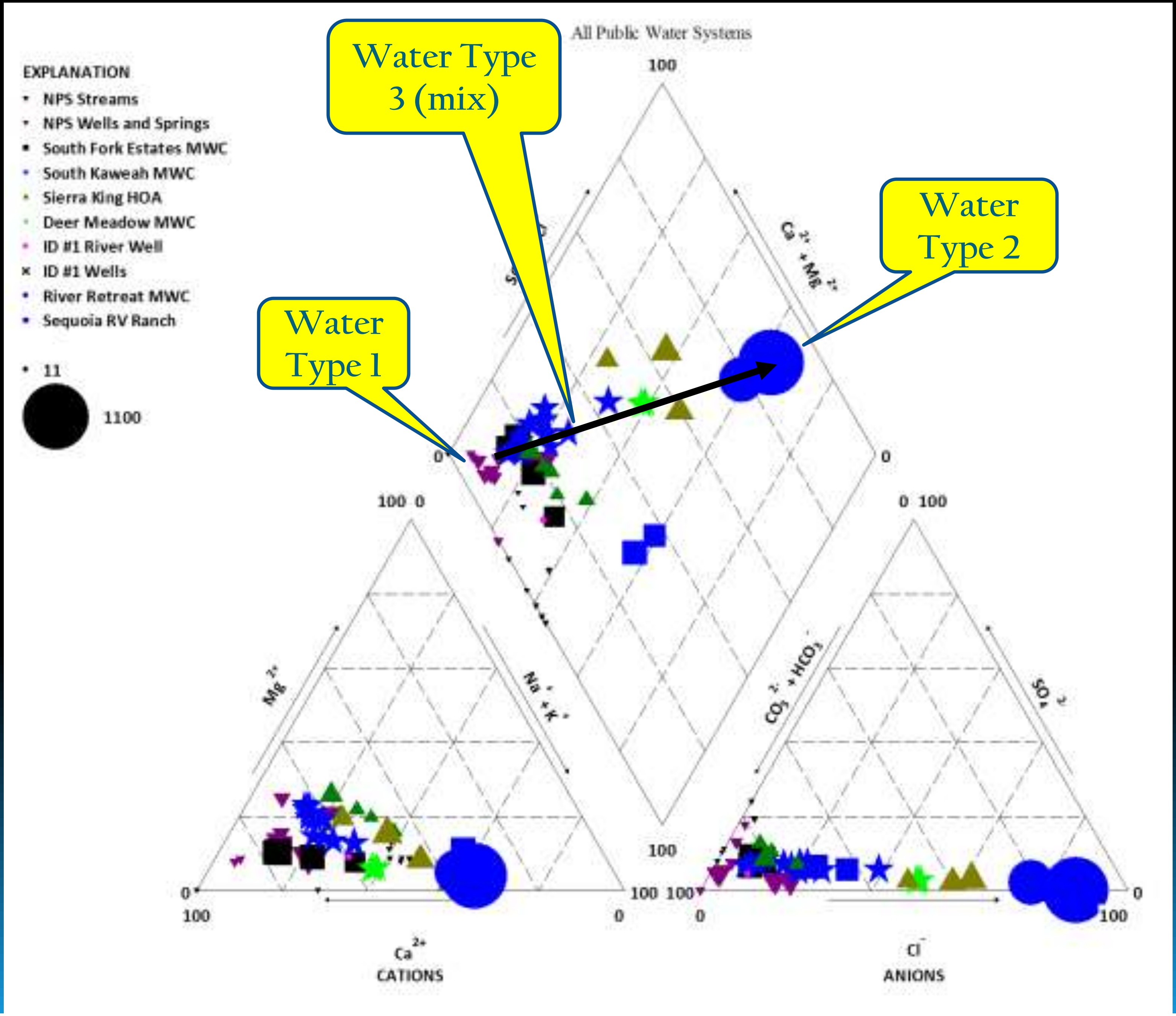
Diameter of the circle is proportional to its dissolved mineral content.

WATER CHEMISTRY

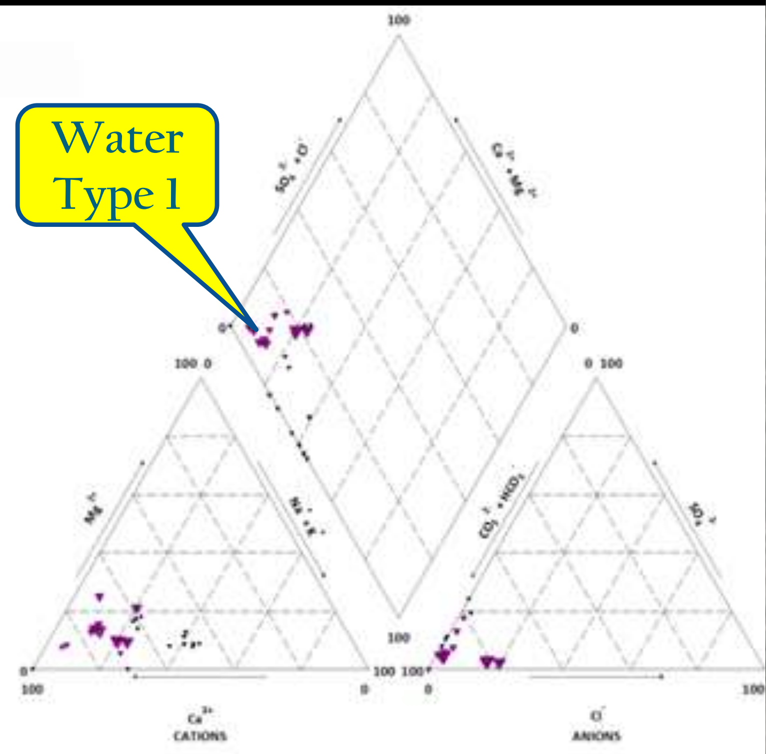


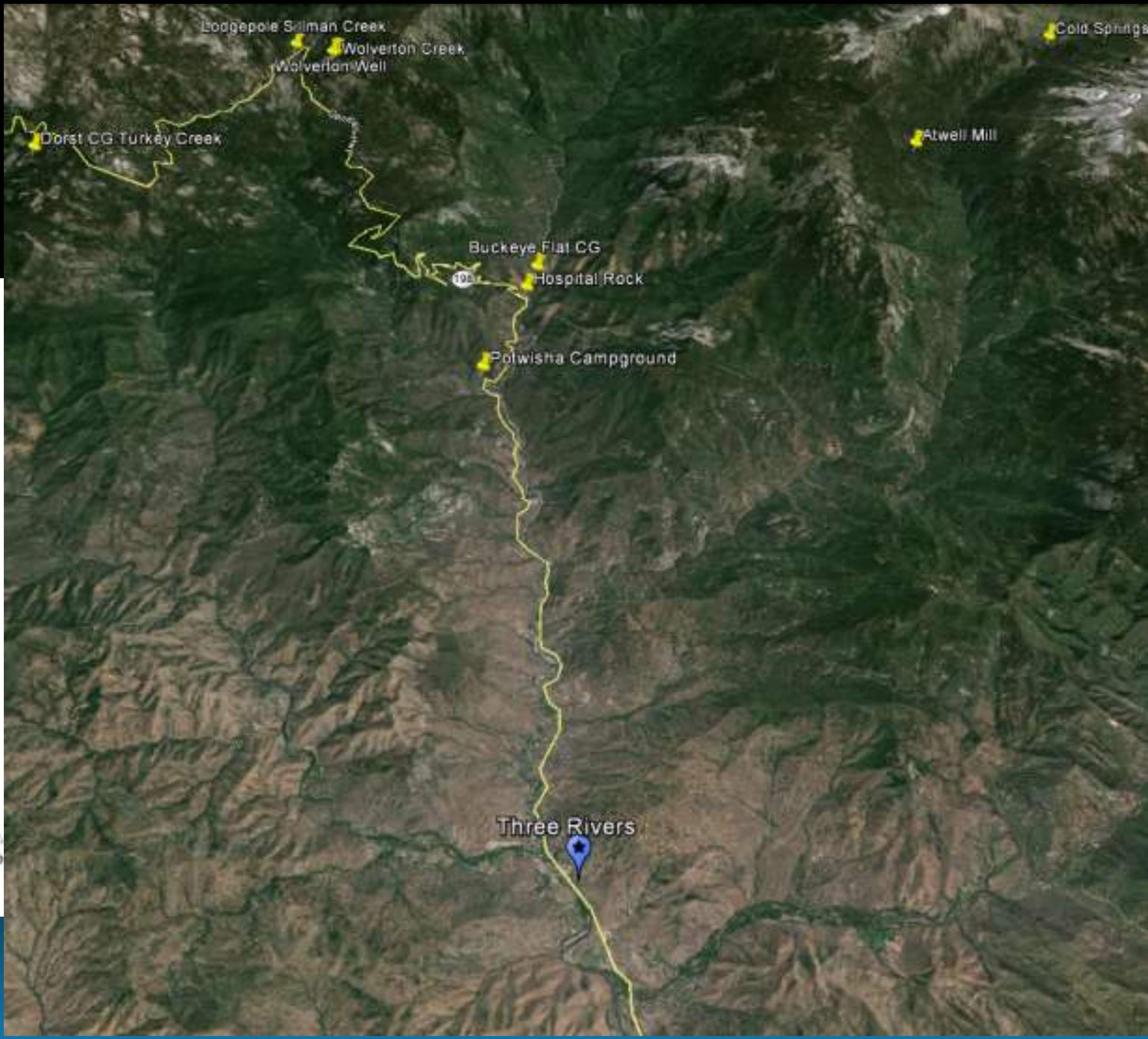
WATER CHEMISTRY

WATER CHEMISTRY OF PUBLIC WATER SYSTEMS IN THE THREE RIVERS AREA



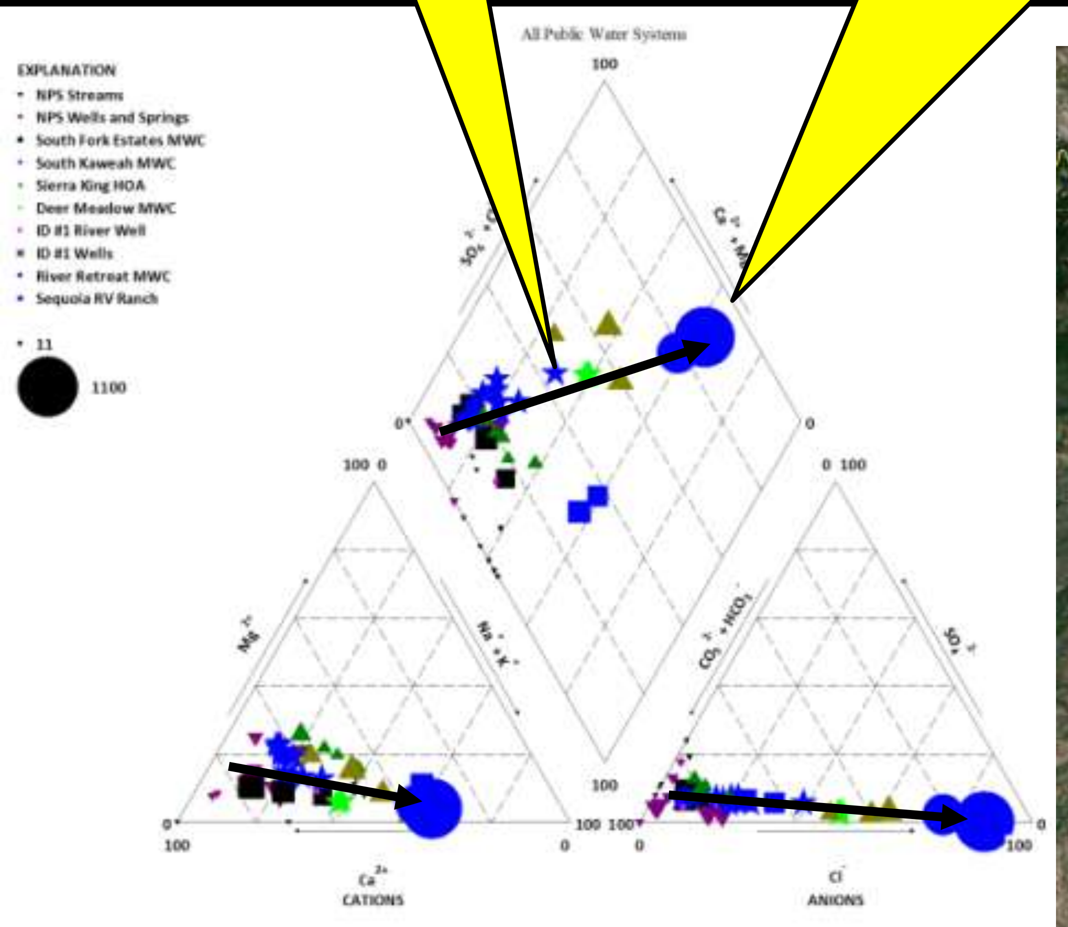
WATER CHEMISTRY

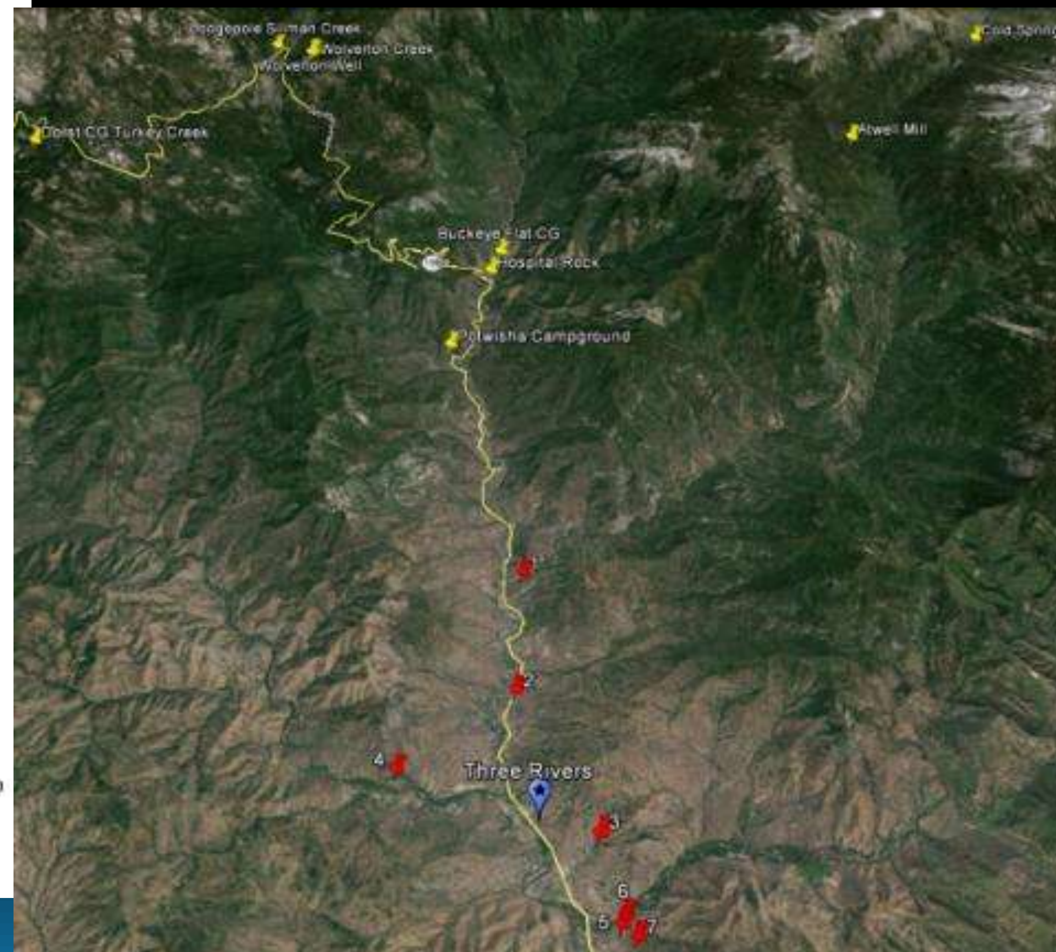




Water Type 3 (mix)

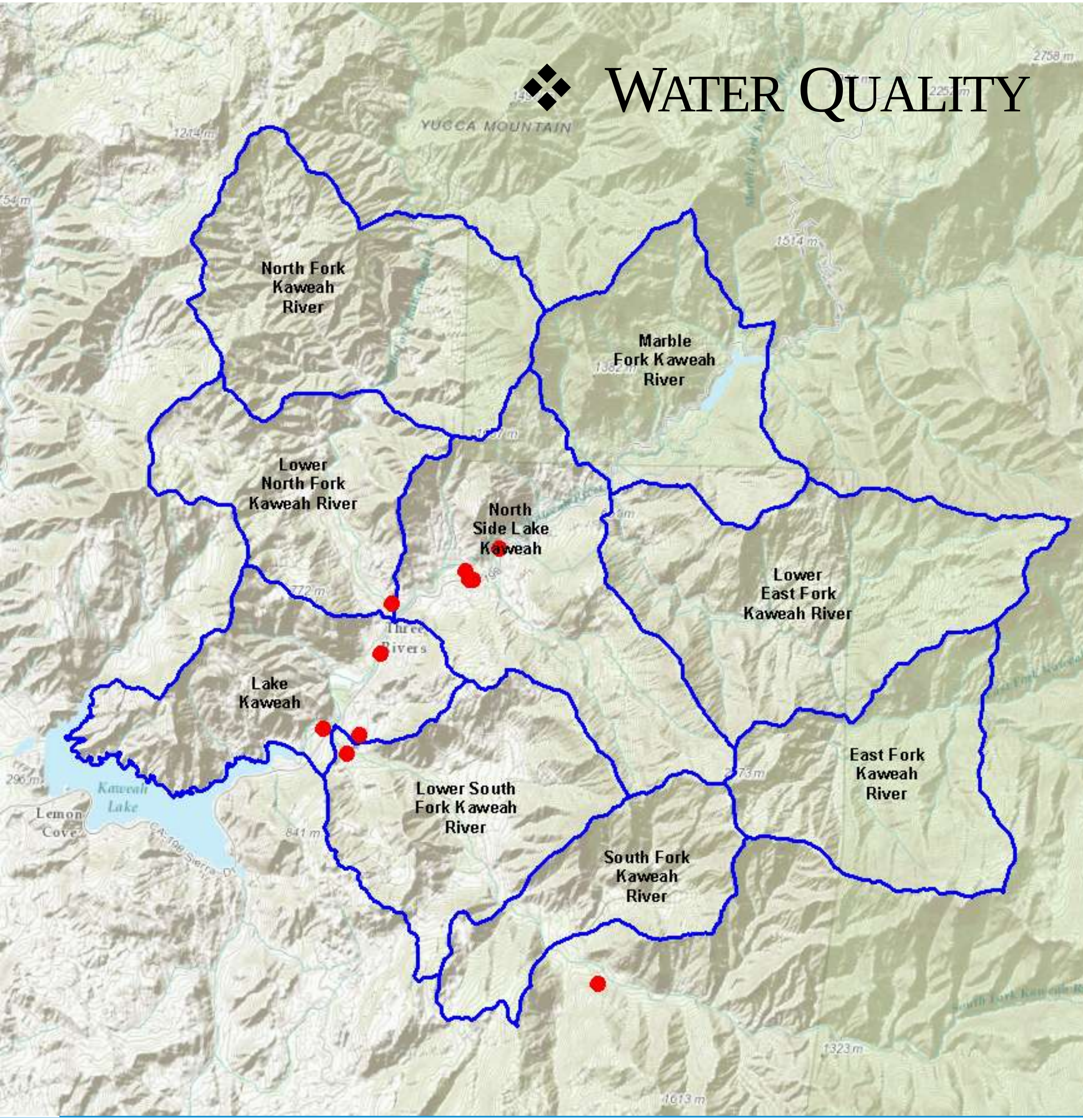
Water Type 2
Saltier groundwater from portions of the rock fractures in the lower basin





- Water Quality

❖ Water Quality



Wells with:

- high salt content (exceeding the secondary drinking water standard).
- Noted as having sulfur water on the well log.
- Noted as having hydrogen sulfide on the well log.
- Noted as salt water on the well log.

❖ PUTTING IT ALL TOGETHER

❖ PUTTING IT ALL TOGETHER

Study Area

- The watersheds of the Kaweah River that contribute to groundwater recharge.

Land Use

- 54% government owned and 46% privately owned.
- There are 1,575 parcels within the watersheds with 81% being less than 10 acres.
- Most of the smaller parcels are located next to the Kaweah River and its tributaries.

Census Data

- Population: 2,182.
- Households: 1,018.
- Household size: 2.14 persons.

❖ PUTTING IT ALL TOGETHER

- **Water Demand**
  - **Daily Average: 300 gallons per home.**
  - Daily Summer Use: 480 gallons per home.
  - Summer is maximum use when water levels are the lowest.
  - Annual use: 110,000 gallons per home (0.34 AF).
- **Water Supply**
  - Provided by wells.
  - Water from the wells comes from precipitation resulting in:
    - Groundwater recharge in the local watersheds.
    - Groundwater recharge from Kaweah River flow – benefit from a large drainage area.
    - Groundwater recharge from subsurface inflow along rock fractures.

❖ PUTTING IT ALL TOGETHER

Groundwater Recharge

- Highest recharge is in the upper the watersheds.
  - Recharge exceeds water supply requirements.
  - Area with the fewest homes.

- The lowest recharge is in the lower watersheds.
  - Little or no recharge in the upper part of each watershed.
  - Area with the most homes.
  - But, most of these are along the river bottom and may benefit from river recharge.

- This is for average precipitation conditions. An extended drought will impact the amount of recharge with greatest impact in the lower watersheds.

❖ Putting It All Together

Aquifers

- A small, shallow alluvial aquifer along the river bottom.
- Rock fractures.
  - Large intersecting fracture system that extends across drainages – provides regional benefit.
  - Cut across differing geologic units, some adversely affecting water quality.
  - Provide water to nearly all of the wells.

Water Wells

- Provide nearly all of the water.
- More than 500 wells identified, representing about one-half of the homes.
- Hard rock wells dependent upon rock fractures.
- One-half of the wells have estimated yields of less than 1 gpm to 7 gpm.
- One-third of the wells are less than 100 feet deep
  - More potential for failure in an extended drought.

❖ PUTTING IT ALL TOGETHER

✧ Water Chemistry and Water Quality

- Groundwater is a blend of high quality surface water and groundwater flowing through the rock fractures of the watersheds.
- There are wells with very high quality water and a few with high salt, sulfur or hydrogen sulfide.
- Salt and sulfur wells are related to the underlying bedrock type.

Questions?

Department of Water Resources
South Central Region Office
John Kirk, Engineering Geologist
3374 E Shields Ave
Fresno, CA 9937260
559-230-3382
John.kirk@water.ca.gov
http://www.water.ca.gov

Appendix E

Special Status Species

Southern Sierra Regional Water Management Group
Special Status Species in Region

Abrams' onion
alpine dusty maidens
alpine jewelflower
American badger
American manna grass
An isopod
aromatic canyon gooseberry
bald eagle
Berry's morning-glory
Big Tree Forest
black swift
black-backed woodpecker
Blandow's bog moss
Bodie Hills rockcress
bog sandwort
Boggs Lake hedge-hyssop
Bolander's bruchia
Bolander's clover
Bolander's woodreed
broad-nerved hump moss
burrowing owl
calico monkeyflower
California condor
California linderiella
California tiger salamander
California wolverine
Cent. Vly Drainage Hardhead/Squawfish Stream
Charlotte's phacelia
Chimney Creek nemacladus
Clough Cave harvestman
common moonwort
Congdon's lewisia
Cooper's hawk
copper-flowered bird's-foot trefoil
cut-leaf checkerbloom
cylindrical trichodon
Dedecker's clover
delicate bluecup
Denning's cryptic caddisfly
Munz's iris
Nine Mile Canyon phacelia
Northern Basalt Flow Vernal Pool
Northern Claypan Vernal Pool
northern clustered sedge
northern goshawk
Northern Hardpan Vernal Pool
northern spleenwort
Olancha Peak buckwheat
Onyx Peak bedstraw
orange lupine
osprey
oval-leaved viburnum
Paiute cutthroat trout
pallid bat
Piedra harvestman
Pierpoint Springs dudleya
pinyon rockcress
Piute cypress
Piute Mountains navarretia
prairie falcon
prairie wedge grass
purple mountain-parsley
pygmy hulsea
pygmy pussypaws
Ramshaw Meadows abronia
Raven's milk-vetch
rayless mountain ragwort
recurved larkspur
Robbins' pondweed
rose-flowered larkspur
rosette cushion cryptantha
round-leaved filaree
San Joaquin adobe sunburst
San Joaquin kit fox
San Joaquin Valley Orcutt grass
scalloped moonwort
Scribner's wheat grass
Sequoia cave isopod

Southern Sierra Regional Water Management Group
Special Status Species in Region

Dry Creek cliff strider bug
elongate copper moss
Father Crowley's lupine
fell-fields claytonia
field ivesia
fisher - West Coast DPS
flat-leaved bladderwort
foothill yellow-legged frog
forked hare-leaf
fringed myotis
golden eagle
gray-headed pika
great blue heron
great gray owl
Great Valley Mixed Riparian Forest
Greene's tuctoria
Greenhorn fritillary
grey-leaved violet
Hall's daisy
Hartweg's golden sunburst
hidden rockcress
hoary bat
Hockett Meadows lupine
Kaweah brodiaea
Kaweah fawn lily
Kaweah monkeyflower
Keck's checkerbloom
Keil's daisy
Kern Canyon clarkia
Kern Canyon slender salamander
Kern Plateau bird's-beak
Kern Plateau horkelia
Kern Plateau milk-vetch
Kern Plateau salamander
Kern River daisy
Kern shoulderband
King's Creek parapsyche caddisfly
Kings River buckwheat
Kings River slender salamander
knotted rush
Sequoia gooseberry
Sharsmith's stickseed
Shevock's copper moss
Shevock's milk-vetch
Shevock's rockcress
Shirley Meadows star-tulip
short-leaved hulsea
Sierra draba
Sierra marten
Sierra Nevada bighorn sheep
Sierra Nevada red fox
Sierra Nevada yellow-legged frog
silver-haired bat
slender moonwort
slender-stalked monkeyflower
small mousetail moss
Southern Interior Cypress Forest
southern mountain yellow-legged frog
spear-fruited draba
spiny-sepaled button-celery
Spjut's bristle moss
spotted bat
Springville clarkia
striped adobe-lily
subalpine fireweed
succulent owl's-clover
sweet-smelling monardella
Sweetwater Mountains draba
Sycamore Alluvial Woodland
Table Mountain harvestman
tall draba
Tehipite Valley jewelflower
The Needles buckwheat
three-ranked hump moss
tight coin (=Yates' snail)
Tompkins' sedge
Townsend's big-eared bat
Tracy's eriastrum
tree-anemone
Tulare cryptantha

Southern Sierra Regional Water Management Group
Special Status Species in Region

Lahontan cutthroat trout
Letterman's blue grass
Little Kern golden trout
long-eared myotis
long-legged myotis
Madera leptosiphon
marble rockmat
marbled harvestman
Mariposa pussypaws
marsh arrow-grass
Mineral King draba
mingan moonwort
moestan blister beetle
Mojave tarplant
molestan blister beetle
Monarch buckwheat
Monarch gilia
Monarch golden-aster
Mono Hot Springs evening-primrose
Moody's gnaphosid spider
Morrison's blister beetle
Mount Lyell salamander
Mount Pinos sooty grouse
mouse buckwheat
Mt. Whitney draba
mud sedge
Muir's tarplant

Tulare cuckoo wasp
Tulare rockcress
tundra thread moss
Twisselmann's buckwheat
Twisselmann's nemacladus
unexpected larkspur
upswept moonwort
valley elderberry longhorn beetle
vernal pool fairy shrimp
vernal pool tadpole shrimp
Volcano Creek golden trout
watershield
Watts Valley harvestman
western goblin
western mastiff bat
western pearlshell
western pond turtle
western small-footed myotis
western spadefoot
western waterfan lichen
willow flycatcher
wooly hydroporus diving beetle
yellow warbler
Yosemite bog orchid
Yosemite ivesia
Yosemite lewisia
Yosemite toad
Yuma myotis

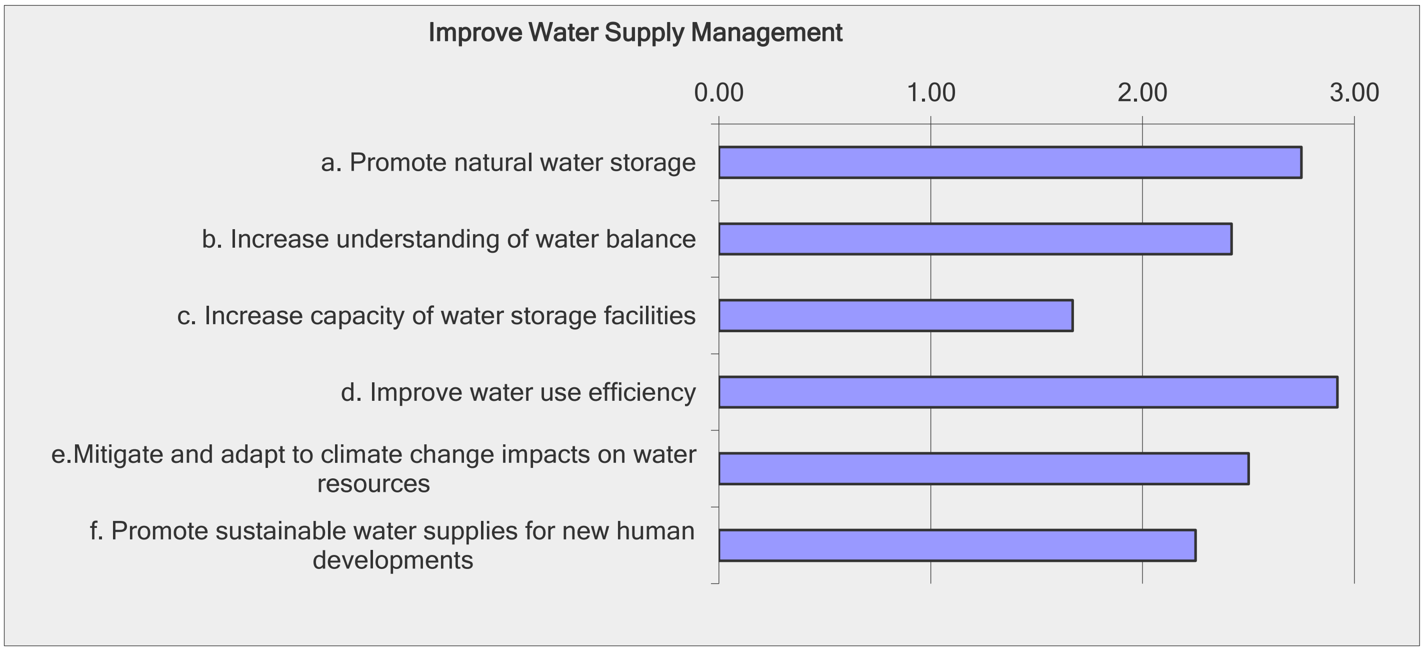
Notes: Special status species include State and Federally listed threatened and endangered species, and species protected under other special acts, laws and regulations.

Appendix F

Regional Objectives Ranking Survey

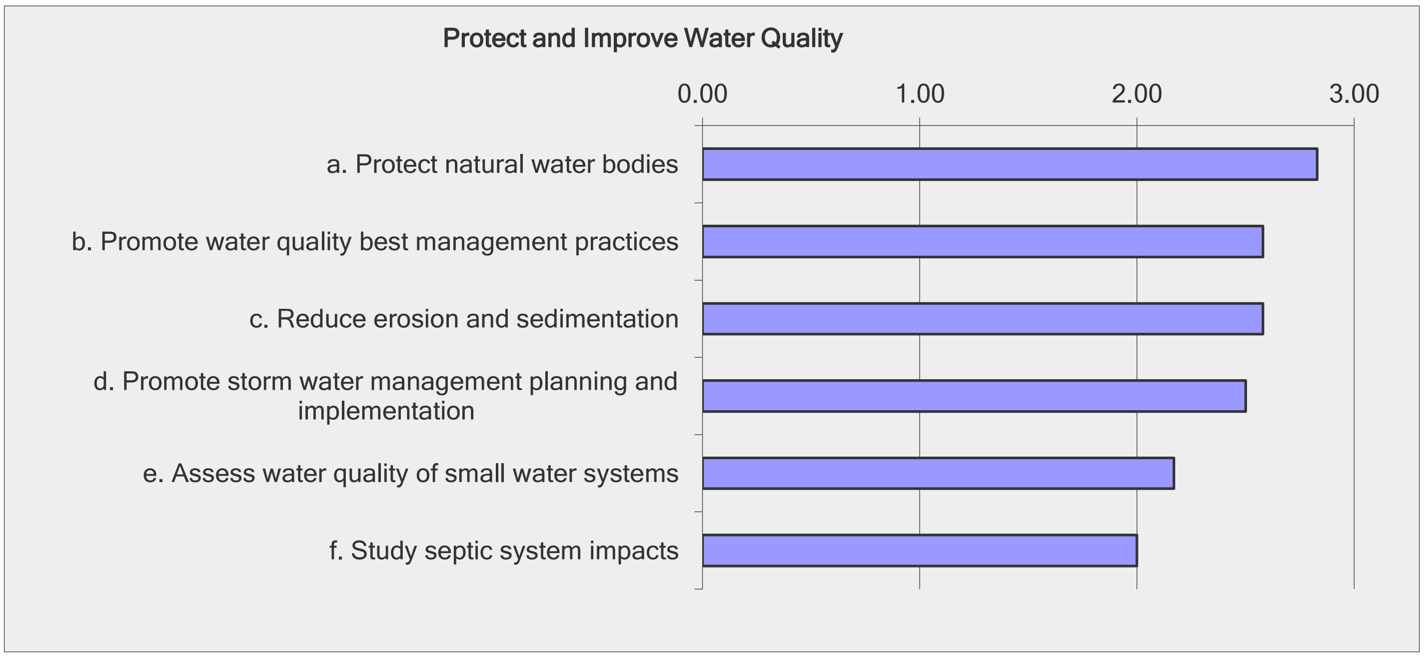
Southern Sierra IRWMP - Objectives Survey

Goal No. 1: Improve Water Supply Management					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Promote natural water storage	0	2	10	2.75	12
b. Increase understanding of water balance	2	4	6	2.42	12
c. Increase capacity of water storage facilities	5	2	5	1.67	12
d. Improve water use efficiency	1	7	4	2.92	12
e.Mitigate and adapt to climate change impacts on water resources	0	2	10	2.50	12
f. Promote sustainable water supplies for new human developments	1	6	5	2.25	12
				answered question	12
				skipped question	0



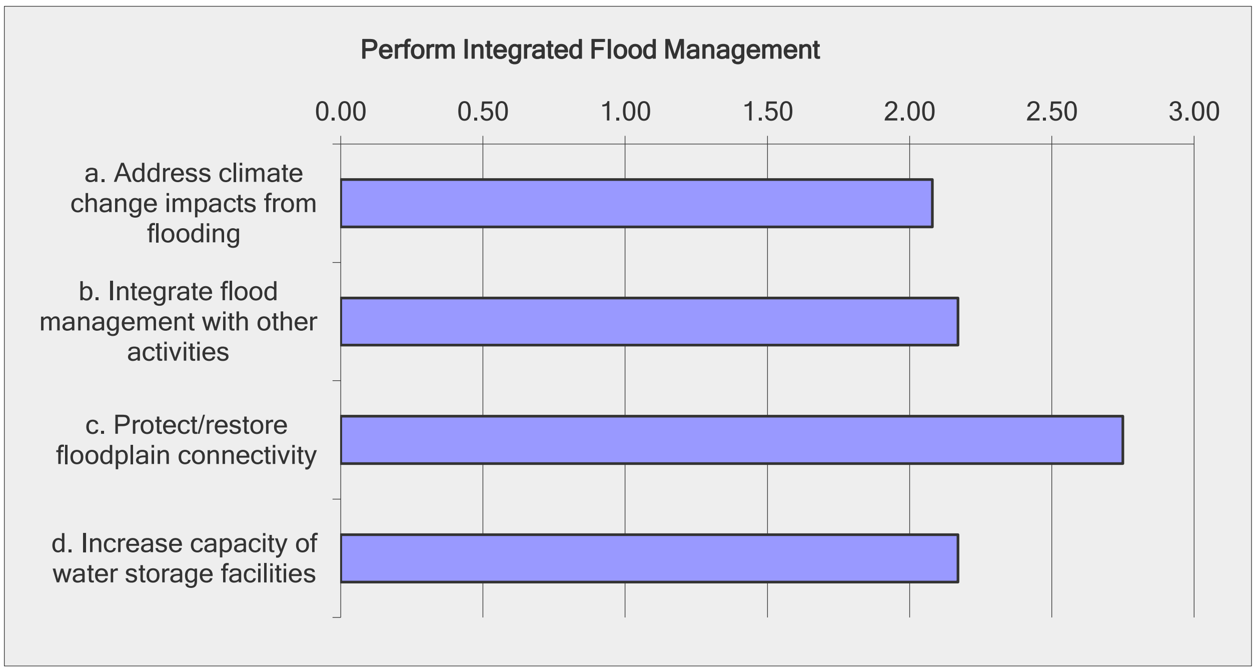
Southern Sierra IRWMP - Objectives Survey

Goal No. 2: Protect and Improve Water Quality					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Protect natural water bodies	0	1	11	2.83	12
b. Promote water quality best management practices	0	5	7	2.58	12
c. Reduce erosion and sedimentation	0	4	8	2.58	12
d. Promote storm water management planning and implementation	3	3	6	2.50	12
e. Assess water quality of small water systems	3	4	5	2.17	12
f. Study septic system impacts	2	7	3	2.00	12
				answered question	12
				skipped question	0



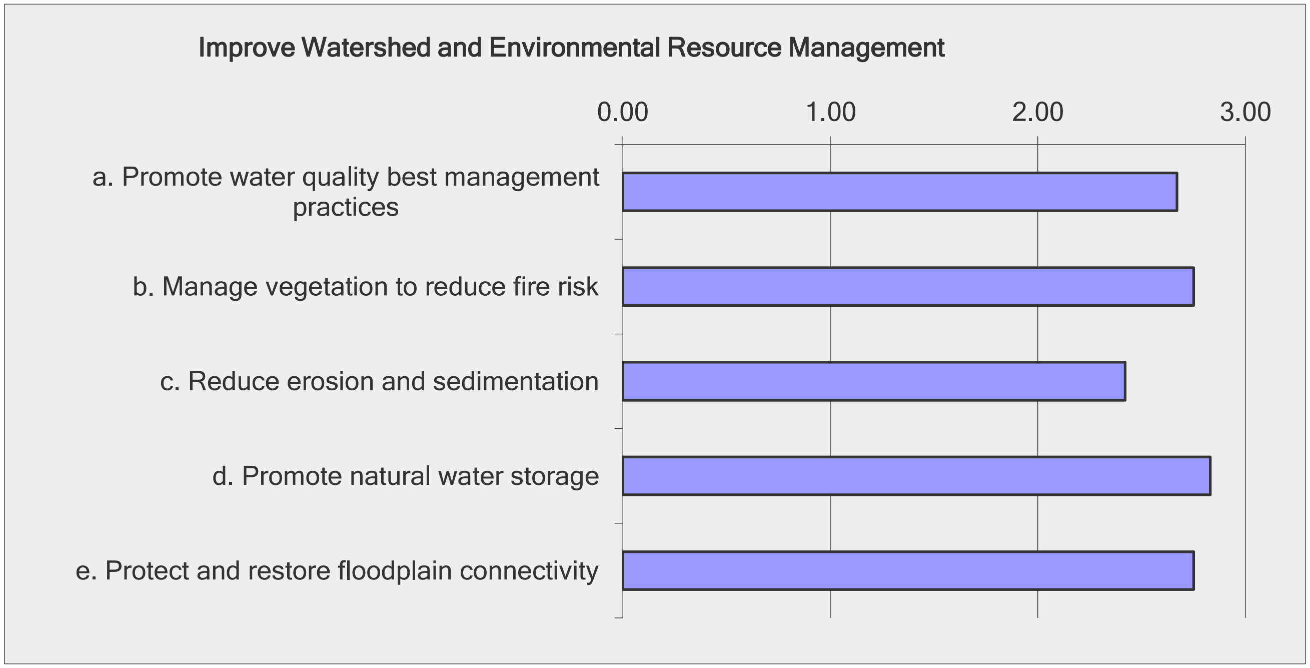
Southern Sierra IRWMP - Objectives Survey

Goal No. 3: Perform Integrated Flood Management					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Address climate change impacts from flooding	2	5	5	2.08	12
b. Integrate flood management with other activities	0	4	8	2.17	12
c. Protect/restore floodplain connectivity	1	4	7	2.75	12
d. Increase capacity of water storage facilities	4	3	5	2.17	12
				answered question	12
				skipped question	0



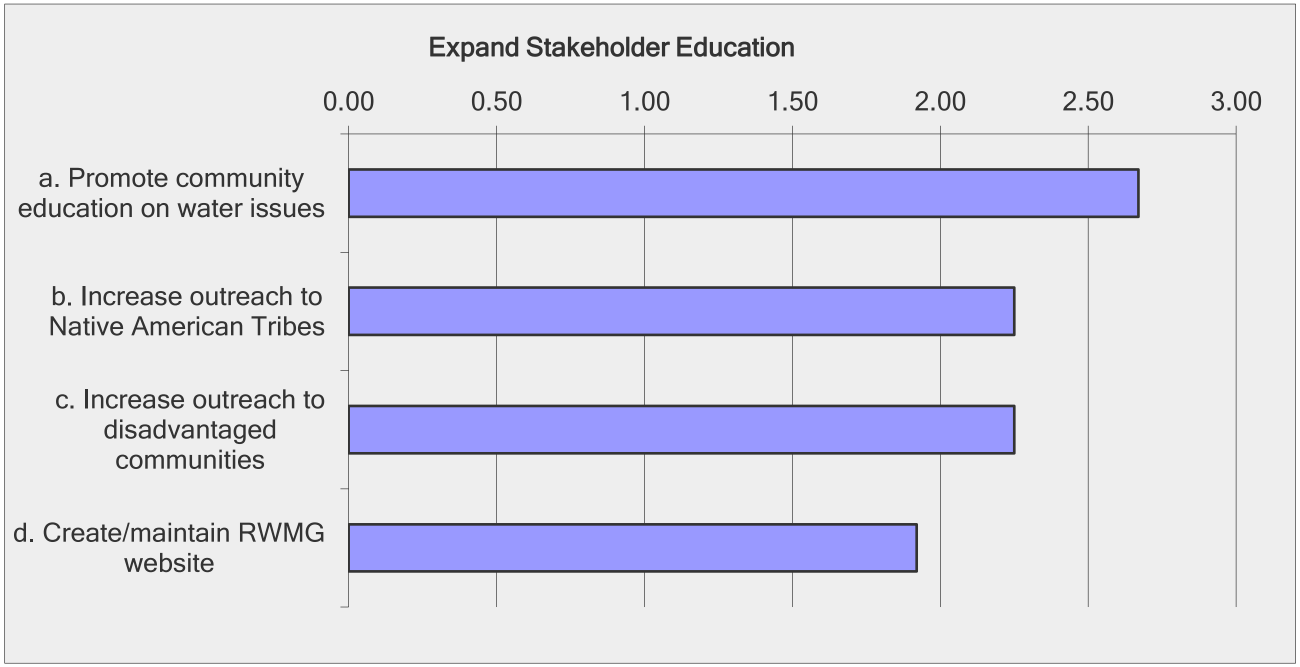
Southern Sierra IRWMP - Objectives Survey

Goal No. 4: Improve Watershed and Environmental Resource Management					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Promote water quality best management practices	0	4	8	2.67	12
b. Manage vegetation to reduce fire risk	0	2	10	2.75	12
c. Reduce erosion and sedimentation	0	5	7	2.42	12
d. Promote natural water storage	0	0	12	2.83	12
e. Protect and restore floodplain connectivity	1	4	7	2.75	12
				answered question	12
				skipped question	0



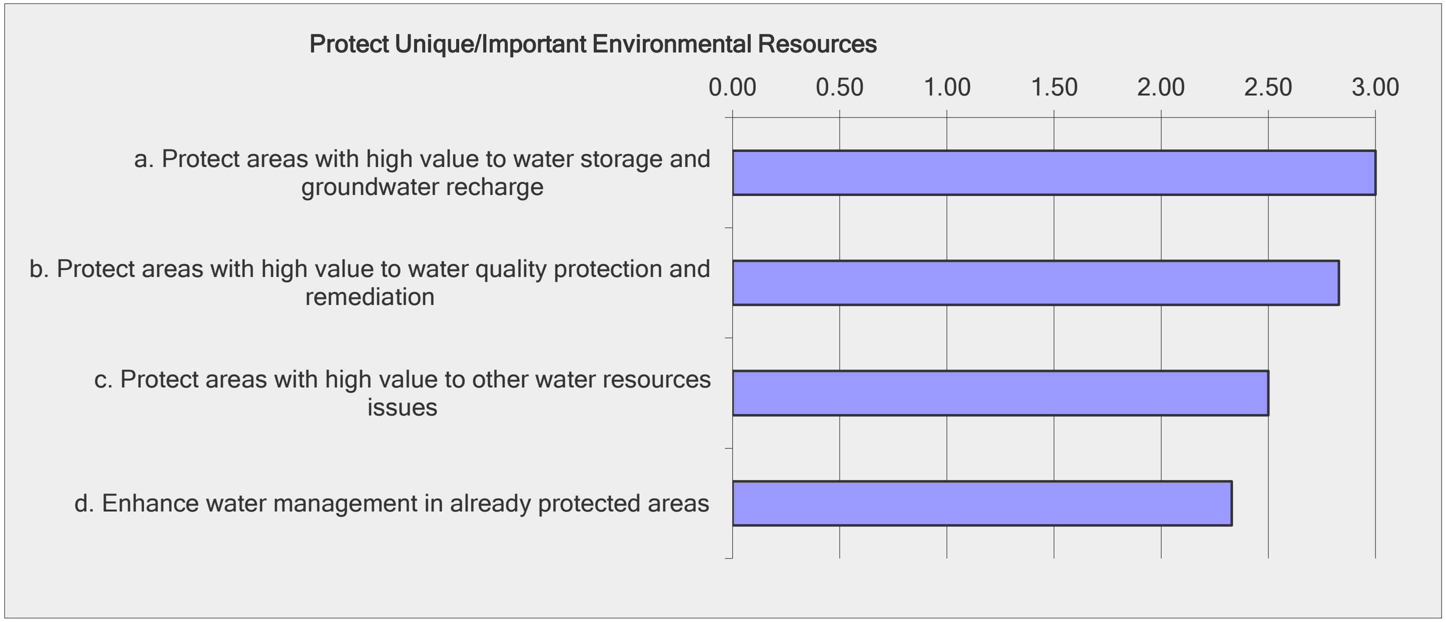
Southern Sierra IRWMP - Objectives Survey

Goal No. 5: Expand Stakeholder Education					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Promote community education on water issues	0	3	9	2.67	12
b. Increase outreach to Native American Tribes	2	3	7	2.25	12
c. Increase outreach to disadvantaged communities	2	3	7	2.25	12
d. Create/maintain RWMG website	1	4	7	1.92	12
				answered question	12
				skipped question	0



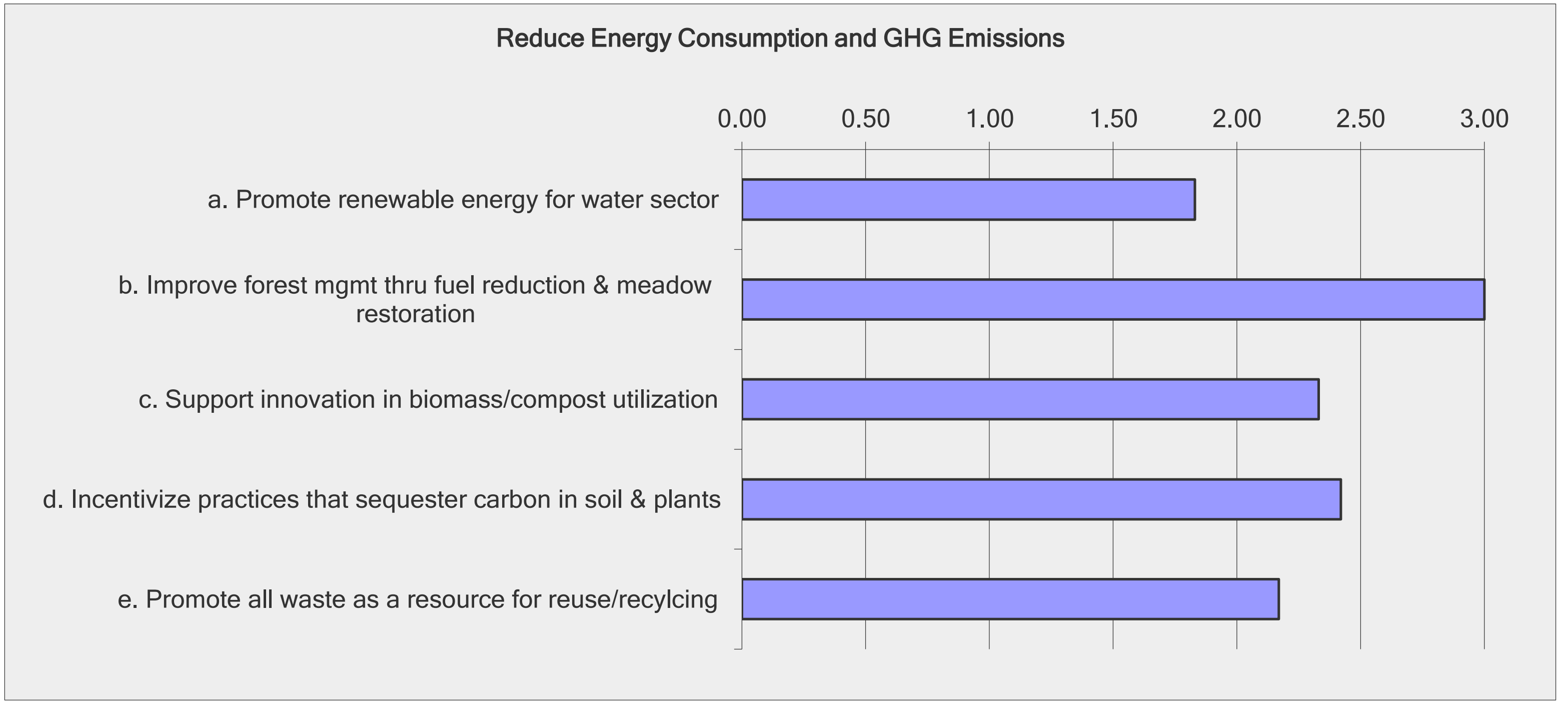
Southern Sierra IRWMP - Objectives Survey

Goal No. 6: Protect Unique/Important Environmental Resources					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Protect areas with high value to water storage and groundwater recharge	0	2	10	3.00	12
b. Protect areas with high value to water quality protection and remediation	0	2	10	2.83	12
c. Protect areas with high value to other water resources issues	0	5	7	2.50	12
d. Enhance water management in already protected areas	1	5	6	2.33	12
				answered question	12
				skipped question	0



Southern Sierra IRWMP - Objectives Survey

Goal No. 7: Reduce Energy Consumption and GHG Emissions					
Answer Options	Low	Medium	High	Rating Average	Response Count
a. Promote renewable energy for water sector	5	4	3	1.83	12
b. Improve forest mgmt thru fuel reduction & meadow restoration	0	0	12	3.00	12
c. Support innovation in biomass/compost utilization	3	2	7	2.33	12
d. Incentivize practices that sequester carbon in soil & plants	2	3	7	2.42	12
e. Promote all waste as a resource for reuse/recylcing	3	4	5	2.17	12
				answered question	12
				skipped question	0



Appendix G

Project List

Southern Sierra Regional Water Management Group

Tiered List of New and On-going Implementation Projects

- 2017 -

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies/Plans				
	Spring wetlands/water supply study	Sierra Club – Kern-Kaweah Chapter	Understand the role of springs in water supply, quality, climate and drought, and how improvement work impacts wetland function, response to climate and drought.	In development
	Water Supply and Water Quality Study in the Southern Sierra Fractured Bedrock Aquifer	SSRWMG/DWR	A study that will determine the availability of water in the fractured rock system - hydrologic capacity in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers (complete), Springville, Posey, and White River communities. Provide a uniform approach to data collection and analysis, methodology, results and recommendations. Monitor wells for quality and quantity in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River communities. Compile all data sets on one table, e.g. nitrates, radon, Uranium, salts etc.	Complete, incorporated into the Three Rivers Community Plan Update/EIR
	Isotopic Tracer Study for Sierra Foothills Water Resource Sustainability	SRCD/Lawrence Livermore Nat'l Lab/CSU East Bay	Southern Sierra foothill communities rely on groundwater wells drilled in alluvium or fractured bedrock aquifers. There are a number of open questions regarding the sustainability of the water resources including the recharge elevation of locally pumped groundwater, the contribution of fractured bedrock flow to wells, and the vulnerability of wells to contamination and droughts. Isotopic	

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
			tracers are a powerful tool for finding answers to these question	
	Highway 168 Fire Safe Council Community Wildfire Protection Plan	Sierra RCD	The Highway 168 Fire Safe Council Community Wildfire Protection Plan (CWPP) summarizes wildfire dangers and issues on a community by community basis within the Council's area of influence. The CWPP also catalogs community wildfire protection needs and identifies corrective action and community projects that will mitigate some of the problems.	The CWPP is currently under revision with the Sierra RCD and is to be completed in September 2018.
	Oak to Timberline Fire Safe Council Community Wildfire Protection Plan	Sierra RCD	Oak to Timberline FireSafe Council is in the process of developing their first Community Wildfire Protection Plan (CWPP) under the auspices of Sierra RCD.	The plan is expected to be completed by September 2018.
	Modelling Hydrologic Capacity with drought and climate change	UC Merced	A modeling exercise to evaluate whether forest fuel reduction and/or restoration activities result in an increase or no change in water yield from small watersheds. Data to parameterize model(s) is available from KREW. The thinning and burning treatments are ongoing and can provide data to verify model results in the next 1-2 years. UC Merced is already in the process of parameterizing one model with KREW data. Forest Service would supply data but there would be a cost for modeling. Quantifies positive and negative effects to stream ecosystems from forest restoration and fuels reduction activities at the watershed	First phase of research complete. Results included in 2017 IRWMP.

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
			scale. It focuses on water yield and water quality in headwater streams of the Kings River watershed and would contribute to the continuation of data collection and analyses that have been ongoing for 10 years.	
Restoration and other Projects				
	Mill Flat Creek Project	USFS - Sequoia	Decommission roads, restore riparian areas and fisheries	
	Trout Creek Bridge Replacement and Fisheries Restoration	USFS Sequoia National Forest	Replacing a bridge and associated wetland enhancement in the Kern River Watershed	Funding applied for under the National Fish and Wildlife Foundation
	Cahoon Meadow Restoration	Sequoia National Park	Restoring a montane meadow with a large gully in the Kaweah Watershed.	Design/NEPA phase.
	Improving water supply and quality in the Kaweah River Watershed with the Goliath Prescribed Fire	Sequoia National Park	Prescribed fire activities to restore watershed conditions.	Project completed with appropriations funding.
	Restoring wetlands and riparian areas at Circle J Norris Ranch	Tulare County Office of Education.	Restoring riparian areas, creating wetland habitat, enhancing water quality, monitoring of flora and fauna.	Project in progress with US Fish and Wildlife and NRCS funding.

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
	Enhancing water supply and water quality in the Kings River Watershed – restoring three meadows on Sierra National Forest	Sierra National Forest	Restoration and permitting for three head-cut and eroding meadows.	Studies and design complete. Seeking NFWF funding.
	Big Dry Creek Diversion Additional Drop Structure	Sierra RCD/Fresno Metropolitan Flood Control District	Big Dry Creek Diversion routes flows out of the base of Big Dry Creek Reservoir, the District's largest flood control structure. The Diversion Channel helps de-water stormwater captured in Big Dry Creek Reservoir and is operated within the framework of the U.S. Army Corps Water Control Manual for the Redbank and Fancher Creek Project. The construction of an additional drop structure within the channel will decrease velocity in the Diversion Channel, reducing erosion and improving the safety of the Project.	Needs funding (Budget estimate of $700,000)
Infrastructure	Retain 200-Year Flood Control Protection, Eastern Fresno County	Sierra RCD/Fresno Metropolitan Flood Control District	There are currently 200-year flood control facilities (dams, detention basins, and bypass structures) east of the metropolitan area. As development occurs upstream of those facilities, the level of protection will diminish. The study and subsequent construction of additional flood control facilities (detention basins and bypass structures) upstream of new development will continue the 200-year protection level.	Needs funding

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Tribal/Infrastructure	Big Sandy Rancheria Leech Field/Pipeline Project	Big Sandy Rancheria	Installing a leech field and potentially a pipeline in the BSR	In progress with Prop 1 technical assistance and implementation.
	Conduct Community Fuel Break Construction and Maintenance on a Landscape Scale	Sierra RCD/Highway 168 Fire Safe Council	Current fuel break projects are effective, but due to lack of sufficient funding, there are large gaps in the system that need to be addressed before maximum benefit can be realized. Due to re-growth after 5 to 6 years, unmaintained fuel breaks start to lose some of their effectiveness, and after 10 to 12 years, unmaintained fuel breaks need to be reconstructed.	Needs funding (estimate of $2.5 million)
	Conduct Prescribed Fires in eastern Fresno County	Sierra RCD	Historical natural fire regimes have been disrupted, which has led to ever increasing fuel loadings and disruptions of natural processes, changing the natural mix of vegetation. This increased fuel loading poses a severe threat to the communities of eastern Fresno County. In many cases, the lack of fire in a given area has led to the suppression (or extinction) of endangered species and the introduction and spread of invasive non-native species. In addition to extreme threat to life and property that modern wildfires pose, they also destroy ecosystems that had once been able to survive the occasional natural fire. The careful reintroduction of fire to the landscape through prescribed burning offers the only environmentally sound method of addressing all these issues in one cost-effective treatment.	Needs funding (estimate of $100,000 annually)

TIER 1 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Other Tier 1 projects are already underway. See Current Projects.				

TIER 2 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies				
	Springville PUD Purple Pipe Project Design and Permitting	Springville PUD	SDAC project collecting treated water and utilizing it for landscaping in the PUD area.	
	Understanding Landslide, Debris Flows and Flood Risks in the Southern Sierra	?		
	SCADA System monitoring wells	Sierra RCD	An automated water monitoring system in Auberry	Needs funding
	Little/Big Dry Creeks Water Quality, Flood Control and Supply Project	Sierra RCD	Focused studies for flood control, salmonid restoration, water quality and supply.	Needs funding
Tribal/Water Supply/Infrastructure	Tule River Water Supply Study	Tule River Tribal Council	Tule River Indian Reservation has identified a need for a reliable supply of water. It has negotiated its water rights and taken steps to implement water supply solutions including the potential for a new dam or other impoundments of surface water.	Studies identified funding/budget need ($900 million, highest) for a dam to ensure water supply. Needs funding.

TIER 2 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies				
Tribal/Water Supply/Infrastructure	Tule River Water Supply and Treatment Enhancement Project	Tule River Tribal Council	Water supply pipeline sections on the reservation, water supply augmentation for the Treatment Plan, and existing dam retrofit for water supply.	Needs funding source.
Restoration	Tule River Water Quality Enhancement and Protection Project	Tule River Tribal Council	Meadow and stream restoration projects on the Reservation.	Needs funding source, final budgets.
Plans				
		USFS Sequoia National Forest	Prioritize meadows for restoration on the Sierra, Sequoia, Inyo national forests, Sequoia and Kings Canyon National Parks	Completed.
	Strengthen Dam Failure/Flood Planning, Coordination, and Training		Dam failure and flood planning are done as required by law. However, due to lack of funding, most of this knowledge and planning are kept at the top levels. Mid- and lower- level first responders are not part of coordination planning and do not receive significant training in procedures, key downstream hazard locations, access routes, alternate evacuation routes, and where to set up roadblocks. While the probability of a dam failure is low, the potential impact is extreme. Flooding from the inability to control water during extreme weather events is much more likely, and response procedures are similar.	
Tribal Projects				

TIER 2 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies				
	Tule River Tribe water supply needs	Tule River Tribal Council	Tule River Indian Reservation has identified a need for a reliable supply of water. It has negotiated its water rights and taken steps to implement water supply solutions including the potential for a new dam or other impoundments of surface water.	Complete. Project has complete studies but differing budgets on federal vs state levels. Moved to Tier 1 implementation project.
Restoration and Other Projects				
	Improving water supply and reduce flooding risk with *Aundo donax* removal in the Kaweah and Tule River watersheds	Sequoia Riverlands Trust	Invasive Species: remove tamarisk, Arundo donax, along the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River	
		Sequoia Riverlands Trust	Watershed protection through protection from development, by voluntary conservation easement especially in the Tule River Watershed, Deer Creek the Kaweah River, Kings River and other flood prone areas in order to protect water quality	
	Mountain Aire Water Tank	Mountain Aire Water Company	Replacing water supply tank and associated infrastructure.	Needs funding, design.
	Camp El-O-Win Water Supply and Recreation Access	Friends of Camp El-O-Win	Camp El-O-Win straddles Dinkey Creek. The two sides of the camp are connected by a foot bridge over Dinkey Creek. Camp El-O-Win is run entirely by volunteers now. All funds must be raised through donations and grants. Concerning water quality and waste water issues, Camp El-O-Win has two original septic systems that	

TIER 2 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies				
			date to the late 1950s. There is one newer engineered system. Otherwise, waste needs are served by 8 pit toilets. The camp is in need of replacing those old pit toilets and decrepit septics with new systems. This is something that would be helpful to identify in the plan.	
	Osa Meadow, Kern Plateau/Kern River Watershed Project		This proposed project would restore approximately 80 acres of meadow through restoration of Osa Meadow.	
	Whispering Springs Fuel Break	Sierra RCD/Highway 168 Fire Safe Council	Lower elevation project off Lodge Road in Tollhouse. We cleared this area a few years ago but it could use some work. It is mostly brush and annual grass that is highly flammable. The area is filled with homes and is located on a steep slope. The Goose Fire threatened this area in 2016 but according to residents some of the work the FSC did help avert the fire away from a certain areas.	
	Historical Beal Fire Road Fuel Break		The Historical Beal Fire Road has been in existence since 1933 when it was constructed by the CCC's under the direction of President Roosevelt. The Beal has over the years been credited with helping halt or slowing down a wildland fire. The area at mid-slope from Auberry Road has homes along	

TIER 2 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Studies				
			the Beal for a couple of miles then turns in to Forest Service Land then picks back up with homes again before connecting with Highway 168 at mid-slope. The values at risk are high here, if a fire gets past this area it could travel into Meadow Lakes, the many subdivisions along Highway 168 and enter Shaver Lake and possibly higher. Types of fuel include brush, annual grass and ladder fuels and some dead trees.	

TIER 3 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Best Management Practices				
			BMPs for residential pesticide use in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River communities.	
			BMPs and educational materials for septic tank maintenance in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers (has an existing program and information), Springville, Posey, and White River communities	
			BMPs regarding fire clearance in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River communities	
			BMPs for flood control and flood management/riparian management along the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River	

TIER 3 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Best Management Practices				
			BMPs regarding preventing sedimentation and erosion in headwaters in the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River watersheds	
			BMPs regarding well maintenance and monitoring in Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River communities	
			BMPs to promote grazing practices, cattle ponds and riparian areas along San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River	
			BMPs to identify land use to minimize environmental impact (cluster development) Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River communities	
Plans				
			Watershed management plans in the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River watersheds	
			Studies and plans to prioritize oak woodland sites for protection in the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River and Kern River watersheds	
Demonstration Projects				
			Meadow restoration – has been complete at Big Meadows and multiple locations on the Sierra National Forest	
			Fuel management for fire safety and water production	
			Invasive species removal (Arundo, Tamarisk, Scarlet Wisteria) along the San Joaquin River, Kings River, Kaweah River,	

TIER 3 PROJECTS				
Project Category	**Project Title**	**Project Proponent**	**Project Description**	**Project Status**
Best Management Practices				
			Tule River, Deer Creek, White River and Kern River	
			Total exclusion of development from certain sensitive watersheds such as Deer Creek, White River	
			Flood control projects (floodplain, etc.) that have multiple benefits (habitat, water quality, groundwater recharge etc.);	
			More detailed vegetation mapping throughout the region	
			Integrated strategies for increasing water supply in Shaver Lake, Auberry, Prather, Squaw Valley, Dunlap, Badger, Three Rivers, Springville, Posey, and White River	
			Native plants (fire resistant/drought tolerant) in public and private landscaping	
			Riparian protection through fencing, grazing rotation, additional water distribution systems.	

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

Note: This two page project description form gathers information about projects that can be used as examples in the South Sierra region's request for Intergrated Regional Water Management Planning funding. If implementation funding is obtained, more information will be required at a later date to submit this project for funding. This form may be printed, filled out by hand and sent to Bobby Kamansky at the P.O. Box 731, Three Rivers, CA 93271 **OR** electronically filled out and e-mailed to: southernsierrairwmp@gmail.com

General Information

Project Name:	FLOODPLAIN STABILIZATION		
Project Sponsor:	TULE RIVER TRIBE		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
KERRI VERA	559-783-9984	559-783-8932	TULERIVERENV@yahoo.com

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

IRWM Goal & Objective: GOAL 2- PROTECT AND IMPROVE WATER QUALITY (a) protect natural water bodies, (b) promote water quality best management practices, and (c) reduce erosion and sedimentation; GOAL 3- PERFORM INTEGRATED FLOOD MANAGEMENT (c) Protect and restore connectivity of floodplains with other water bodies; GOAL 4- IMPROVE WATERSHED AND ENVIRONMENTAL RESOURCE MANAGEMENT (c) reduct erosion and sedimentation, and (e) protect and restore floodplain connectivity; GOAL 6- PROTECT UNIQUE/IMPORTANT ENVIRONMENTAL RESOURCES (b) Protect areas with high value to water quality protection and remediation **Description:** *Restoration of impacted floodplain to reduce sediment loads from runof, provide riparian habitat and maintain biodiversity.*

Project Integration (Describe how the project does or could integrate with other projects in the Region):

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
Tribal Water Quality Management Plan; Tribal Integrated Resource Management Plan

Project Location

Descriptive (Description of property location etc.):
TULE RIVER RESERVATION

Latitude/Longitude - info available at: http://geocoder.us/	Lat: 36.029807°	Long: -118.788018°	

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☑ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	*Area Drained: and/or*	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: (*Describe X amount of benefit*)			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☑ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☑ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information			
Project Name:	Mulching/Reseeding Project		
Project Sponsor:	Tule River Indian Tribe		
If Joint Project, Other Partners:	N/A		
Project Website (if available):	N/A		
Project Contact Person:	Phone	FAX	Email
Charles Lwenya	5597912126	5597912128	charles.lwenya@tulerivertribe-nsn.gov

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

Goal: To improve water supply and management. Objective: To enhance natural water storage by encouraging increased seepage of rain water into the ground so as to recharge the underground aquifers. This water is later released for human and animal use by way of springs and boreholes.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

This project will enhance a spring development program that is being implimented on the reservation. The springs provide water for livestock and wildlife.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

This is one of the projects set out in the Tribe's Intergrated Resources Management Plan (IRMP). It was identified when the Tribe carried out a Range Inventory and Assessment.

Project Location

Descriptive (Description of property location etc.):

Tule River Indian Reservation, Tulare County,

Latitude/Longitude - info available at: http://geocoder.us/	Lat: 36.029807°	Long: -118.788018°

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

		<$100K	$100K - $1M	$1M - $10M	>$10M
Project Cost:		☑	☐	☐	☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☑

Estimated Year of Construction: Project ready and willing sellers available to consider offers.

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☑ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☑ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☑ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☐ Ecosystem Restoration
- ☐ Floodplain Management
- ☑ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information			
Project Name:	Mulching/Reseeding Project 2		
Project Sponsor:	Tule River Indian Tribe		
If Joint Project, Other Partners:	N/A		
Project Website (if available):	N/A		
Project Contact Person:	Phone	FAX	Email
Charles Lwenya	5597912126	5597912128	charles.lwenya@tulerivertribe-nsn.gov

Project Description
Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):
Goal: Protect and Improve Water Quality; Objectives: 1. Reduce erosion and sedimentation, 2. Promote storm water management planning and implimentation.This project will help control storm water runoof by enhancing seepage into the underground water aquifers,
Project Integration (Describe how the project does or could integrate with other projects in the Region):
This project will contibute to the Tribe's efforts to control soil erossion and river sedimentaion. This would result in improved water quality for its residences.
Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
This is one of the projects set out in the Tribe's Intergrated Resources Management Plan (IRMP). It was identified when the Tribe carried out a Range Inventory and Assessment.

Project Location				
Descriptive (Description of property location etc.): Tule River Indian Reservation, Tulare County,				
Latitude/Longitude - info available at:	http://geocoder.us/	Lat: 36.029807°		Long: -118.788018°
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):				
Project Cost:	<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):	Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☑
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.			

Project Benefits			
Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☑ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☑ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☐ Ecosystem Restoration
- ☐ Floodplain Management
- ☑ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information			
Project Name:	Mulching/Reseeding Project 3		
Project Sponsor:	Tule River Indian Tribe		
If Joint Project, Other Partners:	N/A		
Project Website (if available):	N/A		
Project Contact Person:	Phone	FAX	Email
Charles Lwenya	5597912126	5597912128	charles.lwenya@tulerivertribe-nsn.gov

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

Goal: Perform Integrated Flood Mangement ; Objectives: 1. Integrate flood management with other activities. This project will help control storm water runoof by enhancing seepage into the underground water aquifers. This will reduce surface runoff and flooding

Project Integration (Describe how the project does or could integrate with other projects in the Region):

This project will contibute to the Tribe's efforts to control flooding.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

This is one of the projects set out in the Tribe's Intergrated Resources Management Plan (IRMP). It was identified when the Tribe carried out a Range Inventory and Assessment.

Project Location

Descriptive (Description of property location etc.):

Tule River Indian Reservation, Tulare County,

Latitude/Longitude - info available at: http://geocoder.us/ Lat: 36.029807° Long: -118.788018°

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☑
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or		Volume Treated:
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- [ ] Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- [ ] Implementation of Total Maximum Daily Loads that are established or under development
- [ ] Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- [ ] Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- [ ] Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- [ ] Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- [ ] Address environmental justice concerns
- [x] Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards

Program Preferences

- [x] Include integrated projects with multiple benefits
- [ ] Support and improve local and regional water supply reliability
- [ ] Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- [ ] Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- [x] Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- [ ] Agricultural Lands Stewardship
- [ ] Agricultural Water Use Efficiency
- [ ] Conjunctive Management and Groundwater Storage
- [ ] Conveyance
- [ ] Desalination
- [ ] Drinking Water Treatment and Distribution
- [ ] Economic Incentives
- [ ] Ecosystem Restoration
- [x] Floodplain Management
- [ ] Groundwater/Aquifer Remediation
- [ ] Matching Water Quality to Water Use
- [x] Pollution Prevention
- [ ] Precipitation Enhancement
- [ ] Recharge Areas Protection
- [ ] Recycled Municipal Water
- [ ] Surface Storage - CALFED
- [ ] Surface Storage - Regional/Local
- [ ] System Reoperation
- [ ] Urban Land Use Management
- [ ] Urban Runoff Management
- [ ] Urban Water Use Efficiency
- [ ] Water Transfers
- [ ] Water-Dependent Recreation
- [x] Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	Phase II Community Groundwater Monitoring, Analysis and Planning in Sierra Nevada Granitic Fractured Rock within the Non-Basin region of eastern Fresno County		
Project Sponsor:	Sierra Resource Conservation District		
If Joint Project, Other Partners:	Sierra Unified School District		
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Steve Haze	559.855.5840		stevehaze007@gmail.com

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

The purpose of the project is to upgrade existing groundwater sourced systems for the Sierra Unified School District's High/Middle and Elementary schools to state of the art SCADA (System Control and Data Acquisition) and Telemetry functionality. This is to insure that the finite groundwater resources are better managed for long-term sustainability.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

The project is a "Blueprint" and critical component in which to develop the realtime management of finite groundwater resources for high public usage in areas with prolong dry periods. The intent is to integrate the realtime collection of data and realtime monitoring with DWR's Water Data Library and/or CASGEM program.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

The area is an unincorporated part of eastern Fresno County, in which the Fresno County Water Advisory Committee and Technical Advisory Sub-committee and Sierra RCD have been joint proponents of such a project.

Project Location

Descriptive (Description of property location etc.):

Sierra High/Middle School, 33330 Lodge Road, Tollhouse, CA 93667 and Foothill Elementary School, 29147 Auberry Rd, Prather, CA 93651

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	37.037043 ° 37.037737 °	Long:	-119.454619 ° -119.519493 °

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:	$150,000	<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)		☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF	
Water Quality	Area Drained: and/or		Volume Treated:		
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*					

Other: *(Describe X amount of benefit)*

Long-term sustainability of finate groundwater supplies for high public use areas

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☑ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☑ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☑ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☑ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☑ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☐ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Municipal Water
- ☐ CALFED
- ☐ Regional/Local
- ☐ Reoperation
- ☑ Management
- ☑ Management
- ☑ Use Efficiency
- ☐ Water Transfers
- ☐ Dependent
- ☐ Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information			
Project Name:	Eagle Meadows Restoration		
Project Sponsor:	Tule River Tribal Council		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Brian Rueger	559-783-9984	559-783-8932	brueger@ocsnet.net

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

Eagle Meadows is comprised of several natural meadows that are being encroached by dry site woody shrubs such as mountain whitethorn and bush chinquapin. This project proposes to selectively remove shrubs to maintain the wet meadow areas and improve water flow from the meadow downslope to Eagle Creek. The following IRWM Goals and objectives will be addressed: Goal 1 - Improve Water Supply Management / Objective 1a: Promote natural water storage through meadow, stream & forest restoration. Goal 4 - Improve Watershed & Environmental Resource Management / Objective 4d: Promote natural water storage through meadow restoration. Goal 6: Protect and Enhance Unique and Important Environmental Resources / Objective 6a: Protect unique areas of high value for water storage and groundwater recharge.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

The Tule River Indian Reservation is located in Tulare County, CA. The project is located at 6,900 feet elevation near the southeast boundary of the Reservation, within 1/2 mile of Giant Sequoia National Monument. The legal description of the area is within Sections 32 & 33, Township 22 South, Range 31 East.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

Meadow protection and restoration is identified in the Tule River Tribe's Integrated Resource Management Plan and the Tribe's Forest Management Plan.

Project Location

Descriptive (Description of property location etc.):

The Tule River Indian Reservation is located in Tulare County, CA. The project is located at 6,900 feet elevation near the southeast boundary of the Reservation, within 1/2 mile of Giant Sequoia National Monument. The legal description of the area is within Sections 32 & 33, Township 22 South, Range 31 East, MDBM.

Latitude/Longitude - info available at: http://geocoder.us/		Lat:	36.029807°	Long:	-118.788018°
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):	Note:NEPA in progress.	Conceptual ☑	In-Design ☑	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	The year of implementation will depend on the availability of funding.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☑ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):	Approximately 40 acres restored.		
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☑ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☑ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	Dry Meadow and Stream Restoration		
Project Sponsor:	Sequoia National Forest		
If Joint Project, Other Partners:	NFWF through Jim Wilcox Plumas Corporation		
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Nina Hemphill	559 784 1500 x1161		nphemphill@fs.fed.us

Project Description

Project Description (Include which IRWM Goal and Objectives are addressed by the project):

Dry Meadow is on Bull Run Creek a tributary of the North Fork Kern River. Roads surround Dry Meadow, contributing sediment and degrading water quality. Dry Meadow has large gully and is functioning poorly for water storage. The combination of the past logging, road building, the 1990 Stormy fire has caused downcutting and destabilization in Dry Meadow. Surveys of the meadow will be taken in the next 6 months by Jim Wilcox as part of a Sierra Meadow monitoring project. Road decommissioning and culvert removal is currently being planned as well as restoring hydrologic connectivity, fish habitat and water storage (which are all impaired at this time). Without removing the culvert, the meadow cannot be restored. Restoration of the degraded meadow and stream and improving hydrologic connectivity would improve water storage within the meadow, extending cooler flows later into the dry season. Reducing sedimentation of the Kern River will improve water quality. In addition, Bull Run Creek has habitat for Kern River Rainbow (a native golden trout) which would benefit from this project. We anticipate that reconnecting the stream channel to its naturally-evolved floodplain and closing roads around the meadow and in it watershed will provide the following watershed and ecosystem benefits: 1) reduce peak flows and increase/extend summer base flows, 2) enhance aquatic and terrestrial habitat, 3) improve water quality, and 4) raise the local groundwater level within the meadow. These ecosystem benefits will improve downstream fish habitat by cooling and extending the flows longer into the dry season. Downstream water users will benefit by reduced sediment transport, attenuation of sudden storm flows, and better water quality for recreational fishing and other activities.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

This project will be using a statewide protocol for monitoring Sierra meadows and the data once collected will be part of a larger database of how restored meadows function and whether they provide resilience to drought. This would be part of a larger effort to evaluate meadow restorations to detect the benefits and to prioritize meadow restoration across the Sierra Nevada. Different parameters will be monitored included changes in seasonal water storage, seasonal changes in stream flow, return of native flora and fauna; and production of habitat for future species recovery efforts. This restoration would be used to evaluate whether restorations can improve resilience of the meadow or its stream to drought. Recent data suggest that restored meadows maintain steam flows during drought while those not restored do not maintain flows during 2-3 years of drought. Mountain Yellow Legged Frogs are an endangered species at both state and federal levels. The Kern River Rainbow is part of an effort by the State Resources Agency, the USFS, USFWS, NPS and other entities to restore native trout to the north Fork Kern River. In addition extending flows during drought will benefit down stream water users.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

FOURTH EDITION OF THE WATER QUALITY CONTROL PLAN (BASIN PLAN) FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS. 1995 Department of Fish and Wildlife publication “Fish Species of Special Concern in California, Second Edition,” by P. B. Moyle, R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake

Project Location

Descriptive (Description of property location etc.):

This project is located in a tributary of the upper Kern River in Tulare County California. The Kern River flows south to Kern County and terminates in the Tulare Basin. The project is within the Western Divede River Ranger District.

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	35° 50’33.1’’N	Long:	118° 32’43.81” W

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:	$450,000	<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):	NFWF grant survey meadow to initiate NEPA; USFS NEPA on Road closures in the watershed.	Conceptual ☑	In-Design ☑	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	Topographic surveys to be completed in 2015 to prepare for preliminary designs. Road closures will ready with NEPA in 2015. Once funding to complete NEPA is found for the meadow component of the watershed restoration 6 months to a year will be required for completion depending on timing of funding. Once funded 1 year after NEPA/CEQA/Permit completion may be needed to allow for winter closure of area for construction.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF	
Water Quality — Area Drained: and/or		Volume Treated:		
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*	55 acres of meadow habitat restored. 6 miles of perennial stream habitat restored.			

Other: *(Describe X amount of benefit)*

30 acres of meadow habitat and 1 mile of stream habitat for Mountain Yellow Legged Frogs restored and 6 miles of improved flows and water quality for Kern River Rainbows down stream in Osa Creek.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☑ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☑ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	NONPOINT SOURCE BEST MANAGEMENT PRACTICES/STORMWATER RUNOFF CONTROL		
Project Sponsor:	TULE RIVER TRIBE		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
KERRI VERA	559-783-9984	559-783-8932	TULERIVERENV@yahoo.com

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

IRWM Goal & Objective: GOAL 2- PROTECT AND IMPROVE WATER QUALITY (a) protect natural water bodies, (b) promote water quality best management practices, and (c) reduce erosion and sedimentation; GOAL 4- IMPROVE WATERSHED AND ENVIRONMENTAL RESOURCE MANAGEMENT (c) reduct erosion and sedimentation, and (e) protect and restore floodplain connectivity; GOAL 6- PROTECT UNIQUE/IMPORTANT ENVIRONMENTAL RESOURCES (b) Protect areas with high value to water quality protection and remediation. **Description:** *Implementation of Best Management Practices during construction projects to reduce stormwater runoff, erosion and sediment transport; stabilization of areas vulnerable to stormwater runnoff in effort to reduce negative impact to water quality within the South Fork Tule River watershed.*

Project Integration (Describe how the project does or could integrate with other projects in the Region):

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
Tribal Water Quality Management Plan; Tribal Integrated Resource Management Plan

Project Location

Descriptive (Description of property location etc.):
TULE RIVER RESERVATION

Latitude/Longitude - info available at: http://geocoder.us/	Lat: 36.029807°	Long: -118.788018°	

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:		<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☑ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☐ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☑ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
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General Information			
Project Name:	WATER STORAGE IMPROVEMENT PROJECT		
Project Sponsor:	TULE RIVER TRIBE		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
DON WALTON/ KERRI VERA	559-783-9594/ 559-783-9984	559-783-8932	Don.Walton@tulerivertribe-nsn.gov TULERIVERENV@yahoo.com

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

IRWM Goal & Objective: GOAL 1- IMPROVE WATER SUPPLY MANAGEMENT, (a) enhance natural storage and (c) increase capacity of water storage facilities. **Description:** *Installation of new water storage tank(s); improvements/upgrades to existing tanks*

Project Integration (Describe how the project does or could integrate with other projects in the Region):

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
Tribal Integrated Resource Management Plan

Project Location

Descriptive (Description of property location etc.):
TULE RIVER RESERVATION

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	36.029807°	Long:	-118.788018°
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)		☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or		Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):				
Other: *(Describe X amount of benefit)*				

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☑ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☑ Drinking Water Treatment and Distribution
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- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
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- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

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General Information			
Project Name:	WATER INTAKE ENHANCEMENT		
Project Sponsor:	TULE RIVER TRIBE		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
DON WALTON/KERRI VERA	559-783-9594/559-783-9984	559-783-8932	Don.Walton@tulerivertribe-nsn.gov TULERIVERENV@yahoo.com

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

IRWM Goal & Objective: GOAL 1- IMPROVE WATER SUPPLY MANAGEMENT, (a) enhance natural storage and (c) increase capacity of water storage facilities. **Description:** *Removal of silt within existing water impoundment; installation of filters at intake line; enhancement of water transport line from intake to main water system treatment plant*

Project Integration (Describe how the project does or could integrate with other projects in the Region):

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
Tribal Water Quality Management Plan, Tribal Integrated Resource Management Plan

Project Location

Descriptive (Description of property location etc.):
TULE RIVER RESERVATION

Latitude/Longitude - info available at: http://geocoder.us/	Lat: 36.029807°		Long: -118.788018°	
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate): Project Cost:	<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):	Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.			

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☑ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):			
Other: *(Describe X amount of benefit)*			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- [ ] Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- [ ] Implementation of Total Maximum Daily Loads that are established or under development
- [ ] Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- [ ] Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- [ ] Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- [ ] Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- [ ] Address environmental justice concerns
- [ ] Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- [ ] Include integrated projects with multiple benefits
- [x] Support and improve local and regional water supply reliability
- [ ] Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- [ ] Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- [x] Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- [ ] Agricultural Lands Stewardship
- [ ] Agricultural Water Use Efficiency
- [ ] Conjunctive Management and Groundwater Storage
- [ ] Conveyance
- [ ] Desalination
- [x] Drinking Water Treatment and Distribution
- [ ] Economic Incentives
- [ ] Ecosystem Restoration
- [ ] Floodplain Management
- [ ] Groundwater/Aquifer Remediation
- [ ] Matching Water Quality to Water Use
- [ ] Pollution Prevention
- [ ] Precipitation Enhancement
- [ ] Recharge Areas Protection
- [ ] Recycled Municipal Water
- [ ] Surface Storage - CALFED
- [ ] Surface Storage - Regional/Local
- [ ] System Reoperation
- [ ] Urban Land Use Management
- [ ] Urban Runoff Management
- [ ] Urban Water Use Efficiency
- [ ] Water Transfers
- [ ] Water-Dependent Recreation
- [ ] Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
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General Information

Project Name:	Forest Road Rehabilitation		
Project Sponsor:	Tule River Tribal Council		
If Joint Project, Other Partners:			
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Brian Rueger	559-783-9984	559-783-8932	brueger@ocsnet.net

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

Portions of several unsurfaced range and forest roads are contributing sediment to perennial watercourses. Due to their remote locations, these roads receive little maintenance. This project will correct the sedimentation problem by installing water drainage structures and rocking the road approaches to several existing stream crossings on these seasonally travelled roads. IRWM Goals and Objectives to be addressed include Goal 2, Objective 2c; Goal 4, Objective 4c (Reduce erosion and sedimentation).

Project Integration (Describe how the project does or could integrate with other projects in the Region):

The South Fork Tule River headwaters are on federal lands administered by the U.S. Forest Service. Downslope flow transects the Tule River Indian Reservation and a number of private ownerships before reaching Lake Success. The project integrates well with other projects designed to improve water quality into the South Fork Tule River.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

Improving water quality is an objective in the Tule River Tribe's Integrated Resource Management Plan, and the Tribal Water Quality Management Plan.

Project Location

Descriptive (Description of property location etc.):

The project is located on the Tule River Indian Reservation in Tulare County, CA. Project activities are proposed at several remote locations, including within Section 18, T22S, R31E (3,500 ' elevation); and Section 30, T22S, R31E, (5,700'), MDBM.

Latitude/Longitude - info available at: http://geocoder.us/	Lat:	36.029807°	Long:	-118.788018°

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:		<$100K ☑	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☑	In-Design ☑	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project activities can occur the first summer after funding is available.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF	
Water Quality	Area Drained: and/or		Volume Treated:	Year round flow
Public Access, Open Space, Habitat, Recreation (*acres created/restored*):				

Other: *(Describe X amount of benefit)*

Water quality will be enhanced at each rehabilitation site. Existing road approaches to Kessing Creek and Redwood Creek will be targeted. Water from these watercourses flows into the South Fork Tule River, which is a domestic water source for the Tule River Tribal community.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

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- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
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General Information			
Project Name:	Goliath Prescribed Fire Unit		
Project Sponsor:	Sequoia and Kings Canyon National Parks		
If Joint Project, Other Partners:	N/A		
Project Website (if available):	N/A		
Project Contact Person:	Phone	FAX	Email
Will Basye	559-565-3159	559-565-3797	William_Basye@nps.gov

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

The Goliath prescribed fire unit will contribute to meeting several IRWM goals and objectives as well as additional agency objectives. The mixed conifer community of the Goliath unit has a historic fire return interval of 10-20 years. This has resulted in the significant buildup of fuels since full suppression became national fire policy over 100 years ago. This prescribed fire will reintroduce fire to the Goliath unit. It will reduce fuel accumulations and contribute to a more resilient ecosystem. Ecosystem resiliency will become an increasingly important goal as we continue to experience the effects of climate change. The burn will reduce the likelihood of future high intensity wildfire and accompanying potential for erosion and sedimentation. Additional benefits include increased Giant Sequoia reproduction and improved forest health.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

The Goliath prescribed fire unit is part of an integrated plan to restore natural fire regimes and increase ecosystem resiliency in the Redwood Creek drainage (see attached fire history map). This drainage has a rich history of prescribed fire going back to the late 1960's at the inception of the parks prescribed fire program, however, the Goliath unit has not been burned. Many areas surrounding the Goliath unit have been burned twice in the past 45 years in an effort to return fire to this historic area and the Giant Sequoia groves located there. This unit would be last puzzle piece to reintroduce prescribed fire into this drainage.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

This project is part of the Sequoia and Kings Canyon National Parks prescribed fire program. The project falls under guidance provided in the park General Management Plan and the Fire and Fuels Management Plan as well as is in compliance with the Fire and Fuels Management Environmental Assessment. The site specific Burn Plan has been completed and approved.

Project Location

Descriptive (Description of property location etc.):

The 769 acre Goliath prescribed fire unit is within Kings Canyon National Park in the Kaweah River drainage. The unit lies in Redwood Canyon on the east side of Redwood Creek.

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	36.7	Long:	-118.9

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:		<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	Project ready for completion fall 2014				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one) ☐ 1-100 AF ☐ 100-1000AF ☐ 1000+ AF

Water Quality	Area Drained: and/or		Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*				
Other: *(Describe X amount of benefit)*				

Water quality benefits will accrue by preventing erosion and subsequent sedimentation to Redwood Creek which may follow potential high intensity wildfire. The likelihood of an unwanted, high intensity fire will be significantly reduced by the accomplishment of this burn.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	Aquatic Effects from Forest Restoration and Fuels Reduction: Kings River Watershed		
Project Sponsor:	Pacific Southwest Research Station, USDA Forest Service		
If Joint Project, Other Partners:	Southern California Edison and University of California		
Project Website (if available):	www.fs.fed.us/psw/topics/water/kingsriver		
Project Contact Person:	Phone	FAX	Email
Dr. Carolyn Hunsaker	559-323-3211	559-297-3355	chunsaker@fs.fed.us

Project Description

Project Description (1 -2 sentences):

This project quantifies positive and negative effects to stream ecosystems from forest restoration and fuels reduction activities at the watershed scale. It focuses on water yield and water quality in headwater streams of the Kings River watershed and would contribute to the continuation of data collection and analyses that have been ongoing for 10 years.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

It represents the primary surface water source supply for the region. It received funding from 2005-2010 through the CALFED Watershed Program and addressed CALFED's primary objectives of ecosystem quality and water quality. This project addresses CALFED Watershed Program goals of "provide assistance--both financial and technical for watershed activities that help achieve the mission and objectives of CALFED, and to promote collaboration and integration among existing and future local watershed programs." It can be considered a restoration project and has some relationship to meadow restoration.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

Sierra Nevada Framework, USDA Forest Service 2001 and 2004

Project Location

Descriptive (Description of property location etc.):

Providence Creek, Bull Creek, and Teakettle Creek headwaters, Sierra National Forest. Region 5, Tulare Lake Basin Kings River (552.0) of the Central Valley Regional Water Quality Control Board. Pine Flat Reservoir (52.32) and North Fork of the Kings (52.30)

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:		Long:	
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☑	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☑ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality — Area Drained: and/or	2,000 acres	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*	2,000 acres		

Other: *(Describe X amount of benefit)*

Reduced risk of wildfire and associated debris flows and water quality degradation.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☑ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☑ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☑ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☑ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☑ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	Mill Flat Creek Road Management Project		
Project Sponsor:	Sequoia National Forest		
If Joint Project, Other Partners:	None at this time.		
Project Website (if available):	none		
Project Contact Person:	Phone	FAX	Email
Jeff Cordes	(559) 338-2251	(559) 338-2131	jcordes@fs.fed.us

Project Description

Project Description (1 -2 sentences):
The Sequoia National Forest proposes to decommission 14 Forest roads or portions of roads (a total of approximately 3.3 miles) within the Mill Flat Creek to reduce resource damage.

Project Integration (Describe how the project does or could integrate with other projects in the Region):
Other projects within the Mill Flat Creek Watershed: Fuel reduction projects to reduce the potential for catastropic wildfire, (Pine Ridge Fuels Reduction and Big Stump Fuels Reduction) Davis Road Maintenance and Millwood OHV staging area, (Improvement of water quality problems, habitat fragmentation, and riparian vegetation) and Weed Abatement (yellow starthistle).

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):
USDA Forest Service Watershed Condition Framework: Mill Flat Watershed 2011, Giant Sequoia National Monument Plan, 2012

Project Location

Descriptive (Description of property location etc.):
Mill Flat Creek Watershed, (180300100703) The majority of the watershed lies within the Hume Lake Ranger District, of the Sequoia National Forest. Mill Flat Creek is a tributary to the Kings River above Pine Flat Reservoir.

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	N 36.8915	Long:	W 119.1690

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:	$125,000	<$100K ☐	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☑	In-Design ☐	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	Starting in 2013 and continuing for the next 5 years.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)		☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality	Area Drained: and/or	31,292	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*		500		

Other: *(Describe X amount of benefit)*
Acres of habitat improved by road decommissioning.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☑ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☑ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
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- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
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SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information

Project Name:	Osa Meadow and Stream Restoration		
Project Sponsor:	Sequoia National Forest		
If Joint Project, Other Partners:	Cal Trout, Kern Fly Fishers		
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Nina Hemphill	559 784 1500 x1161		nphemphill@fs.fed.us

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

Osa Meadow is on Osa Creek a tributary of the North Fork Kern River. The combination of the past gullying, the 2002 McNally fire followed by a severe 2002 storm increased downcutting in Osa Meadow. Erosion and warming of stream temperatures occurs within Osa meadow and influences Osa Creek. Osa Meadow Restoration would restore 2,000 feet of degraded meadow and stream improving hydrologic connectivity and thus water storage within the meadow, extending cooler flows later into the dry season. Reducing sedimentation of the Kern River would be an additional benefit. This project would also improve suitable habitat for Mountain Yellow Legged Frogs, an endangered species. Improving water quality by reducing fine sediment loading and moderating temperatures will improve water for downstream water users. In addition, Osa Creek has 3.5 kilometers of habitat for Kern River Rainbow (a native golden trout) which will benefit from this project. We anticipate that reconnecting the stream channel to its naturally-evolved floodplain will provide the following watershed and ecosystem benefits: 1) establish a single-thread, low flow channel, 2) reduce peak flows and increase/extend summer base flows, 3) increase in-stream cover and shading, 4) enhance aquatic and terrestrial habitat, 5) improve water quality, and 6) raise the local groundwater level within the meadow. These benefits will improve downstream fish habitat by cooling and extending the flows longer into the dry season. Reducing gullying and erosion as well as inundating the meadow in the spring and summer will reverse the declines in the quality and quantity of aquatic habitats for native fish and amphibians and improve water quality.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

This project will be using a statewide protocol for monitoring Sierra meadows and the data once collected will be part of a larger database of how restored meadows function and whether they provide resilience to drought. This would be part of a larger effort to evaluate meadow restorations to detect the benefits and to prioritize meadow restoration across the Sierra Nevada. Different parameters will be monitored included changes in seasonal water storage, seasonal changes in stream flow, return of native flora and fauna; and production of habitat for future species recovery efforts. This restoration would be used to evaluate whether restorations can improve resilience of the meadow or its stream to drought. Mountain Yellow Legged Frogs are an endangered species at both state and federal levels. The Kern River Rainbow is part of an effort by the State Resources Agency, the USFS, USFWS, NPS and other entities to restore native trout to the upper north Fork Kern River. Habitat loss from the region's long history of grazing, logging, and roads, as well as stochastic events such as floods, drought, and fire, can degrade habitats reducing population persistence.

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

FOURTH EDITION OF THE WATER QUALITY CONTROL PLAN (BASIN PLAN) FOR THE SACRAMENTO RIVER AND SAN JOAQUIN RIVER BASINS. 1995 Department of Fish and Wildlife publication "Fish Species of Special Concern in California, Second Edition," by P. B. Moyle, R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake

Project Location

Descriptive (Description of property location etc.):

This project is located in a tributary of the upper Kern River in Tulare County California. The Kern River flows south to Kern County and terminates in the Tulare Basin. The project is within the Kern River Ranger District. T. 20 S., R. 34 E., SW ¼ of Section 16 and SE ¼ of Section 17; Mount Diablo Base Meridian

Latitude/Longitude - info available at: http://geocoder.us/	Lat: 36^o 10'52.50''	Long:	-118^o 18 '18.34"

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:	$350,000	<$100K ☐	$100K - $1M ☑	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):	$120,000 NFWF grant submitted; will need $250000	Conceptual ☑	In-Design ☑	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	Preliminary surveys done, species surveys to be completed in 2015, hydrologic sampling to start in 2015. Project will be ready with NEPA and CEQA within 6 months once funding to complete NEPA is found. Once funded 1 year after NEPA/CEQA/Permit completion may be needed to allow for winter closure of area for construction. Estimate 2017 for construction of project.				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one)	☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF
Water Quality — Area Drained: and/or		Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*	45 acres of meadow restored. 3.5 miles of stream restored.		

Other: *(Describe X amount of benefit)*

20 acres of meadow habitat and 1 mile of stream habitat for Mountain Yellow Legged Frogs restored and 3.5 miles of improved flows and water quality for Kern River Rainbows down stream in Osa Creek.

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☑ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☑ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☑ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☑ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Economic Incentives
- ☑ Ecosystem Restoration
- ☐ Floodplain Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Matching Water Quality to Water Use
- ☑ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☑ Watershed Management

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information			
Project Name:	Restore Critical Wetlands in Cahoon Meadow, Sequoia National Park		
Project Sponsor:	Sequoia and Kings Canyon National Parks		
If Joint Project, Other Partners:	Colorado State University		
Project Website (if available):			
Project Contact Person:	Phone	FAX	Email
Athena Demetry	559-565-4479	559-565-4429	athena_demetry@nps.gov

Project Description

Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):

This project will complete an Environmental Impact Statement and will implement restoration of the 17-acre Cahoon Meadow, which contains severe and active erosion gullies as a result of historic grazing. The erosion gully is about 1,150 feet long, from 56 to 92 feet wide, and a maximum of 17 feet deep; it has dewatered 5 acres of former wetlands and continues to threaten 13 acres of high-quality fen and wet meadow habitat. The meadow is located in designated wilderness, and treatment techniques that will achieve a restoration objective will require helicopter transport of mechanized equipment. In addition to improving water storage, wildlife habitat, and watershed health, this project will serve as a prototype for improving conditions of highly degraded wilderness meadows that have legacy impacts of past grazing. This project addresses IRWM goals/objectives 1a, 2a, 2c, 3c, 4c, 4d, 4e, and 6d.

Project Integration (Describe how the project does or could integrate with other projects in the Region):

This cooperative project was developed by staff of Sequoia National Park, the NPS Water Resources Division, Colorado State University, and UC Davis. When proposing the plan for this project, we consulted with Yosemite National Park and local agencies including Sequoia Riverlands Trust, the Southern Sierra Partnership, Sequoia National Forest, the Bureau of Land Management in Bakersfield, and Tulare Basin Wildlife Partners. We will consult widely with the public, local community, and concerned agencies and organizations during the NEPA scoping and public comment periods. Technical planning for this project is supported by the Sierra Nevada Conservancy ($74,500).

Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):

Beginning in 2014, the parks are developing a stand-alone plan to restore Cahoon Meadow. Restoration at Cahoon Meadow is conceptually included under the umbrella of the 2007 General Management Plan and 2014 Draft Wilderness Stewardship Plan for Sequoia and Kings Canyon National Parks.

Project Location

Descriptive (Description of property location etc.):

Cahoon Meadow is a 17-acre wet meadow located at 7,350 feet elevation at the headwaters of Cahoon Creek, a tributary of the East Fork of the Kaweah River in Sequoia National Park. Held in private ownership until 1977, the meadow was historically dedicated to cattle grazing, now discontinued. Cahoon Meadow is within the designated John Krebs Wilderness.

Latitude/Longitude - info available at:	http://geocoder.us/	Lat:	36.385636	Long:	-118.703713

Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):

Project Cost:		<$100K ☐	$100K - $1M ☐	$1M - $10M ☑	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☑	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	2020				

Project Benefits

Water Supply: *New Supply Created (AFY)* (Check one) ☐ 1-100 AF ☐ 100-1000AF ☐ 1000+ AF

Water Quality	Area Drained: and/or	Volume Treated:	
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*	loss		
Other: *(Describe X amount of benefit)*			
Approximately 20,000 cubic yards of sediment has been lost from the 372-acre watershed.			

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

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- ☐ Urban Land Use Management
- ☐ Urban Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

Appendix H

Project Description Form

SOUTH SIERRA REGION
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
PROJECT DESCRIPTION FORM
Project Identification Short Form

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General Information					
Project Name:					
Project Sponsor:					
If Joint Project, Other Partners:					
Project Website (if available):					
Project Contact Person:	Phone	FAX	Email		
Project Description					
Project Description (Inculde which IRWM Goal and Objectives are addressed by the project):					
Project Integration (Describe how the project does or could integrate with other projects in the Region):					
Project Source (Cite Plan(s) to which the project belongs [e.g., Watershed Master Plans, Capital Improvement Plans]):					
Project Location					
Descriptive (Description of property location etc.):					
Latitude/Longitude - info available at: http://geocoder.us/		Lat:		Long:	
Estimated Capital Costs: (Note estimated cost, if known OR check rough estimate):					
Project Cost:		<$100K ☐	$100K - $1M ☐	$1M - $10M ☐	>$10M ☐
Project Status (Check all that apply):		Conceptual ☐	In-Design ☐	Ready for Construction ☐	CEQA Complete ☐
Estimated Year of Construction:	Project ready and willing sellers available to consider offers.				
Project Benefits					
Water Supply: *New Supply Created (AFY)* (Check one)		☐ 1-100 AF	☐ 100-1000AF	☐ 1000+ AF	
Water Quality	Area Drained: and/or		Volume Treated:		
Public Access, Open Space, Habitat, Recreation (*acres created/restored):*					
Other: *(Describe X amount of benefit)*					

Project Criteria

Please review the project against the Statewide Priorities, Program Preferences, and Water Plan Management Strategies and place a check in the box if the project meets the criteria.

Statewide Priorities

- ☐ Reduce conflict between water users or resolve water rights disputes, including interregional water rights issues
- ☐ Implementation of Total Maximum Daily Loads that are established or under development
- ☐ Implementation of Regional Board (RWQCB) Watershed Management Initiative Chapters, plans and policies
- ☐ Implementation of the SWRCB's Non-point Source (NPS) Pollution Plan
- ☐ Assist in meeting Delta Water Quality Objectives; IRWM Grant Program Guidelines 6
- ☐ Implementation of recommendations of the floodplain management task force, desalination task force, recycling task force, or state species recovery plan
- ☐ Address environmental justice concerns
- ☐ Assist in achieving one or more goals of the CALFED Bay-Delta Program

Program Preferences

- ☐ Include integrated projects with multiple benefits
- ☐ Support and improve local and regional water supply reliability
- ☐ Contribute expeditiously and measurably to the long-term attainment and maintenance of water quality standards
- ☐ Eliminate or significantly reduce pollution in impaired waters and sensitive habitat areas, including areas of special biological significance
- ☐ Include safe drinking water and water quality projects that serve disadvantaged communities

CA Water Plan - Water Management Strategies

- ☐ Agricultural Lands Stewardship
- ☐ Agricultural Water Use Efficiency
- ☐ Conjunctive Management and Groundwater Storage
- ☐ Conveyance
- ☐ Crop Idling for Water Transfers
- ☐ Desalination
- ☐ Drinking Water Treatment and Distribution
- ☐ Drought Planning
- ☐ Economic Incentives
- ☐ Ecosystem Restoration
- ☐ Flood Management
- ☐ Groundwater/Aquifer Remediation
- ☐ Irrigation Land Retirement
- ☐ Land Use Planning & Management
- ☐ Matching Water Quality to Water Use
- ☐ Outreach and Education
- ☐ Pollution Prevention
- ☐ Precipitation Enhancement
- ☐ Rainfed Agriculture
- ☐ Recharge Areas Protection
- ☐ Recycled Municipal Water
- ☐ Salt and Salinity Management
- ☐ Sediment Management
- ☐ Surface Storage - CALFED
- ☐ Surface Storage - Regional/Local
- ☐ System Reoperation
- ☐ Urban Land Use Management
- ☐ Urban Stormwater Runoff Management
- ☐ Urban Water Use Efficiency
- ☐ Water and Culture
- ☐ Water Transfers
- ☐ Water-Dependent Recreation
- ☐ Watershed Management

Appendix I

Project Scoring Criteria

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
PROJECT SCORING CRITERIA & RELATION TO STATE CRITERIA (Revised 2013)

Southern Sierra Criteria	Pass/Fail	Purpose of Question	Relation to State Criteria
Support for SOUTHERN SIERRA IRWMP. *The project proponent must have formally adopted the plan.*	P/F	Demonstrates that the project proponent has formally adopted the IRWMP plan	• Adopted IRWMP Plan and Proof of formal adoption
Implementation of the SOUTHERN SIERRA IRWMP. *The project must address the values, goals, objectives and strategies identified in the IRWMP.*	P/F	To fund projects that directly support and further the implementation of the region's water management goals and objectives.	• Consistency with IRWMP standards • Objectives • Priorities and Schedule • Impacts and Regional Benefits • Implementation

Southern Sierra Question No.	Southern Sierra Criteria	Range of Points Possible	Scoring Standard	Purpose of Question	Relation to State Criteria
1	**Objectives.** Does the project contribute to IRWM Plan Objectives?	1-10	A higher score indicates that the project is expected to contribute to the achievement of more of the plan objectives.	Assists in prioritizing projects into the regional plan and ensures that the project will meet plan objectives	• Objectives • Priorities
2	**Resource Management Strategies.** How well does the project relate to the SSIRWM Plan Resource Management Strategies?	1-10	A higher score identifies a project that contributes to more resource management strategies that diversify the water and land management and conservation portfolios used to meet plan objectives, including projects that consider the amount, intensity, timing, quality and variability of runoff and recharge.	Ensures a diversity of resource management strategies are implemented towards fulfilling plan objectives	• Objectives • Resource Management Strategies • Integration
3	**Technical Feasibility.** Is the project based on a sound technical feasibility?	1-5	Higher scores indicate a thorough readiness to implement the project. Technical feasibility is related to knowledge of project location, water system, and geologic or hydrologic conditions. Lower scores could indicate gaps in data or information that could prevent a project's success.	Evaluate readiness to proceed, project feasibility, and obtain documentation.	• Technical Analysis • Plan Performance and Monitoring

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
PROJECT SCORING CRITERIA & RELATION TO STATE CRITERIA (Revised 2013)

Southern Sierra Question No.	Southern Sierra Criteria	Range of Points Possible	Scoring Standard	Purpose of Question	Relation to State Criteria
4	**Disadvantaged Community.** Does the project address critical water supply and quality needs of a "disadvantaged community" as defined by the State?	1-10	A score of one to three will reflect the projects benefits to the community. A score of zero will be assigned if the project is not benefiting a disadvantaged community.	Identify projects that benefit disadvantaged communities	• Disadvantaged Communities • Impacts and Benefits • Ensure Equitable Distribution of Benefits • Stakeholder Involvement • Coordination
5	**Native American Communities.** Are there specific benefits to Native American tribal communities?	1-10	A higher score will be assigned to those projects that include strategies for addressing critical water supply and water quality needs of Native American tribal communities.	Identifies projects that benefit Native American tribal communities	• Improve Tribal Water and Natural Resources • Impacts and Regional Benefits • Ensure Equitable Distribution of Benefits • Stakeholder Involvement • Coordination
6	**Environmental Justice Considerations.** Does the project provide consideration for environmental justice or equality?	1-5	A higher score would address the important considerations for the SSIRWM of inequitable distribution of pollution and access to clean water and air, parks, recreation, and nutritious foods.	Encourages the equal distribution of resources to ensure that environmental benefits are fairly distributed	• Impacts and Benefits • Water Management Strategies and Integration • Ensure Equitable Distribution of Benefits • Coordination

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
PROJECT SCORING CRITERIA & RELATION TO STATE CRITERIA (Revised 2013)

Southern Sierra Question No.	Southern Sierra Criteria	Range of Points Possible	Scoring Standard	Purpose of Question	Relation to State Criteria
7	**Project Costs and Financing.** Are project costs documented? If so, what are they based on?	1-10	A higher score is based on documented project costs that are based on a feasibility study, conceptual idea, design, etc.	Determine if the project costs are within reason for this project	• Budget • Implementation • Financing
8	**Economic Feasibility.** Does the project describe a feasible program of financing for implementation of project?	1-10	Higher score based on documentation of firm financial commitments; clear resource commitments for ongoing monitoring, maintenance and operations; and a high percentage local match.	Evaluate readiness to proceed, clear financial commitments	• Financing • Budget • Implementation
9	**Project Status.** What is the status of the project? Is the project ready to proceed?	1-10	Higher scores would be assigned to projects that are implementable and well documented. Conceptual projects may also be included in the IRWM Plan because the planning horizon for an IRWM Plan is 20-years. Projects with low readiness may be developed or the RWMG may seek additional funding in order to develop the project to be ready.	Evaluates the readiness to proceed with a given project	• Technical Analysis • Relation to Local Water Planning • Relation to Local Land use Planning • Implementation
10	**Strategic Considerations.** Could a smaller/local project be strategically restructured to satisfy regional objectives?	1-5	The RWMG will review strategic considerations that may bring multiple benefit and greater integration to projects. In this way, local projects may be integrated for regional benefit and explaining when a single purpose project needs to be implemented in order to best implement an IRWM Plan.	Evaluate readiness to proceed, provide greater integration	• Implementation • Multiple Stakeholder Benefits • Coordination • Objectives
11	**Climate Change.** Does the project address the effects of climate change?	1-10	Higher scores will be given to projects that specifically will identify impacts of and contributions to climate change mitigation or resiliency; implement adaptive management strategies and techniques--as effects of climate change manifest, as new tools are developed, and as new information becomes available; or, reduce vulnerabilities to climate change effects.	Does the project contribute to regional and state goals of adaptation for climate change, monitoring methods and reducing vulnerabilities?	• Climate Change • Impacts and Benefits

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
PROJECT SCORING CRITERIA & RELATION TO STATE CRITERIA (Revised 2013)

Southern Sierra Question No.	Southern Sierra Criteria	Range of Points Possible	Scoring Standard	Purpose of Question	Relation to State Criteria
12	**Greenhouse Gas Emissions.** Does the project contribute to the reduction of GHG emissions as compared to project alternatives?	1-5	Higher scores will be given to projects that, over the course of their life, will help the region lower GHG emissions, particularly synergistically in the energy and water sectors and contribute to regional sustainability.	Considerations such as energy efficiency and reduction of GHG emissions are important when choosing between project alternatives	• Mitigate Climate Change Impacts • Reduce GHG • Sustainability Benefits
Total # of points (Out of 100)	**Projects will be determined based on scoring from the 12 questions above.**				

Appendix J

Outline for Grant Pre-Application

Southern Sierra Regional Water Management Group
Outline for Grant Pre-Application

1 – PROJECT DESCRIPTION
1.1 – Project Summary
1.2 – Goals and Objectives of Project
1.3 – Relation to Southern Sierra IRWMP

2 – PROJECT TASKS

3 – PROJECT BENEFITS
3.1 - Water Supply
3.2 - Water Quality
3.3 - Flood Damage Reduction
3.4 - Ecosystem
3.5 - Other Benefits

3 – PERMITTING AND ENVIRONMENTAL ISSUES

4 – DATA MANAGEMENT AND MONITORING DELIVERABLES

5 – PROJECT BUDGET

6 – PROJECT SCHEDULE

8 – IRWM PROGRAM PREFERENCES AND STATEWIDE PRIORITIES

9 – CONCLUSIONS AND JUSTIFICATION FOR IRWMP GRANT APPLICATION

<u>Attachments</u>
1 – Vicinity Map
2 – Project Location Map
3 – Cost Estimate

APPENDICES

Appendix K

Resource Database

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
1	AB3030 Groundwater Management Plan Madera County Final Draft	January 2002	Todd Engineers		In this AB3030 plan, the County desires to: study the current conditions of the groundwater basins, document current groundwater management practices, and explore techniques to cooperatively manage one of the County's most important resources. Focuses on valley floor.		No	10
2	Ahwahnee/Nipinnawasee Area Plan	1999	USFS	Rocky Mtn Research Station USFS	Cumulative Watershed Effects of Fuel Management, some Value for future climate change RMS.	http://forest.moscowfsl.wsu.edu/engr/cwe/	No	9
3	Biological Assessment & Criteria		Wayne S. Davis & Thomas P. Simon	Available in Carolyn Hunsaker library, Lewis Publishers	Various articles in the area of conceptual framework for biocriteria development, water resource planning and decision-making, methods advancement and technical applications, and policy and perspectives.		No	1
4	CAL/Ecotox		CAL Office of Environmental Health Hazzard Assessment	OEHHA 1001 I Street, 12th Floor, Sacramento, CA 95814	Cal/Ecotox database provides ecological, physiological, and toxicity data for California fish, reptiles, mammals, amphibians and birds.	http://www.oehha.ca.gov/cal_ecotox/DEFAULT.HTM	No	4
5	California Department of Fish & Game (CDFG) BIOS		California Department of Fish and Game	DFG Headquarters 1416 9th Street, Sacramento, CA 95814 • Google Map (916) 445-0411	BIOS is a system designed to enable the management, visualization, and analysis of biogeographic data collected by the Department of Fish and Game and its Partner Organizations. In addition, BIOS facilitates the sharing of those data within the BIOS community. BIOS integrates GIS, relational database management, and ESRI's ArcIMS technology to create a statewide, integrated information management tool that can be used on any computer with access to the Internet.	http://bios.dfg.ca.gov/	No	1
6	California Dept. Fish & Game: CalFish Database	2008, Updated		CDFG	CalFish provides direct access to many different types of data relating to fish and aquatic habitat data. These data include categories such as: - Population trends and counts - Distributions - Migration barriers - Hatcheries - Habitat restoration projects - Genetics - Monitoring		No	4
7	California Dept. of Fish & Game (CDFG) CWHR		California Dept. of Fish and Game	California Wildlife Habitat Relationships (CWHR)	CWHR contains life history, geographic range, habitat relationships, and management information on 694 species of amphibians, reptiles, birds, and mammals known to occur in the state.	http://www.dfg.ca.gov/biogeodata/cwhr/	No	1, 4, 12

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
8	California Environmental Resources Evaluation System (CERES)	2008, updated			CERES focuses on three related components: technology, data, and community. The first, technology, includes the development of new software and network structures to accommodate the search and retrieval, organization, and accessibility demands associated with huge volumes of data in a wide range of forms. The second, data, encompasses the conversion of vast quantities of information into digital form as well as the evaluation of existing digital data sets and the development of metadata catalogs required searching and data-quality and appropriate use assessment. The third, community, contains CERES' efforts to promote the use of the network for planning and policy and to foster the growth of new users and contributors in a far-reaching web of affiliations.	http://ceres.ca.gov/	No	12, 13
9	California Natural Diversity Database (CNDDB)		CA Dept. of Fish and Game	Biogeographic Data Branch 1807 13th Street, Suite 202 Sacramento, CA 95811 (916) 322-2493 Information Services 916-324-3812	The California Natural Diversity Database (CNDDB) is a program that inventories the status and locations of rare plants and animals in California . CNDDB staff work with partners to maintain current lists of rare species as well as maintain an ever-growing database of GIS-mapped locations for these species.	http://www.dfg.ca.gov/biogeodata/cnddb/	No	4, 3, 12, 16
10	California Water Plan Update 2009, Volume 3, Regional Reports - Chapter 7 San Joaquin River Hydrologic Region, Working Draft	2008	CA DWR	working draft 9/4/2008	More specific to the San Joaquin hydrologic area including: land use, water use, water supplies, water quality, flood management, regional water planning and management.	http://www.waterplan.water.ca.gov/regions/sjr/	No	7
11	California Water Plan Update 2013, Volume 3, Regional Reports - Chapter 13 Mountain Counties Area, Working Draft	2008	CA DWR	working draft 9/8/2008	Has chapters including: land use, water use, water supplies, water quality, flood management, regional water planning and management.	http://www.waterplan.water.ca.gov/regions/mc/	No	3, 5, 8, 12, 13

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
12	California Watershed Assessment Manual: Volume I	2005	F. Shilling, S. Sommarstrom, R. Kattelmann, B. Washburn, J. Florsheim, R. Henly.	Prepared for the California Resources Agency and the California Bay-Delta Authority	This manual is intended to provide guidance for planning and conducting watershed assessments for wildland and rural areas of northern and central California. Volume I of the Manual currently contains 8 chapters. These flow from the introductory chapter (1), through chapters describing the details of assessment planning (2), fundamentals of watershed functioning (3), data collection (4), data analysis (5), and data integration (6). Chapter 7 gives details on how to structure an assessment report; and chapter 8 describes connecting the assessment with decision-making.	http://www.cwam.ucdavis.edu/Manual_chapters.htm	No	12
13	California Watershed Assessment Manual: Volume II	2008 + drafting	F. Shilling, et. al.		Volume II of the CWAM provides guidance on specific aspects of watershed assessment and evaluation, including water quality, benthic macroinvertebrates, and fire ecology. Each chapter describes current methods to monitor and evaluate conditions of these watershed processes and features. They also include descriptions of how you can include the data collected about these watershed attributes in your watershed assessment or environmental indicator score-card.	http://cwam.ucdavis.edu/Volume_2/TOC.htm	No	7, 9
14	California Watershed Portal (CWP)	2008, Updated	CA DWR	cwp@resources.ca.gov	Identifies ongoing watershed activities, provides access to important data and information, and links to the larger California Watershed community.	http://cwp.resources.ca.gov/	Yes	
15	Coursegold Area Plan	2006	Mark H. Eisenbies	USFS Technical Report	Bibliography of Forest Water Yields, Flooding Issues, and the Hydrologic Modeling of Extreme Flood Events	N/A	No	7
16	Dangerous Development		Sierra Nevada Alliance	Sierra Nevada Alliance PO Box 7989 South Lake Tahoe, CA 96158	Dangerous Development - Wildfire and Rural Sprawl in the Sierra Nevada. Report on wildfire, population growth, development and consequences of current land use methods. Includes fire and land use statistics for Fresno and Madera Counties.	http://www.sierranevadaalliance.org/publications/db/pics/1190122868_27040.f_pdf.pdf	No	8, 9, 16
17	Declines of the California Red-Legged Frog: Climate, uv-b, Habitat, and Pesticides Hypotheses	Apr-01	Carlos Davidson, Bradley Shaffer, and Mark R. Jennings	Ecological Applications: Vol. 11, No. 2, pp. 464-479.	The federally threatened California red-legged frog (Rana aurora draytonii) has disappeared from much of its range for unknown reasons. We mapped 237 historic locations for the species and determined their current population status. Using a geographic information system (GIS), we determined latitude, elevation, and land use attributes for all sites and analyzed the spatial pattern of declines	http://www.esajournals.org/doi/abs/10.1890/1051-0761(2001)011%5B0464%3ADOTCRL%5D2.0.CO%3B2?prevSearch=null&searchHistoryKey=	No	4, 12, 16
18	Eastern Madera County and Mariposa County Long Term Plan for Watershed Conservation and Restoration	2007	Sarah Marvin	Dept. of Environmental Science, UC Berkeley	Possible Changes in Water Yields and Peak Flows in Response to Forest Management	http://fresnoriver.org/	No	7

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
19	Eastern Madera County and Mariposa County Long Term Plan MC2LTP		Central Sierra Watershed Committee	Central Sierra Watershed Committee November 2001	Eastern Madera County and Mariposa County Long Term Plan MC2LTP for Watershed Conservation and Restoration Includes the San Joaquin watershed. Managing watershed. Background info, community info, permitted and known facilities, potential problems, planned projects, monitoring and beneficial uses.		No	9, 8, 12
20	Eastern Madera County Coarsegold Resource Conservation District Voluntary Water Quality, Grazing Land, Oak Woodland Conservation Management Guidelines	Sept 26, 1996	Coarsegold Resource Conservation District, North Fork, CA		These Conservation Guidelines are designed to address the nonpoint source water pollution as identified in the 1972 Clean Water Act, as amended, on the private grazing lands and oak woodlands of Madera County. They integrate Best Management Practices (BMP); agronomic, forestry, wildlife, ecology, and economic principals; to protect, enhance, and manage the beneficial uses of the waters, and associated riparian area, of the County, while protecting the agriculture and forestry enterprises. They provide for cost-share conservation programs under the USDA 1996 Farm Bill to strengthen the land stewardship partnership between landowners, agencies, and groups, while protecting private property rights. The County Oak Woodland Guidelines are incorporated to integrate multi-resource benefits in the voluntary implementation of (?)	http://www.crcd.org/	No	7, 8
21	Ecological Assessment of Aquatic Resources: Linking Science to Decision-Making	2000	Michael T. Barbour, ed., et al.	Available in Carolyn Hunsaker's Library; Setac Press (Society of Environmental Toxicology and Chemistry)	Ecological Assessment Formulation, Engaging community stakeholders, Designing data collection, interpreting results of ecological assessments, valuing ecological resources, translating ecological science, Injecting ecological knowledge into decsion-making process, case studies for forumulating effective questions		No	1

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
22	Environmental Protection Indicators for California (EPIC)		CAL/EPA OEHHA --Office of Environmental Health Hazzard Assessment	Office of Environmental Health Hazard Assessment 1001 I Street, 12th Floor, Sacramento, CA 95814 P. O. Box 4010, Sacramento, CA 95812-4010 Phone: (916) 324-2829 FAX: (916) 322-9705	Environmental Protection Indicators for California (EPIC) describes the process for the identification and selection of environmental indicators that are adopted as part of the EPIC system, and presents the initial set of environmental indicators.	http://www.oehha.ca.gov/multimedia/epic/Epicreport.html	follow link	9, 10, 12
23	EPA Storet Data Warehouse	2008	US EPA	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 (202) 272-0167	Online database for US watershed info water quality, habitat and biological results. Basic information: liilte input. As of 7/14 Kings River Lower and Mendota Pool are list as impared.	http://www.epa.gov/storet/dw_home.html	Yes	7 and 12
24	Final EIR of Fresno County's General Plan.		County of Fresno	County of Fresno 2220 Tulare Street, 6th floor Fresno, CA 93721	Final EIR of Fresno County's General Plan. Includes environmental analysis of water resources, biological resources, forestry resources, mineral resources, air quality and sesmic and geologic hazards.	http://www2.co.fresno.ca.us/4510/4360/General_Plan/GP_Final_EIR/EIR/toc.html	No	11, 6, 7, 2, 8
25	Final Environmental Impact Report for the Hillview OSL Water System Improvement Project; Hillview Water Company, Inc.	December 2004	Valley Planning Consultants, Inc.	Prepared for the California Dept of Health Services, SCH#2000072011	This EIR was prepared for a project in Oakhurst, Madera County. It does not contain the full text from the June 2004 Draft EIR, but only a few pages of revisions to the Draft EIR, plus comments and responses. It contains several letters from agencies related to the California Red-legged Frog and the Valley Elderberry Longhorn Beetle. One of the Appendices is a report titled: "The Status of the California Red-Legged Frog in the Vicinity of the Hillview Water Company Water System Improvement Project, Oakhurst, California."		No	4
26	Fresno County Regional Data Center		Fresno COG 2035 Tulare Street Suite 201 Fresno, CA 93721 (559) 233-4148	website info		http://www.fresnocog.org/document.php?pid=20	No	1

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
27	Fresno River Landscape Analysis	July 2005	Sierra National Forest Bass Lake Ranger District		Has chapters on: ecosystem elements and environmental indicators, reference variability, existing conditions, desired conditions, management opportunities.		No	7, 4, 9
28	FSGeodata Clearinghouse	2008, Updated		USFS Databases	Forest Service datasets, GIS, Aerial Survey, Aerial insect & disease, land cover monitoring, forest health protection data, FIA spatial data.	http://svinetfc4.fs.fed.us/clearinghouse/other_fs/other_fs.html	No	1, 4, 9, 10, 12,16
29	Geology, Hydrology and Quality of Water in the Madera Area, San Joaquin Valley, CA.	1970	Kenneth Schmidt	Kenneth D. Schmidt and Associates	Expert Report of Kenneth D. Schmidt on potential impacts of reduced friant water deliveries on groundwater	http://www.restoresjr.net/program_library/05-Pre-Settlement/Expert%20Reports/Friant%20Water%20Users%20Authority%20Expert%20Reports/	No	2
30	Groundwater Conditions Eastern Madera County, Draft Technical Memorandum	March 2002	Gordon E. Grant, et al.	May 2008 USFS Pacifc NW Station	Effects of Forest Practices on Peak Flows and Consequent Channel Response: A state of science report for western oregon and washington	N/A	No	7
31	Groundwater Conditions in the Oakhurst Basin. AB 303 Study	November 2005	EPA Science Advisory Board	EPA Science Advisory Board 1400A Washington, DC	A Framework for Assessing and Reporting on Ecological Condition: An SAB Report	http://www.epa.gov/sab/pdf/epec02009.pdf	No	12
32	Madera Area Investigation	August 1966	California Department of Water Resources	Bulletin 35, Preliminary Edition	This investigation was conducted between March 1961 and June 1965 to determine water supply available to the Madera Area, to determine the water requirements for continued development of the area, and to plan for the optimum development of all local supplies for maximum beneficial use. The investigation concluded that additional water would have to be imported to ensure continued economic growth of the area between the time of the report and 2020.	http://www.worldcat.org/oclc/9588557?tab=holdings#tabs	No	
33	Madera County Community Wildfire Protection Plan	2008	Madera County Resource Management Agency		Summarizes planning process. Describes environmental conditions, infrastructure, and population in the planning area. Summarizes fire policy, trends, and risk as well as existing mitigation standards. Presents community wildfire risk assessment and offers mitigation actions for communities at risk. Contains section on education and outreach, and funding possibilities.		No	8, 9, 16

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
34	Madera County General Plan. Policy Document and Background Report	1995	Madera County		Planning document with section called Agriculture and Natural Resources that contains info on forest resources, water resources, riparian habitat, fish and wildlife habitat, vegetation, etc.	pdf, available at: http://www.madera-county.com/rma/archives/uploads/1128960251_Document_gppolicy.pdf	No	8, 4
35	Madera County Integrated Regional Water Management Plan, Volume 1	2008	Boyle Engineering in association with Kenneth D. Schmidt and Associates		Major topics are: water demand, water supply, water quality, flood control, water resources management opportunities, watershed management	pdf, available at http://www.madera-county.com/supervisors/water-plan.html	No	7, 9, 8
36	Madera County Integrated Regional Water Management Plan, Volume 2 - Appendices	2008	Boyle Engineering in association with Kenneth D. Schmidt and Associates		Reports of Groundwater Studies: Oakhurst AB 303 Study: pg 7-99; Coarsegold groundwater study: pg 560 - 640; Raymond/Daulton Ranch groundwater study: pg 850 - 896. Proposed Groundwater Monitoring Plan for Madera County: pgs 1075-1109	pdf, available at http://www.madera-county.com/supervisors/water-plan.html	No	2
37	Madera County Regional Transportation Plan 2007	2007	Madera County Transportation Commission	Adopted May 23, 2007	Regional transportation plan.	Electronic - on line at http://www.maderactc.org/public.html	No	
38	Millerton Area Watershed Coalition	2008?	Cal State Parks		Covers the following area: Surface Water Quality, Groundwater Quality and Quantity, Fuels and Fire Safety, Invasive Species, Wildlife	http://www.sierrafoothill.org/watershed/		9,12
39	Natural Resources Conservation Service		Natural Resources Conservation Service	Natural Resources Conservation Service 14th and Independence Avenue, SW Washington, DC 20250	The NRCS is a federal conservation department in the US Dept of Food and Agriculture. Their Technical resources include GIS data, geospatial data gateway, forestry, range and pasture, soils and water resources.	http://www.nrcs.usda.gov/technical/	No	1, 4, 3, 8,
40	Natural Resources Council		National Resources Council	National Academies Press 888-624-8373 http://www.nap.edu/catalog/12223.html	National Resources Council - Hydrological effects of a changing forest landscape - Executive Summary	http://www.nap.edu/catalog/12223.html	No	2, 8
41	Oakhurst Area Plan	Sept 2005	Oakhurst Plan		Planning document with section called Environmental Setting that contains info on watersheds, geology, vegetation, wildlife, etc.	pdf, available at: http://www.madera-county.com/rma/archives/uploads/1157730052_Document_upload_oakhurstareaplan.pdf		4, 3, 9

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
42	Oakhurst-Ahwahnee Area General Growth Mgmt Plan	1980			Maps - GIS,HUC, (watershed and sub-watersheds) Topographic, Satellite, flood maps, DEM (Digital Elevation Model), Aerial			
43	Proposed Groundwater Monitoring Program for Madera County	2008	Calflora	Calflora 1700 Shattuck Ave. #198, Berkeley, CA 94709 510 528-5426	Calflora has a searchable database listing invasive species and reported observations. Searchable areas include the San Joaquin River areas.	http://www.calflora.org/	No	9
44	Revision of the workplan: Learning how to apply adaptive management in the Sierra Nevada Forest Plan Amendment	2007	University of California Science Team		Goal of the research proposed in plan is to learn how to use an adaptive management and monitoring system to understand ecosystem behavior, incorporate stakeholder participation, and inform the implementation of adaptive management for Forest Service lands in the Sierra Nevada. Focal questions: fire and forest ecosytem health; participatory processes; water quantity and quality; wildlife. One study site is in Fresno River basin	pdf, available at http://snamp.cnr.berkeley.edu/documents/91/	No	9, 4
45	Sanitary Engineering Investigation of Course Gold Creek. Prepared for Tital Group, Inc.	Mar-71	California Invasive Plant Council	California Invasive Plant Council 1442-A Walnut St. #462 Berkeley, CA 94709 (510) 843-3902	CIPC has risk assessment mapping of CA invasive plant species. Mapping includes the San Joaquin watershed areas.	http://www.cal-ipc.org/ip/mapping/statewide_maps/index.php	No	9
46	SEKI water resources information and isues report	2005	NPS		Sequoia and Kings Canyon NP Water Resoences inventory on quantity and quality and issues, 2005	http://www.nature.nps.gov/water/planning/Info_Issuesoverview_reports/seki_wriio_final_High.pdf	Y	
47	Shaver Lake Forest Specific Plan	1973, amended 1993	Wilsey & Ham Planners and Engineers	1973, amended 1993 prepared for Fresno County by Wilsey & Ham 393 Vintage Park Drive, Suite 100 Foster City, CA 94404 Phone:(650) 349-2151	Shaver Lake Forest Specific Plan - Refinement of Sierra Foothills General Plan. Includes land use, development, standards for population and building density, water supply, drainage, waste disposal, standards for conservation and natural resources includeing underground and surface waters, forests, soils, vegetation and wildlife specific to the Shaver Lake Forest (as defined within the plan.)	http://www.co.fresno.ca.us/departmentpage.aspx?id=19705	No	3, 7, 8, 13
48	Sierra National Forest Supervisors Office, Water Quality by PWI, Water Quality Records for the Sierra National Forest	1984	Earle Franks, Frank Estril					7

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
49	Sierra Watershed Community Directory	2005	Sierra Nevada Alliance		Directory of watershed councils, organizations, coordinated resource management processes, and conservation groups that work to conserve, protect, and restore watershed health in the Sierra Nevada. Contains map of Sierra Nevada Watersheds.	pdf; available at: http://www.sierranevadaalliance.org/publications/db/pics/1111699364_4254.f_pdf.pdf	No	1
50	SJR Flight Line Images		US Bureau of Reclamation	Ayres Associates 2445 Darwin Road Madison, WI 53704 (608)249-0471	San Joaquin River, U.S. Bureau of Reclamation, Flight Line Index 4 Images of SJR named for the miles of river they cover.		follow link	1
51	Soil Data Mart			USDA NRCS	Sierra National Forest:Brief Soil Descriptions (CA) Hydric Soils (CA) Storie Index Rating (CA) The following local interpretations are included: Basin, Border, and Furrow Irrigation (CA) California Revised Storie Index Rating (CA) Camp Areas, Off-Road Motorcycle Trails and Paths and Trails (CA) Desert Tortoise (CA) Dwellings and Small Commercial Buildings (CA) Landfills (CA) Picnic Areas, Playgrounds, and Lawns, Landscaping, Golf Fairways (CA) Ponds and Embankments (CA) Roads and Streets and Shallow Excavations (CA) Sewage Disposal (CA) Source of Reclamation Material, Roadfill, and Topsoil (CA) Source of Sand and Gravel (CA) Sprinkler and Drip Irrigation (CA)"	http://soildatamart.nrcs.usda.gov	No	2
52	State of Sierra Waters: a Sierra Nevada Watersheds Index	2006	Kerri Timmer, Megan Suarez-Brand, Janet Cohen, Joan Clayburgh	Sierra Nevada Alliance	Uses publicly available data to measure and assess watershed health for 24 watersheds in Sierra. Uses indicators and provides baseline data. Offers recommendations for ways to improve watershed health. Includes individual watershed reports.	pdf. Available at www.sierranevadaalliance.org	No	7
53	StreamNet		SteamNet	http://www.streamnet.org/	StreamNet is a cooperative venture of the Pacific Northwest's fish and wildlife agencies and tribes and is administered by the Pacific States Marine Fisheries Commission. Provides data and data services in support of the region's Fish and Wildlife Program and other efforts to manage and restore the region's aquatic resources.	http://www.streamnet.org/	No	4

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
54	Streams of the San Joaquin, El Valle De Los Tulares - The Valley of the Tules, Geographic and Ecological Considerations of California's San Joaquin Valley	2002	Robert Edminster	Published by Robert Edminster	Focuses on the ecology of the San Joaquin Valley. In addition to discussing the streams themselves, this publication has quite a bit of information on plant communities and wildlife.			4
55	Surface Water Ambient Monitoring Program, Fresno River Watershed, Annual Report Fiscal Year 2001-2002	July 2003	Pamela Bufurd, Annee Ferranti	Staff Report of the California Environmental Protection Agency and State Water Resources Control Board, Central Valley Region	The SWAMP has provided funding to develop a surface water monitoring program to evaluate water quality within the San Joaquin River basin. Water quality results have been assessed using the water quality objectives contained in the Water Quality Control Plan for the Sacramento and San Joaquin Rivers – Fourth Edition 1998. During Fiscal Year 2001-2002, the intent of the study was to begin baseline sampling and gather preliminary data from the Fresno River and Hensley Lake. Algal blooms have been observed in Hensley Lake. The Fresno River watershed has been identified as a possible contributor of nutrients.	http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/fresnorvr_ann_rpt0102.pdf	No	9,10
56	The Montreal Process	1994	Various Countries	http://www.rinya.maff.go.jp/mpci/meetings_e.html	The Montréal Process is the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests. It was formed in Geneva, Switzerland, in June 1994 to develop and implement internationally agreed criteria and indicators for the conservation and sustainable management of temperate and boreal forests.	http://www.rinya.maff.go.jp/mpci/whatis_e.html	No	8, 9
57	The Natural Resource Projects Inventory (NRPI)	2008, updated	Natural Resources Projects Inventory (NRPI)	ICE, UC Davis Dept. of Environmental Science and Policy Phone: (530) 752-2378 Email: kcward@ucdavis.edu	The Natural Resource Projects Inventory (NRPI) began as a collaborative effort between UC Davis Information Center for the Environment (ICE) and the California Biodiversity Council (CBC) in 1995. In response to a growing need for more project related data on California's natural resources, existing inventories* were synthesized into one database and thousands of new projects have been added through individual online entries and electronic database transfers. Today, NRPI is the most comprehensive statewide database of its kind in California with over 6,000 natural resource projects searchable on the Internet. These projects include watershed conservation and acquisition, restoration and noxious weed eradication, assessment, planning, and scientific studies.	http://www.ice.ucdavis.edu/nrpi/Home.aspx	No	2, 4, 7, 8, 9, 10
58	Tulare Basin Conservation Plans	2005, 2009	Tulare Basin Wildlife Partners		Corridor plan prescribing management on riparian and wildlife corridors	tularebasinwildlifepartners.org	Y	

Southern Sierra Regional Water Management Group

Resource Database

No	Name	Year of Publication	Author	Publication Info	Description	Website Address	Info on website?	IRWM Chapter relevance
59	Update for Eastern Madera County and Mariposa County Long Term Plan MC2LTP	2007	Central Sierra Watershed Committee	Central Sierra Watershed Committee January 2007	2007 Update for Eastern Madera County and Mariposa County Long Term Plan MC2LTP for Watershed Conservation and Restoration Includes the San Joaquin watershed. Managing watershed. Background info, community info, permitted and known facilities, potential problems, planned projects, monitoring, and beneficial uses.		No	9, 8, 13
60	Upper Fresno River Watershed	in progress	Jones & Stokes 2600 V Street Sacramento, CA 95818-1914 Contact: Russ Grimes or Mike Rushton 916/737-3000	Central Valley Regional Water Quality Control Board 11020 Sun Center Drive, Suite 200 Rancho Cordova, CA 95670 Contact: Devra Lewis	Irrigated Lands Program Existing Conditions Report for the Central Valley. Prepared by Jones & Stokes for the CVRWQB. Covers watershed basins and sub-basins in the Central Valley. Areas include General Description of each, plus land use patterns, basin plan status, impaired status, and water quality of each watershed. Report covers the San Joaquin.		No	4, 8
61	US EPA Upper San Joaquin Watershed -- 18040006	2008	US EPA	Environmental Protection Agency Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460 (202) 272-0167	EPA Surf your Watershed - upper san joaquin watershed profile	http://cfpub.epa.gov/surf/huc.cfm?huc_code=18040006	No	7, 8
62	USFS Aerial Detection Survey	2008	USFS		Aerial Detection Survey Draft Results (Sierra National Forest, Inyo National Forest) Shows diseased trees on maps, fire and fuel locations.	http://www.fs.fed.us/r5/spf/fhp/fhm/aerial/draft/index.shtml	No	9
63	USJR Plant and Animal Species Fect Sheet	2008	multiple see report	Nature Serve Explorer Database	Comprehensive list of 63 animal and plant species in the USJR watershend. Includes endangered / legal status, population / occurrence viability, distribution and some images.	http://www.natureserve.org/explorer/	No	
64	Watershed Management and Water Yield		Theodore E. Adams, Jr., Ray Coppock	UC Water Task Force, Cooperative Extension University of California Division of Agriculture and Natural Resources, Leaflet 21420	Pamphlet on managing vegetatation (e.g. prescribed burning of brushlands) to increase water yield and protect against fire.		No	9

Appendix L

Grant Programs and Funding Sources

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
GRANT PROGRAMS AND FUNDING SOURCES

No.	Agency/Organization	Grant Program	Projects Funded	Available Funding	Recurrence	Website
1	Bass Pro Shop	Corporate Contributions	Wilderness Conservation Projects			https://basspro.custhelp.com/app/answers/detail/a_id/25/kw/donations
2	Bureau of Land Management	Fish, Wildlife and Plant Conservation Resource Management	Protect, Restore, & Enhance Fish, Wildlife, & Plant Conservation Resources	$500 - $1,400,000		http://www.federalgrantswire.com/fish-wildlife-and-plant-conservation-resource-management.html
3	Bureau of Land Management	Habitat Restoration	Restores Areas on the Land in Need of Attention- Like Abandoned Roads or Erosion Scars			http://www.blm.gov/ca/st/en/fo/hollister/fort_ord/restoration_fo.html
4	Bureau of Land Management	Environmental Quality & Protection Resource Management	Reduce or Remove Pollutants in the Environment for the Protection of Human Health, Water & Air Resources			http://www.federalgrantswire.com/environmental-quality-and-protection-resource-management.html
5	Bureau of Land Management	Rangeland Resource Management	Manage, Develop, & Protect Public Lands & Enhance the Understanding of Rangeland & Watershed Resources	$49,000 Avg. Per Project		http://www.federalgrantswire.com/rangeland-resource-management.html
6	Bureau of Land Management	Recreation Resource Management	Manage and/or Upgrade Recreational Resources & Related Facilities in Lands Administered by the BLM	$33,000 Avg. Per Project		http://www.federalgrantswire.com/recreation-resource-management.html
7	Bureau of Land Management	Secure Rural Schools & Community Self - Determination	Road & Trail Construction, Culvert Replacements for Fish Passage, Stream Channel Enhancement, Watershed Restoration	$83,000 Avg. Per Project		http://www.federalgrantswire.com/secure-rural-schools-and-community-self-determination.html
8	Bureau of Land Management	Wildland Fire & Resource Management	Wildland Fire Management Needs	$30,000 Avg. Per Project		http://www.federalgrantswire.com/wildland-fire-research-and-studies-program.html
9	Bureau of Reclamation	WaterSMART Programs (Water & Energy Efficiency Grants)	Increase Water Conservation & Efficiency	$20 Million / $1 million per project		http://www.usbr.gov/WaterSMART/weeg/index.html
10	Cabelas	Outdoor Fund	Conservation Programs			http://www.cabelas.com/category/Outdoor-Fund/112097880.uts
11	California Department of Conservation	California Farmland Conservancy Program	Agricultural Conservation Easements			http://www.conservation.ca.gov/dlrp/cfcp/Pages/Index.aspx
12	California Department of Conservation	Resource Conservation District Assistance Program		Currently Inactive (01/03/2014)		http://www.conservation.ca.gov/dlrp/RCD/Pages/Index.aspx
13	California Department of Conservation	Watershed Coordinator Grants Program	Watershed Improvements & Management			http://www.conservation.ca.gov/dlrp/wp/grants/Pages/wcgp_intro.aspx
14	California Dept. of Fish & Wildlife	Landowner Incentive Program	Habitat Management Plans that Benefit at-Risk Species			http://www.dfg.ca.gov/lands/lip/
15	California Dept. of Fish & Wildlife	Traditional Section 6 Species Recovery Program	Conserve & Recover Federally Threatened & Endangered Species by Focusing on Habitat Restoration			http://www.dfg.ca.gov/wildlife/grants/tradsec6/
16	California Dept. of Fish & Wildlife	Natural Community Conservation Planning Local Assistance Grants	Conservation Planning & Purchases of Vital Habitat for Threatened & Endangered Fish, Wildlife, & Plant Species			http://www.dfg.ca.gov/habcon/nccp/grants.html
17	California Dept. of Parks & Recreation	Land & Water Conservation Fund	Acquisition or Development of Recreation Areas & Facilities	50% Match	Annually	http://www.parks.ca.gov/?page_id=21360
18	California Dept. of Parks & Recreation	Habitat Conservation Fund	Acquisition or Development of Wildlife Corridors & Trails	$2 Million	Annually	http://www.parks.ca.gov/?Page_id=21361
19	California Dept. of Parks & Recreation	Statewide Park Program	Creation of New Parks and Recreation Facilities in Critically Underserved Communities	$368 Million		http://www.parks.ca.gov/?page_id=26025
20	California Dept. of Parks & Recreation	Recreational Trails Program	Recreational Trails & Trails Related	$1.47 Million; Max. Funding is 88% of Project	Annually	http://www.parks.ca.gov/?Page_id=24324
21	California Dept. of Parks & Recreation	Environmental Enhancement & Mitigation Program	Acquisition, Restoration, or Enhancement of Resource Lands	Currently Inactive (01/03/2014)		http://www.resources.ca.gov/eem/
22	California Dept. of Public Health	American Recovery & Reinvestment Act	Infrastructure Development for California's Drinking Water Systems	$20 Million Per Project		http://www.cdph.ca.gov/services/funding/Pages/ARRA.aspx
21	California Dept. of Water Resources	IRWMP Implementation Grant	IRWM Plan process developed water management projects	TBD, 25% Match	Round 3, Summer 2014 PSP	http://www.water.ca.gov/irwm/grants/implementation.cfm
22	California Dept. of Water Resources	IRWMP Prop 1E Stormwater Flood Management Grant	Projects designed to manage stormwater runoff to reduce flood damages consistent with IRWMP and the Basin Plan	Up to $30 Million Per Project, 50% Match	Future Round unknown	http://www.water.ca.gov/irwm/grants/stormwaterflood.cfm
23	California Dept. of Water Resources	Local Groundwater Assistance (LGA)	Groundwater studies or carry out groundwater monitoring and management actitivies	Up to $250,000. No Match	Future unknown	http://www.water.ca.gov/lgagrant/
24	California Dept. of Water Resources	Urban Streams Restoration Program	Reduce flooding and erosion & associated property damages; restore, enhance, or protect the natural ecological values of streams; & promote	Less than $1 Million	Spring 2014 PSP	http://www.water.ca.gov/urbanstreams/
25	California Dept. of Water Resources	FloodSAFE	Various programs: Delta Levee, Flood Control Sebventions, Flood Corridor, Flood Emergency Response and Local Levee Assistance	Varies	Varies	http://www.water.ca.gov/floodsafe/grants/
23	California Edison	Corporate Contributions	Environmental			http://www.edison.com/community/contribution_guidelines.asp

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP
INTEGRATED REGIONAL WATER MANAGEMENT PLAN
GRANT PROGRAMS AND FUNDING SOURCES

No.	Agency/Organization	Grant Program	Projects Funded	Available Funding	Recurrence	Website
24	California Infrastructure Bank	Infrastructure State Revolving Fund Program	Drainage, Water Supply & Flood Control, Environmental Mitigation Measures	$50,000 - $25 Million		http://www.ibank.ca.gov/infrastructure_loans.htm
25	Edison International	Environmental Giving Program	Environmental Sustainability	$2.7 Million		http://www.edison.com/community/programs.asp?id=7873
26	Environmental Protection Agency	Clean Water State Revolving Fund	Water Quality Protection Projects for Wastewater Treatment, Non-Point Source Pollution Control & Watershed Management	$5 Billion	Annually	http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm
27	Environmental Protection Agency	Drinking Water State Revolving Fund	Public Health Protection, Compliance with Drinking Water Standards, & Affordable Access to Drinking Water			http://water.epa.gov/grants_funding/dwsrf/index.cfm
28	Farm Services Agency	Water & Waste Disposal Direct Loans & Grants	Develop Water & Waste Disposal Systems in Rural Areas			http://www.rurdev.usda.gov/UWP-dispdirectloansgrants.htm
29	Farm Services Agency	Water & waste Revolving Fund Grant	Assist Communities with Water & Wastewater Systems			http://www.rurdev.usda.gov/UWP-revolvingfund.html
30	Federal Emergency Management Agency	Flood Mitigation Assistance Programs	Flood Mitigation Plans, & Implement Measures to Reduce Flood Losses	$120 Million		http://www.fema.gov/flood-mitigation-assistance-program
31	International Federation of Fly Fishers	Conservation Small Grants	Stream Access & Wild Fish Rescue	$1,500	Annually	http://www.fedflyfishers.org/Conservation/Programs/SmallGrants.aspx
32	National Fish & Wildlife Foundation	Five Star & Urban Waters Restoration Grant Program	Water Quality Issues in Priority Watersheds			http://www.nfwf.org/fivestar/Pages/home.aspx
33	National Fish & Wildlife Foundation	Sierra Nevada Meadow Restoration	Restore & Protect Meadows in the Sierra Nevada			http://www.nfwf.org/sierranevada/Pages/home.aspx
34	National Forest Foundation	Matching Awards Program	Conservation & Restoration Projects	1:1 Match	Annually	http://www.nationalforests.org/conserve/grantprograms/ontheground/map
35	National Forest Foundation	Wilderness Stewardship Challenge	Conservation Projects Benefiting National Forest Wilderness Areas	Match up to $50,000	Annually	http://www.nationalforests.org/conserve/grantprograms/ontheground/wilderness
36	National Forest Foundation	Ski Conservation Fund	Watershed Restoration, Recreation Enhancements, & Forest Projects		Annually	http://www.nationalforests.org/conserve/grantprograms/ontheground/scf
37	National Forest Foundation	Community Capacity & Land Stewardship	Watershed Restoration	$5,000 - $24,000	Annually	http://www.nationalforests.org/conserve/grantprograms/capacitybuilding/ccls
38	National Institute of Food & Agriculture	Foundational Program	Agriculture, Community Development, Natural Resources & Environmental	$82 Million		http://www.csrees.usda.gov/fo/foundationalprogramafri.cfm
39	National Science Foundation	Hydrologic Science	Studying Processes from Rainfall to Runoff to Infiltration & Streamflow	$10 Million	Annually	http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13684&org=ERE
40	Natural Resources Conservation Service	Conservation of Private Grazing Lands	Grazing Land Management & Conservation of Water	$47 Million for Technical Assistance		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/cpgl/
41	Natural Resources Conservation Service	Conservation Reserve Program	Establishing Conservation Practices	50% of Costs		http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp
42	Natural Resources Conservation Service	Conservation Technical Assistance	Opportunities, Concerns, & Problems Related to Natural Resource Projects	Technical Assistance		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/
43	Natural Resources Conservation Service	Environmental Quality Incentives Program	Establishing Conservation Practices that address various Natural Resource Concerns	Varies		http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ca/programs/?cid=nrcs144p2_063939
44	Natural Resources Conservation Service	Wildlife Habitat Incentive Program	Establish & Improve Fish & Wildlife Habitat	Technical Assistance & up to 75% Cost-Share Assistance		http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/whip/?cid=nrcs143_008423
45	Natural Resources Conservation Service	Watershed Protection & Flood Prevention Program	Watershed Planning			http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/wfpo/
46	Natural Resources Conservation Service	Emergency Watershed Protection Program	Projects that Address Watershed Impairments	75% of Construction Cost		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp/
47	Natural Resources Conservation Service	Farm & Ranch Lands Protection Program	Acquisition of Conservation Easements or Other Interests in Land from Landowners	50% of Fair Market Easement Value		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/farmranch/
48	Natural Resources Conservation Service	Grassland Reserve Program	Protection of Grassland, Enhancement of Plant & Animal Biodiversity, & Grazing Operations	Currently Inactive (01/03/2014)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/grassland/
49	Natural Resources Conservation Service	Healthy Forests Reserve Program	Restoring & Protecting Forests	Currently Inactive (01/03/2014)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
50	Natural Resources Conservation Service	Wetlands Reserve Program	Wetland Improvements	Currently Inactive (01/03/2014)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands/
51	Natural Resources Conservation Service	Conservation Security Program	Conservation & Improvement of Water	Currently Inactive (01/03/2014)		http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/alphabetical/csp/

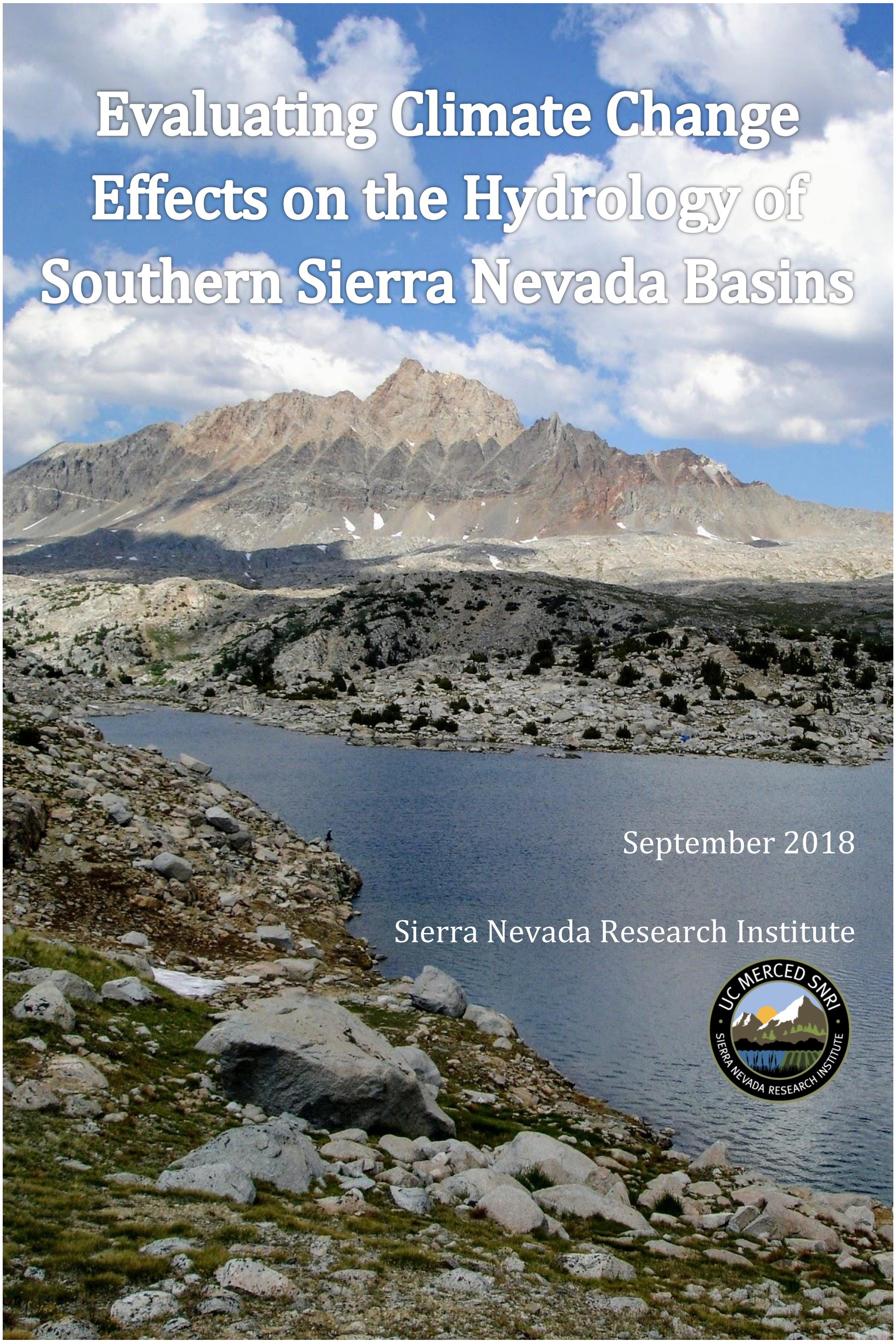
No.	Agency/Organization	Grant Program	Projects Funded	Available Funding	Recurrence	Website
52	Pacific Gas & Electric	Nature Restoration Trust	Restoration Projects that Benefit Wildlife	$30,000/ Request		http://www.nfwf.org/nrt/Pages/home.aspx
53	Pacific Gas & Electric	Community Investment Program	Projects Vary			http://www.pge.com/en/about/community/contributions/index.page
54	Patagonia	Corporate Contributions	Environmental	$12,000	Annually	http://www.patagonia.com/us/patagonia.go?assetid=2942
55	Regional Water Quality Control Boards	Supplemental Environmental Projects Regional Water Quality Improvement Projects Program	Various Environmental Projects			http://www.waterboards.ca.gov/rwqcb5/water_issues/enforcement/index.shtml
56	Resources Legacy Fund Foundation	California Water Foundation	Improving Water Management			http://www.californiawaterfoundation.org/page.php?id=32&menuid=94
57	Rotary Club of Auberry Intermountain	Charitable Foundation	Projects That Support Broad Goals of an Organization and Groups			http://auberryrotary.org/requests.php
58	Sierra Nevada Conservancy	Prop 84 Grant Program	Forest Management to increase Forest resilience , Enhance Water Supply & Quality	$350,000		http://www.sierranevada.ca.gov/other-assistance
59	Sloan Foundation		Various			http://www.sloan.org/apply-for-grants/grant-proposals/?L=ilbfnjfrwnqn
60	State Water Resources Control Board	Non-Point Source Grant Program	Water Quality Problems in Surface & Ground Water Resulting from NPS Pollution	$40 Million	Annually	http://www.waterboards.ca.gov/water_issues/programs/nps/grant_program.shtml
61	US Bureau of Indian Affairs	Numerous	Water and environmental resources projects on tribal reservations	Varies		http://www.federalgrants.com/Bureau-of-Indian-Affairs-Grant-23918.html
62	US Fish & Wildlife Service	North American Wetlands Conservation Act	Wetlands Conservation Projects	$75,000		http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm
63	US Fish & Wildlife Service	Wildlife Restoration Grant Program	Habitat Management, Species Restoration, & Land Acquisition			http://www.fws.gov/southwest/federal_assistance/wr.html
64	US Fish & Wildlife Service	Sport Fish Restoration Grant Program	Protect, Manage, & Restore Aquatic Habitats			http://www.fws.gov/midwest/wsfr/sfr.htm
65	US Fish & Wildlife Service	Clean Vessel Act Grant Program	Construction, Renovation, Operation, & Maintenance of Pump Out Stations & Waste Reception Facilities for Recreational Boaters			http://www.fws.gov/southwest/federal_assistance/cva.html
66	US Fish & Wildlife Service	State Wildlife Grant Program	Develop & Implement Programs that Benefit Wildlife & their Habitats			http://wsfrprograms.fws.gov/Subpages/GrantPrograms/SWG/SWG.htm
67	US Fish & Wildlife Service	Multistate Grant Program	Wildlife & Sport Fish Restoration	$6 Million	Annually	http://wsfrprograms.fws.gov/Subpages/GrantPrograms/MultiState/MS.htm
68	US Fish & Wildlife Service	Neotropical Migratory Birds Conservation Act	Conservation of Habitat for Hundreds of Neotropical Migratory Birds			http://www.fws.gov/birdhabitat/Grants/NMBCA/index.shtm
69	US Forest Service	Woody Biomass Utilization	Removal of Hazardous woody Biomass	Currently Inactive (01/03/2014)		http://www.fs.usda.gov/detail/r1/communityforests/?cid=stelprdb5339807
70	US Forest Service	Collaborative Forest Landscape Restoration Program	Achieve Ecological and Watershed Health	$40,000,000	Annually	http://www.fs.fed.us/restoration/CFLRP/
71	US Forest Service	Legacy Roads & Trails Restoration Program	Forest Service Roads that may be Contributing to Water Quality Problems in Streams & Water Bodies			http://www.fs.fed.us/restoration/Legacy_Roads_and_Trails/
72	Wildlife Conservation Board, State of California	Prop. 40	Wildlife Corridors & Landscapes, Public Access, Land Management	$89,000,000		https://www.wcb.ca.gov/FundingSources/Prop40.aspx
73	Wildlife Conservation Board, State of California	Prop. 50	Protect & Improve Regional Water Quality	$140,000,000	Continuously	https://www.wcb.ca.gov/FundingSources/Prop50/WaterCodeandFundingUses.aspx
74	Wildlife Conservation Board, State of California	Prop. 84	Water Quality & Supply, Flood Control	$823,855		http://bondaccountability.resources.ca.gov/p84.aspx
75	Wildlife Conservation Board, State of California	Prop. 1E	Flood Protection	$65,646		http://bondaccountability.resources.ca.gov/p1e.aspx

Note: Funding available is typically for a region, State or the entire Country. Only a portion of this funding would be available to the Southern Sierra Region.

Appendix M

Climate Change Study

Evaluating Climate Change Effects on the Hydrology of Southern Sierra Nevada Basins



September 2018

Sierra Nevada Research Institute

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SIERRA NEVADA RESEARCH INSTITUTE

Evaluating Climate Change Effects on the Hydrology of Southern Sierra Nevada Basins

A report for the Southern Sierra Integrated Regional Water Management Plan

September 2018

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Mohammad Safeeq
Roger C. Bales

Sierra Nevada Research Institute, University of California, Merced

Recommended Citation:
Bart RR, Safeeq M, Bales RC. 2018. Evaluating Climate Change Effects on the Hydrology of Southern Sierra Nevada Basins: A report for the Southern Sierra Integrated Regional Water Management Plan. Sierra Nevada Research Institute, University of California, Merced.

Cover Photo: Muriel Lake & Mount Humphries, San Joaquin River Basin

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

The Southern Sierra Regional Water Management Group (RWMG) develops strategic, collaborative approaches to managing water in the Southern Sierra in order to achieve social, environmental and economic objectives of local stakeholders [*CDWR*, 2013]. Through the implementation of water management programs, the Southern Sierra RWMG is able to provide support for sustainable water use, flood management, improved water quality, groundwater recharge, healthier forests, environmental restoration, protection of agriculture and economy benefits across watershed and jurisdictional boundaries. This report evaluates climate change effects on the hydrology of Southern Sierra RWMG Region and has been developed in support of the 2018 update to the Southern Sierra Integrated Regional Water Management Plan (SSIRWMP).

The Southern Sierra RWMG boundary includes the headwaters of the major rivers draining the western side of the Southern Sierra that discharge into the southern San Joaquin Valley, including the San Joaquin River, Kings River, Kaweah River, Tule River, Deer Creek, White River, Poso Creek and Kern River (Figure 1). The Regions eastern boundary begins at the Sierra Crest; the Regions western boundary extends to the Sierra foothills. Reservoirs at the Sierra foothills capture much of the streamflow that flows out of the watersheds and that water is frequently diverted to support downstream urban and agriculture needs.

The Southern Sierra Region has a Mediterranean-type climate. Most precipitation occurs during the winter season while summers are exceptionally dry. The high topographic relief of the Region, which stretches from the Sierra foothills to the tallest peak in the contiguous U.S., Mount Whitney, produces strong orographic effects on precipitation and historically a large proportion of high elevation precipitation occurs as snowfall. The snowpack that forms at high elevations acts as a natural reservoir that stores winter precipitation for release to streamflow during the spring and summer periods. Year-to-year variability in California is extremely large, with annual precipitation ranging by an order of magnitude across some areas. More recently, the Southern Sierra Region experienced the most extreme drought on record from 2012-2016. The drought was followed by one of the wettest years on record in 2017.

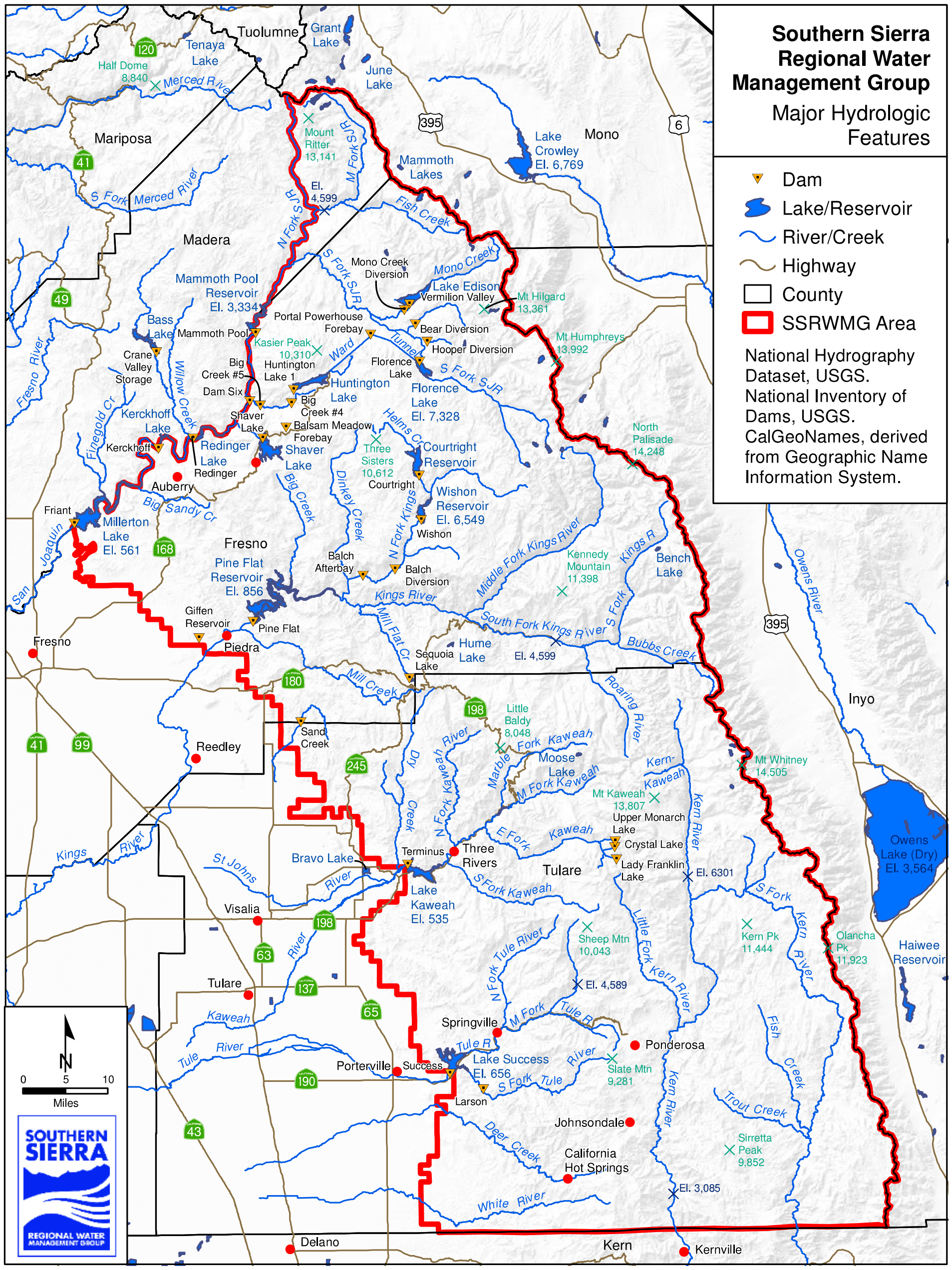

Figure 1: Map of the major hydrologic features of the Southern Sierra Regional Water Management Group.

The large elevational range of the Southern Sierra Region contributes to high ecological diversity in the Region. A spectrum of ecological zones exists, from grasslands and shrublands to montane and subalpine forests to tundra, as elevations increase. These vegetation types have an important role in controlling evapotranspiration (ET), which affects both streamflow and groundwater recharge. Vegetation in the Southern Sierra Region is increasingly in transition, as larger and more severe wildfires, in combination with unprecedented forest mortality during the recent drought, are increasing the potential for vegetation type conversion.

Management of water resources in the Southern Sierra Region has many stakeholders with different needs and a complicated biophysical environment that is not fully understood. The boom and bust nature of precipitation in California also makes it necessary to plan for widely disparate conditions to meet water demands. Climate change compounds each of these challenges and its effects are already being observed in the Southern Sierra Region. Temperatures over the past decade have been the highest on record, contributing to the extensive forest mortality and the severity of recent wildfires. Sierra snowpacks are getting smaller and melting earlier, contributing to higher winter flows and smaller summer flows. These processes have a direct impact on the water resources of the Region. As the 21st century progresses, further climate change will transform the way that water resources need to be managed in California. Yet not enough is known about how water resources will be altered to adequately adapt and reduce water resource vulnerabilities.

The objective of this report is to improve understanding of how climate change will affect hydrology and water resources in the Southern Sierra Region. Three research questions will guide the narrative. 1) How is the climate in the Southern Sierra Region expected to change throughout the 21st century? 2) How will changes in climate directly impact hydrology in the Region? 3) How will climate change alter vegetation and vegetation disturbances in the Region and how will these changes further affect the Regions hydrology. The California Department of Water Resources funded this report through a grant to the Sierra Nevada Research Institute at the University of California, Merced.

CHAPTER 2: CHANGES IN CLIMATE FOR THE SOUTHERN SIERRA REGION

An increase in global atmospheric greenhouse gas concentrations is contributing to higher temperatures in California [*Office of Environmental Health Hazard Assessment*, 2018]. As greenhouse gas concentrations continue to rise, further changes to California's climate are anticipated, with additional effects on California's water resources, ecosystems, and economy. The extent of these effects will depend on the ultimate level and timing of peak greenhouse gas concentrations. Under the Paris Climate Accord in 2015, a framework was established for limiting the rise in global temperatures under two degrees Celsius. In California, policies have been put in place to reduce greenhouse gas emissions to at least 40% and 80% below 1990 levels by 2030 and 2050, respectively [*California Air Resources Board*, 2017]. These policies will help to moderate increases in temperature but uncertainty remains regarding how high greenhouse gas concentrations will be in the future.

In this section, we analyze how climate has changed in the recent past and how it is projected to further change in the Southern Sierra Region.

Approach

Global climate models (GCMs) are mechanistic models used to understand and predict how changes in variables such as greenhouse gas concentrations will affect future climate at global scales. GCMs are developed and maintained by numerous research groups around the world, with each group using a slightly different approach to modeling the underlying atmospheric physics. The 5th Coupled Model Intercomparison Project (CMIP5) is a coordinated experiment to simulate each GCM using the same forcing inputs (i.e. greenhouse gas concentrations). This project permits the comparison of output between different GCMs, providing an estimate of the uncertainty in climate projections. As future concentrations are unknown, CMIP5 uses four different scenarios, or Representative Concentration Pathways (RCPs), to force the models [*van Vuuren et al.*, 2011]. The four RCPs, RCP2.6, RCP4.5, RCP6.0, and RCP8.5, represent different levels of greenhouse gas emissions and accumulated concentrations in the atmosphere. The four pathways roughly equate to aggressive, moderate, little and no action being taken to reduce greenhouse gas emissions, respectively.

Spatial output from individual GCMs is generally greater than 100km by 100km, making it difficult to directly apply GCM results to heterogeneous areas such as the Southern Sierra Region, which is topographically, climatically, ecologically and hydrologically variable. Instead, output from GCMs must be downscaled, or transformed to a higher resolution, in order to be analyzed at a regional scale. Two commonly used approaches for downscaling are dynamic and statistical. Dynamic downscaling involves running high-resolution, regional mechanistic models using low resolution GCM output as the driving data. Alternatively, statistical downscaling consists of developing statistical relationships between local-scale climate variables and large-scale climate variables that can be modeled by GCMs [*Abatzoglou and Brown*, 2012].

For this study, the Multivariate Adaptive Constructed Analogs (MACA) downscaled climate dataset, generated from by Abatzoglou and Brown [2012], was used to examine temperature and precipitation changes in the Southern Sierra Region. This dataset has a resolution of 1/24th degree (~4 km) and provides monthly projections. The MACA projections have an improved spatial resolution compared to other downscaled projection product (e.g. Pierce et al. [2014]). Climate forcings for MACA were derived from statistical downscaling of CMIP5 GCM data. An ensemble of six downscaled climate projections were used in the analysis, including the CanESM2, CCSM4, CNRM-CM5, HadGEM2-CC365, HadGEM2-ES365, and MIROC5 GCM models. Three periods were compared in the analysis, a baseline period from 1950-2005, a mid 21st century projection from 2040-2069 and a late 21st century projection from 2070-2099. Two RCP scenarios were examined, the RCP4.5 moderate scenario and the RCP8.5 business-as-usual scenario.

<u>Temperatures</u>

Temperatures throughout California and the Sierra Nevada are increasing. Over the period from 1918 to 2006, maximum and minimum temperatures in California rose an average of 0.07°C and 0.17°C per decade, respectively [*Cordero et al.*, 2011]. These trends have accelerated since 1970 [*Cordero et al.*, 2011] and particularly during the past decade, with the four hottest years on record occurring between 2014-2017 [*Office of Environmental Health Hazard Assessment*, 2018]. These increases in temperature are consistent with climate projections and indicate that California is already seeing the effects of climate change. In the Sierra Nevada, significant warming has also been observed, although the increases have been smaller than for California as a whole (0.08 and 0.21°C per decade for maximum and minimum temperatures, respectively) [*Cordero et al.*, 2011]. For both the Sierra Nevada and California, nighttime temperatures have been rising faster than daytime temperatures.

California temperatures are projected to continue to increase during the 21st century. Using downscaled CMIP5 GCM projections, He et al. [2018] estimated that California temperatures would increase between 1.8 and 2.0°C by mid-century and 2.2 to 2.4°C by the end of the century, even under the optimistic RCP4.5 scenario. Slightly higher estimates are projected for the Southern Sierra Region. For RCP4.5, mean annual maximum temperatures are projected to increase 2.5°C by mid-century (2040-2069) and 3.3°C by the end of the century (2070-2099) (Figure 2 & 3). Under the RCP8.5, temperatures are projected to increase 3.4°C and 5.2°C, respectively, over the same time periods. Mean annual minimum temperatures in the Southern Sierra Region are projected to increase 2.3°C (2040-2069) and 2.9°C (2070-2099) under the RCP4.5 scenario and 3.1°C (2040-2069) and 5.0°C (2070-2099) under RCP8.5. All of these finding indicate that temperatures in the Southern Sierra Region are going to substantially increase in the future. Further, projections indicate that maximum temperatures will increase more than minimum temperatures. These changes run counter to currently observed temperature increases in California, where minimum temperatures are increasing faster than maximum temperatures. However, He et al. [2018] has reported similar findings throughout California.

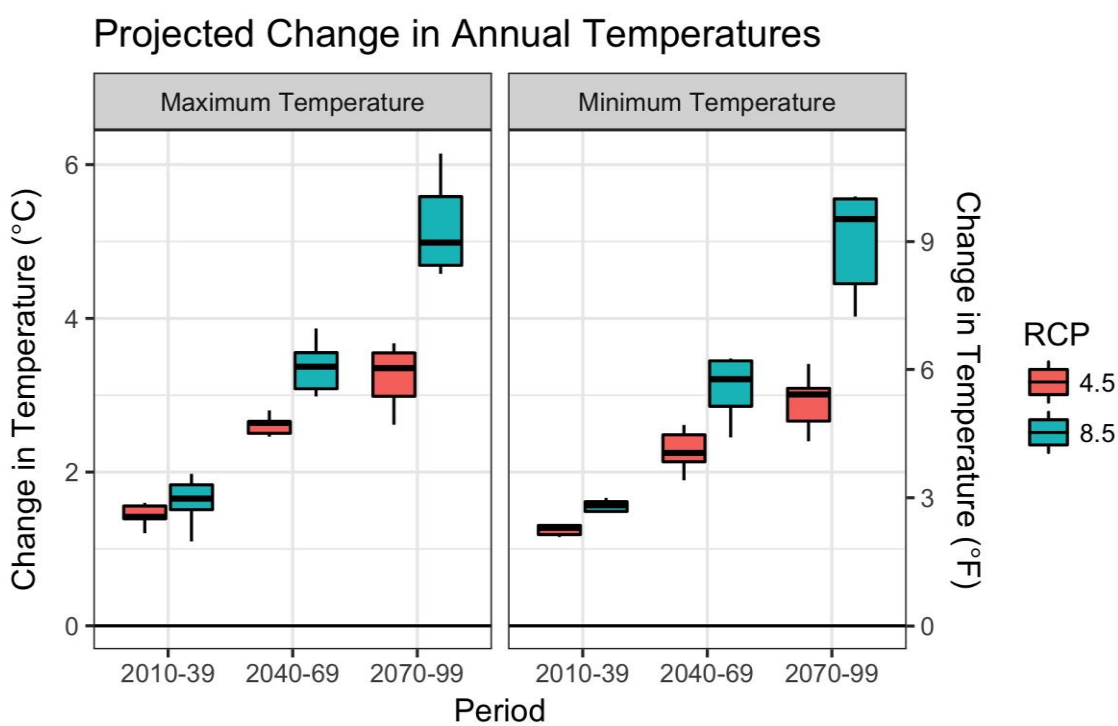

Figure 2: Projected changes in mean annual temperatures for the Southern Sierra Region, relative to 1950-2005 baseline. Variability in projections represents different

GCMs. Historical baseline values of maximum and minimum mean annual temperatures are 15.4°C and 2.2°C, respectively.

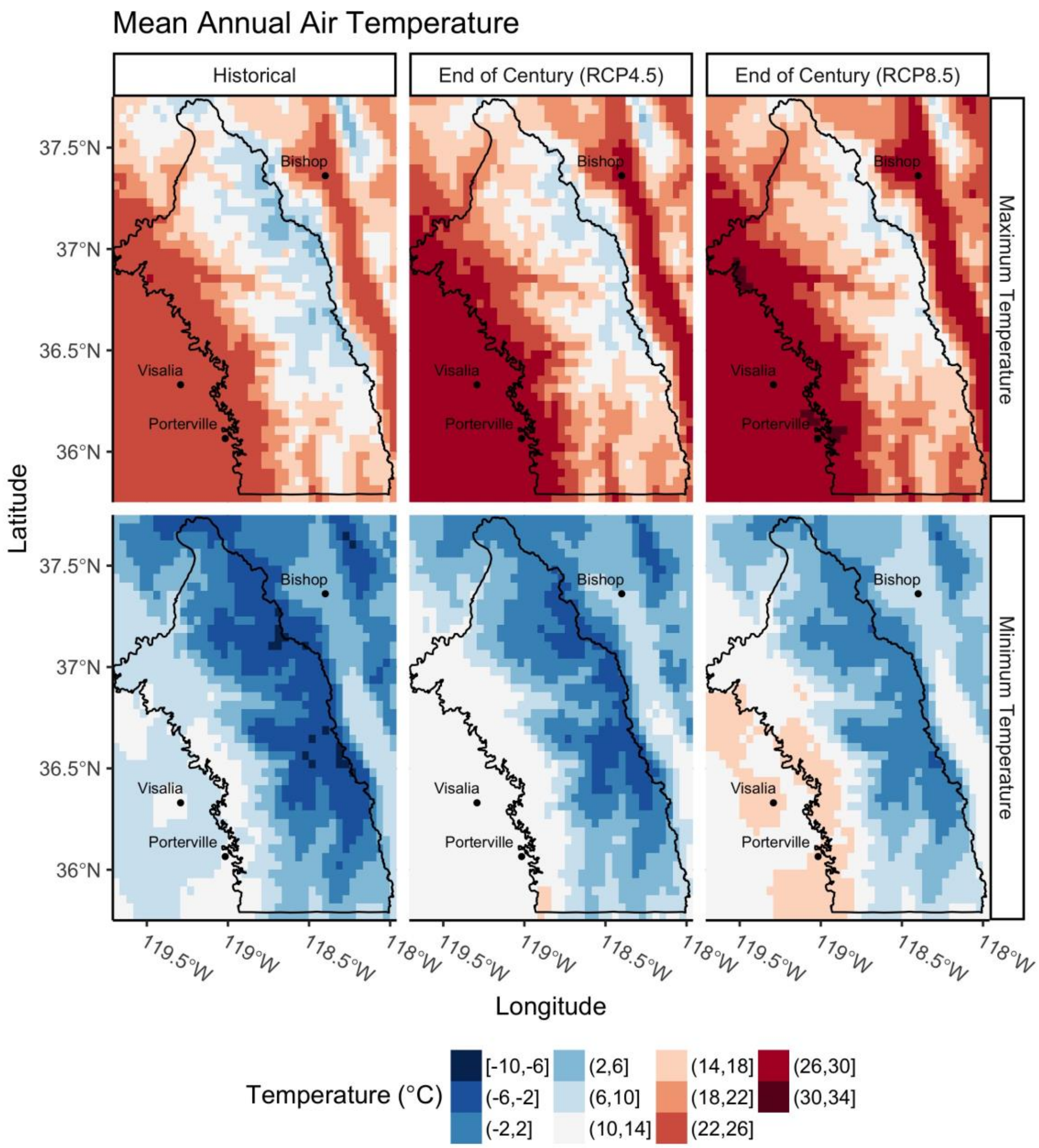

Figure 3: Map of mean annual maximum and minimum temperatures under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

Projected increases in temperatures are expected to vary seasonally in the Southern Sierra Region. Increases in winter (Jan-Feb-Mar) maximum temperatures are projected to be slightly smaller than seasonal maximum temperatures during the remainder of the year (Figure 4). While winter maximum temperatures will still be well above historical baseline levels, the relatively smaller increases may aid in snowpack accumulation. However, this will be counterbalanced by relatively larger increases in maximum temperatures during the non-winter months, which will increase evaporative demand, decrease soil moisture and increase forest water stress. For seasonal minimum temperatures, the summer (Jul-Aug-Sep) season is projected to show the largest relative increase in temperature (Figure 5).

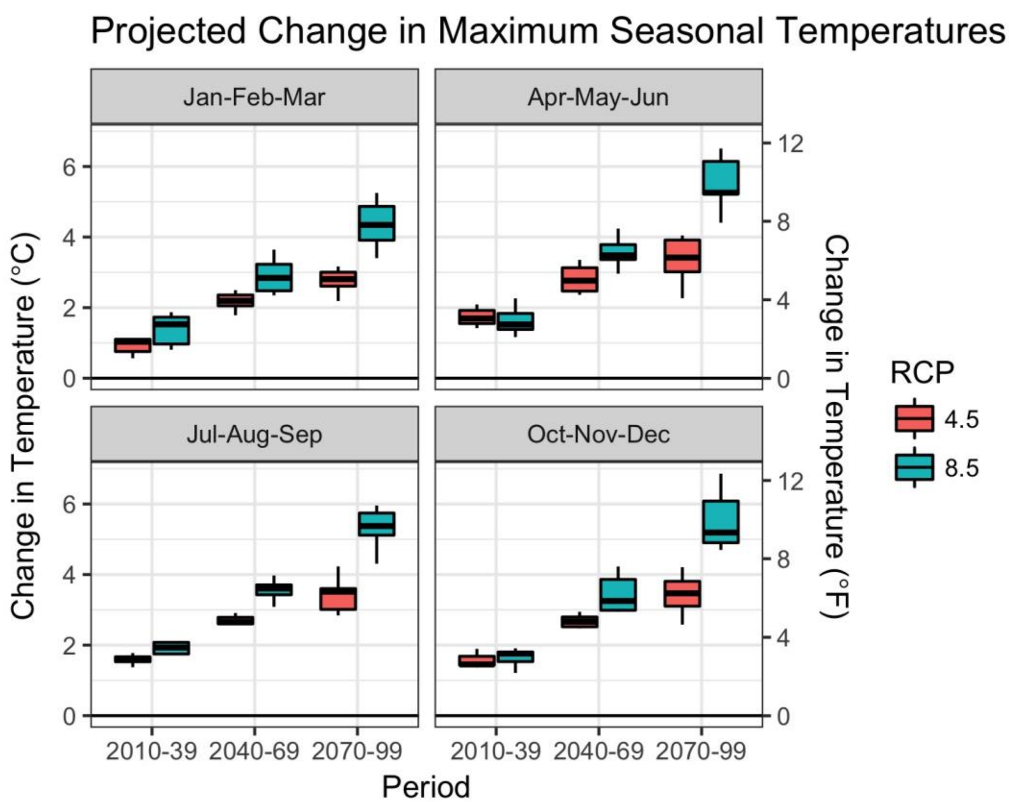

Figure 4: Projected changes in maximum mean seasonal temperatures for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline values of maximum mean seasonal temperatures are 8.3°C, 17.4°C, 24.4°C and 11.5°C for Jan-Feb-Mar, Apr-May-Jun, Jul-Aug-Sep, and Oct-Nov-Dec, respectively.

The frequency of heat waves, which are defined as when daily maximum and minimum temperatures exceed a respective percentile threshold, are projected to increase in California [*Diffenbaugh and Ashfaq*, 2010; *Gershunov and Guirguis*, 2012]. Gershunov and Guirguis [2012] found that both humid nighttime heat waves and dry daytime heat waves will increase with climate change in California, though they note the former is expected to increase more intensely. Extreme heat waves are well-documented to have an adverse affect on ecosystems, agriculture and human health [*Meehl and Tebaldi*, 2004]. It will be important for communities within the Southern Sierra Region to take precautions to protect vulnerable populations during extreme heat waves [*Guirguis et al.*, 2013].

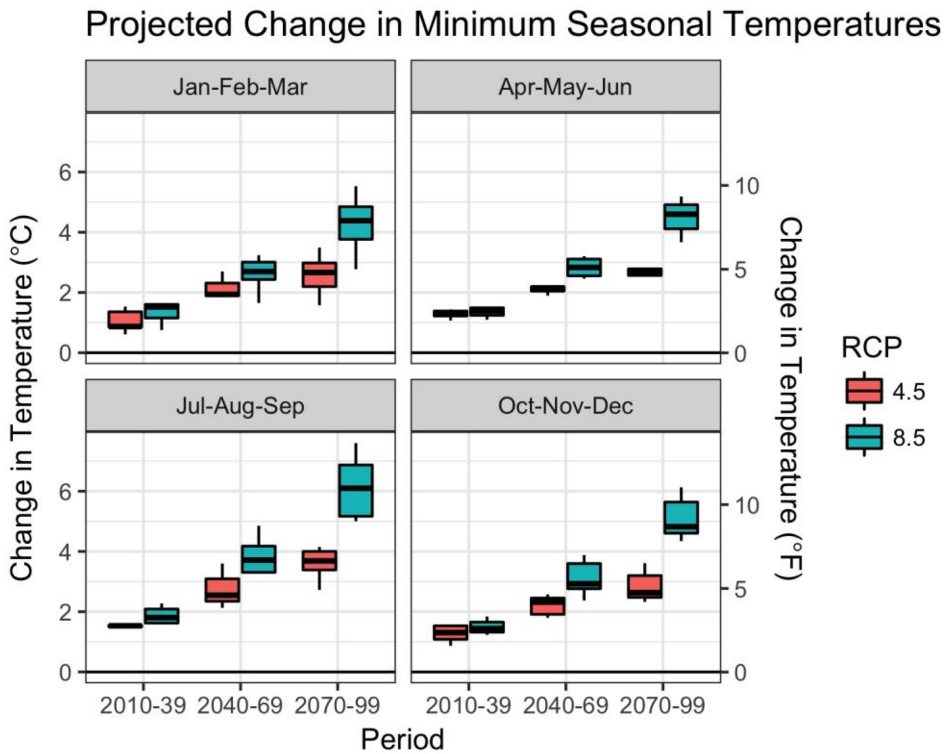

Figure 5: Projected changes in minimum mean seasonal temperatures for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline values of minimum mean seasonal temperatures are -3.6°C, 3.5°C, 9.6°C and -0.7°C for Jan-Feb-Mar, Apr-May-Jun, Jul-Aug-Sep, and Oct-Nov-Dec, respectively.

Increases in temperature are a primary driver behind many of the other climate change related effects that are documented in the remainder of this section. For example, changes in snowpack, streamflow timing, forest vulnerability, wildfire, and bark beetles are each influenced by increases in temperature. Hence, temperature can be considered a key metric for accurately predicting how climate change will affect the Southern Sierra Region.

<u>Precipitation</u>

Precipitation in California exhibits Mediterranean-climate characteristics, with most precipitation falling during the winter season (November to March) while the remainder of the year is dry. Precipitation in California is also highly variable, with inter-annual variability being the highest in the U.S and annual precipitation totals varying by up to an order of magnitude [*Dettinger et al.*, 2011]. This variability is partly due to atmospheric rivers constituting a substantial fraction (20% to 50%) of the total annual precipitation in California [*Dettinger et al.*, 2011]. Since California receives relatively few atmospheric river events in a given year, a swing of a few more or less storms during a wet season can produce large differences in total precipitation.

Downscaled GCM climate projections for California have generally indicated minimal changes in annual precipitation under future warming scenarios [*Hayhoe et al.*, 2004]. For the recent CMIP5 GCM projections, He et al. [2018] found that projected annual precipitation ranged from +50% to -25% depending on the individual GCM/scenario investigated. Collectively however, the models showed small increases in precipitation (1% - 11%) across different regions of California under the RCP4.5 scenario. Similar changes in precipitation are projected for the Southern Sierra Region. The average increase in annual precipitation among all the downscaled models was 5%-10% for the Southern Sierra Region, although the variability in the projections encompasses both positive and negative changes in annual precipitation (Figure 6 and 7).

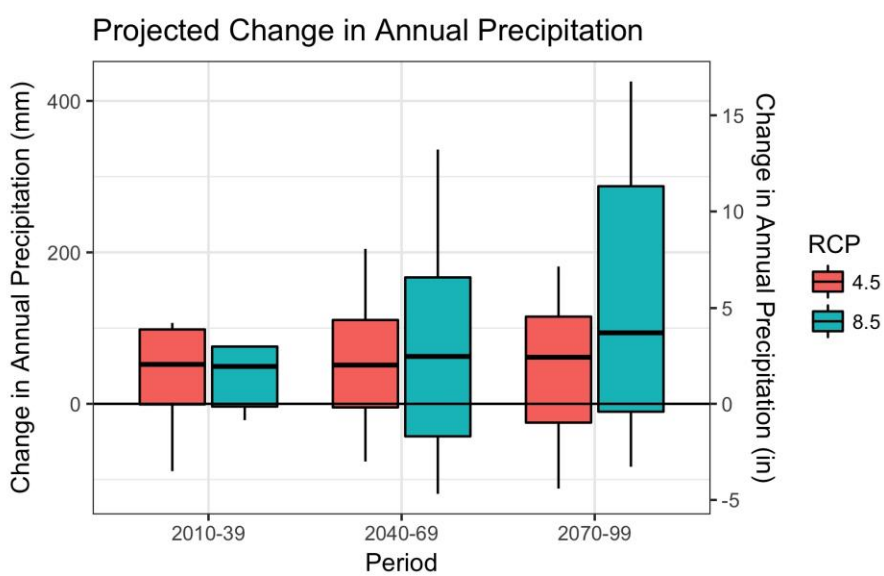

Figure 6: Projected changes in annual precipitation for the Southern Sierra Region. Variability in projections represents different GCMs. Historical baseline annual precipitation is 819 mm/year (32 in/year).

Although the average amount of precipitation in the Southern Sierra Region is projected to only slightly increase with climate change, there is mounting evidence that inter-annual variability of precipitation will substantially increase, with dry years becoming drier and wet years becoming wetter [*Pendergrass et al.*, 2017].

Berg and Hall [2015] have reported that by the end of the century, extremely dry years will become 1.5 - 2 times more frequent and extremely wet years will become 3 times more frequent, with the number of average years becoming more scarce. Climate change will also increase year-to-year volatility swings. Swain et al. [2018] report that transitions from extreme drought to extremely wet conditions, such as was observed from the 2012-2016 drought to the wet 2016/2017 winter, is projected to increase 25% to 100% by the end of the century.

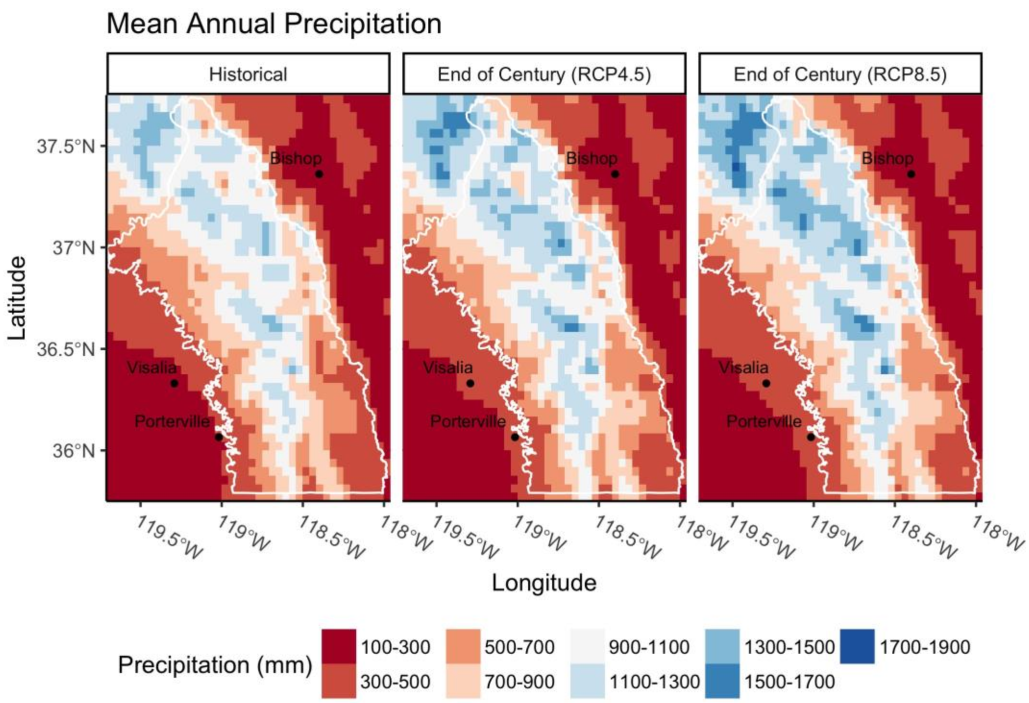

Figure 7: Map of mean annual precipitation under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

This increase in precipitation extremes will make management of water resources in the Southern Sierra Region more challenging. Excess precipitation during wet years frequently cannot be stored in reservoirs due to flood risks. Flood risks in the Southern Sierra Region are also increasing due to precipitation shifts from snow to rain. An increase in extremely wet years will only exacerbate this problem. On the other hand, a greater number of very dry years will stretch water supplies in the Southern Sierra Region and the San Joaquin Valley as a whole.

<u>Snowfall</u>

Snowpack in the Southern Sierra Region is being affected in numerous ways as temperatures increase in California. Foremost, a larger proportion of precipitation is falling as rain than as snow. This effect is most pronounced near the rain-snow transition zone, as this zone is particularly sensitive to temperature changes since winter temperatures hover near the freezing point. Increasing temperatures cause the rain-snow transition zone to migrate upslope and produce a smaller snow footprint. Throughout the western U.S., the areal extent of historical snowfall area is expected to decrease by an average of 30% under RCP8.5 scenarios [*Klos et al.*, 2014]. For the Southern Sierra Region, the amount of area that is predominately snowfall-driven, defined as locations where the probability of snowfall compared to rainfall is greater than 90%, is projected to decrease by approximately 50% by the mid 21st century under a RCP 8.5 scenario (Figure 8).

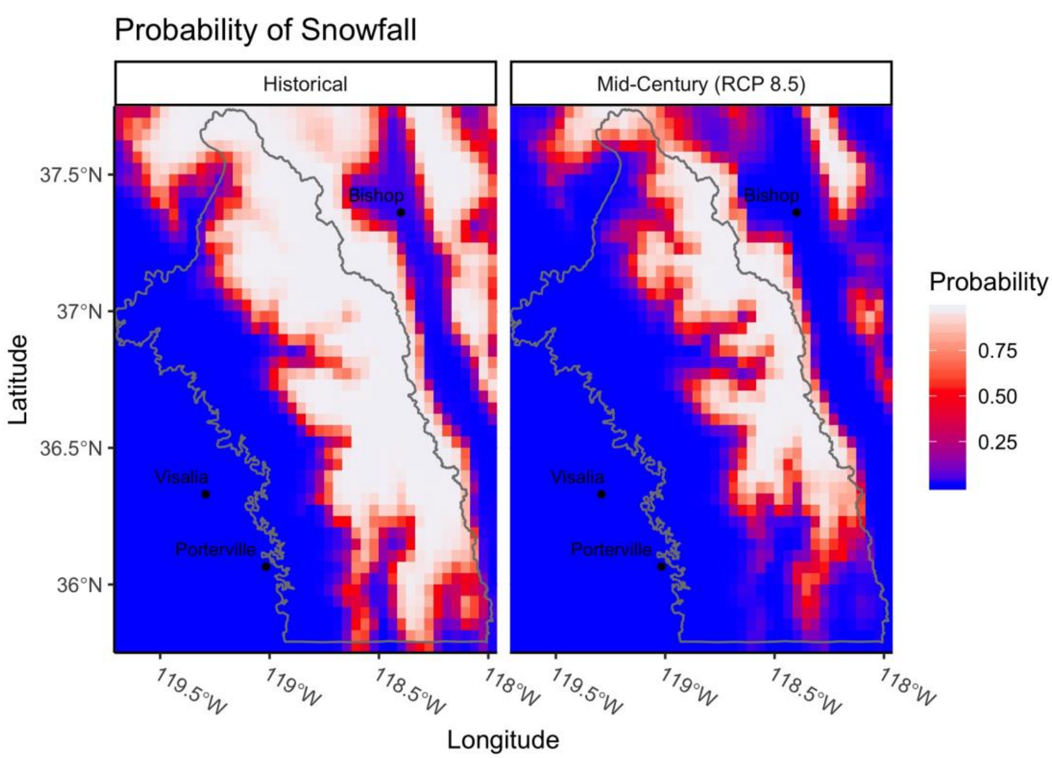

Figure 8: Map of the probability of snowfall compared to rainfall for the Southern Sierra Region under two scenarios: Historical (1979-2012) and Mid-Century (2035-2065) RCP8.5 using a 20-model GCM mean. Blue indicates areas of predominately rainfall, white is predominately snowfall and red is the rain-snow transition zone. Data from Klos et al. [2014].

<u>Drought</u>

Due to high precipitation variability, California has always been subject to multi-year droughts, where precipitation totals fall well below normal. However, the recent multi-year drought and projected future droughts are different because periods of low precipitation are more likely to coincide with periods of high temperatures, increasing atmospheric water demands and making conditions drier. It was this combination, very little precipitation and record high temperatures, that contributed to the severity of the California drought [*Shukla et al.*, 2015]. As temperatures continue to rise, drought risk is predicted to become even more severe in the future even in the absence of precipitation change [*Cook et al.*, 2015].

For the Southern Sierra Region, the magnitude of droughts under climate change will depend on how dry conditions are, how warm conditions are, and over how many years these conditions persist. In a recent study, He et al. [2018] used a drought index, the Standardized Precipitation-Evapotranspiration Index (SPEI), to investigate changes in future drought severity in California. They found that in the Tulare region of California, which encompassed most of the Southern Sierra Region, that the severity of droughts would increase throughout the century, indicating that small increases in precipitation for the region would not offset the effects of higher temperatures.

CHAPTER 3: DIRECT EFFECTS OF CLIMATE CHANGE ON HYDROLOGY IN THE SOUTHERN SIERRA REGION

This section examines how hydrology in the Southern Sierra Region will be directly altered by climate change, independent of changes in vegetation.

Approach

GCM's provide projections of atmospheric variables such as temperature and precipitation. However, in order to understand how climate change will affect hydrology in the Southern Sierra Region, a hydrologic model is needed that uses GCM output variables as inputs. For this study, downscaled temperature and precipitation projections for the Southern Sierra Region were used as inputs into the Variable Infiltration Capacity (VIC) hydrologic model [*Liang et al.*, 1994]. VIC is a daily, semi-distributed model that operates at large scales, typically 1-km^2. Each cell within VIC is modeled independently, with no water transfer between cells, although streamflow can be routed separately through a channel network. The model statistically accounts for sub-grid heterogeneity in variables such as vegetation cover, soils and elevation. Hydrologic processes simulated in VIC include interception, evaporation, transpiration, infiltration, soil moisture and snowpack. Evaporation and transpiration are calculated using Penman-Monteith while snowpack takes into account snowfall, energy balance and temperature. For this study, VIC used the temperature and precipitation outputs from the six individual GCM models as inputs and run over the same periods as the GCM data, a baseline run from 1950 to 2005 and GCM projected conditions (RCP4.5 and RCP8.5) from 2007 to 2099. This latter simulation was further divided for analysis into a mid-century 2040-2069 period and a late century 2070-2099 period. Snowpack and ET were simulated across the entire Southern Sierra Region, however a detailed analysis of the effects of climate change on watershed hydrology was conducted specifically for the Kings River watershed, a major river in the central part of the Southern Sierra Region.

Evapotranspiration

Mean annual evapotranspiration (ET) in the Southern Sierra Region is expected to increase with higher temperatures (Figure 9). This is due to a combination of factors. First, higher temperatures lead to an increase in evaporative demand, which increases the rate of evaporation. Higher temperatures may also increase the rate of vegetation transpiration, though vegetation can moderate transpiration rates via leaf stomatal control when water stressed. Second, higher temperatures promote an earlier start to the growing season in the Southern Sierra Region. Since this early growing period (late winter to late spring depending on elevation) also coincides with the end of the wet season, the vegetation is able to exploit more available water. Overall, a higher proportion of precipitation will be partitioned to annual ET in the Southern Sierra Region under climate change, with less water being available for streamflow.

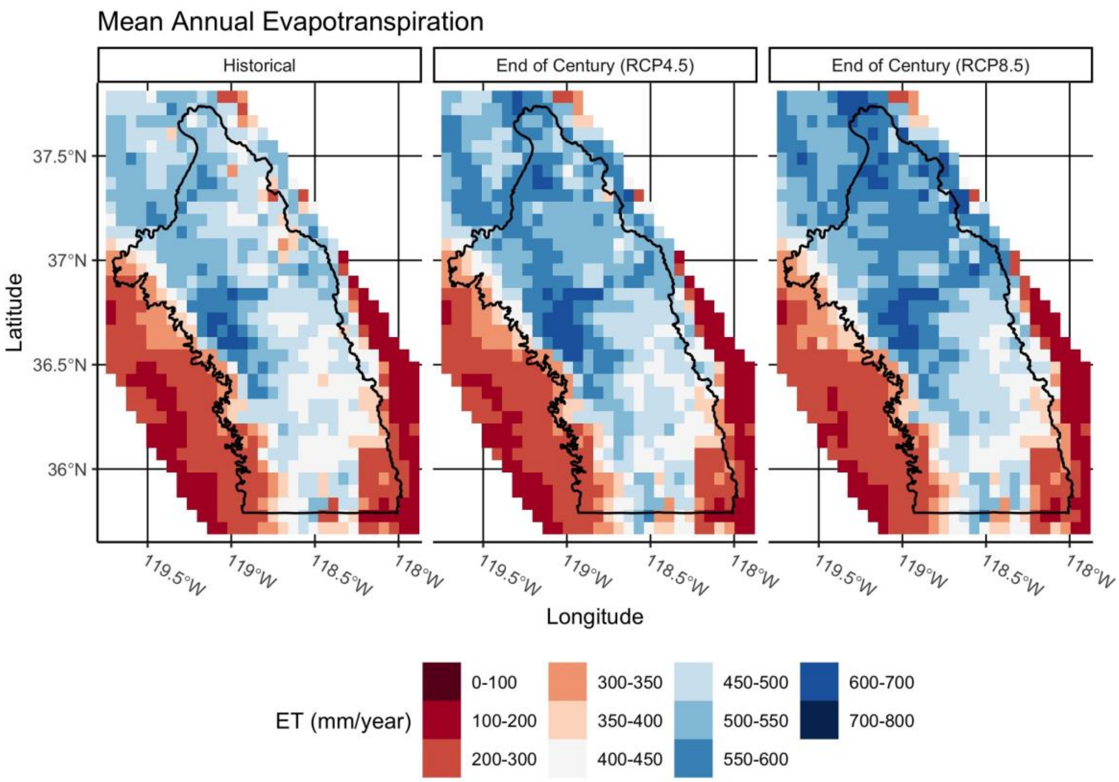

Figure 9: Map of mean annual evapotranspiration (ET) in the Southern Sierra Region under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

The seasonality of ET is projected to change with higher temperatures in the Southern Sierra Region. As previously mentioned, ET rates will increase during the winter (Jan-Feb-March) and the spring (April, May, June) periods (Figure 10). However, this early-season use of water produces corresponding shortages during the summer, resulting in decreased ET during those months. This shift in the timing of water availability will increase water stress for vegetation in the Southern Sierra Region as the length of time when vegetation transpire is limited becomes longer.

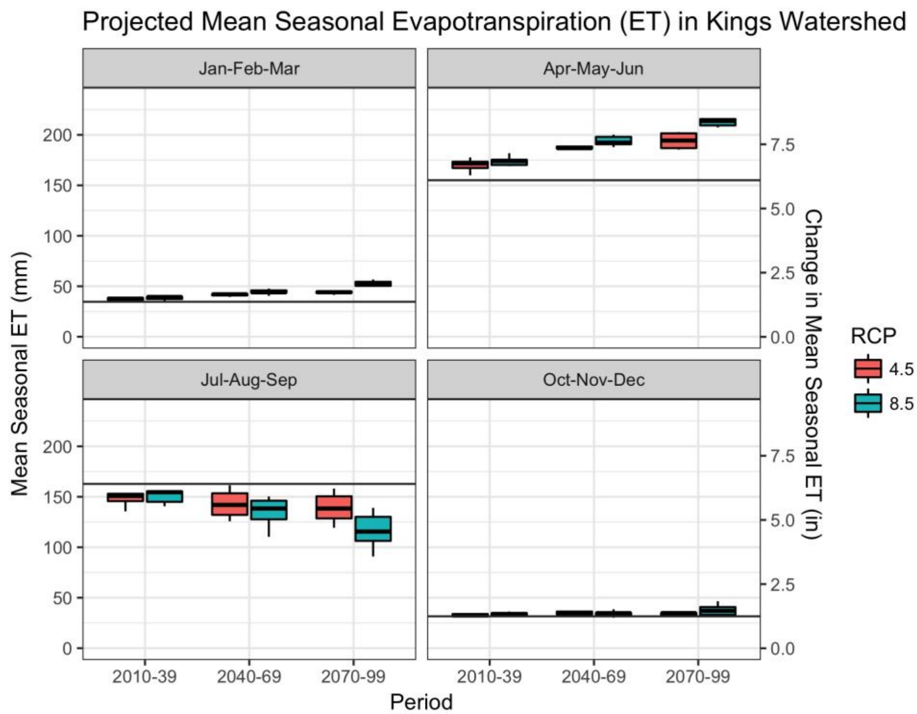

Figure 10: Projected mean seasonal evapotranspiration (ET) for the Kings River Watershed in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey lines represent historical mean seasonal ET.

<u>Snowpack</u>

Winter snowpack will persist for a shorter period of time with climate change. This is partly due to less snow accumulation and partly due to more rapid snowmelt. Projections for the western U.S. suggest that the snow-covered period may decrease by 25 days/year by the mid-century under RCP8.5 [*Naz et al.*, 2016]. A more transient snowpack will also have implications for the measurement of snow water equivalent (SWE) on April 1st, the traditional date when the snowpack is measured for forecasting spring streamflow. Naz et al. [2016] project that April 1 SWE may decrease by 50% by mid-century across the western U.S. (RCP8.5). Further, a study by Young et al. [2009] found that the greatest reduction in snowpack would be at mid-elevations between 1750-2750m.

Results from the VIC model indicate that for the Kings River watershed, snowpack is projected to decrease during all months, with the greatest decreases being observed during the early spring months (e.g. March, April, May) (Figure 11). These changes will have considerable implications for water resources. In the Southern Sierra Region, snowpack accumulation during the winter wet season acts as a water reservoir that is slowly released as temperatures warm throughout the spring and summer. Reductions in this reservoir will complicate water resource management in the Region and will likely necessitate that alternative storage solutions be found such as groundwater banking.

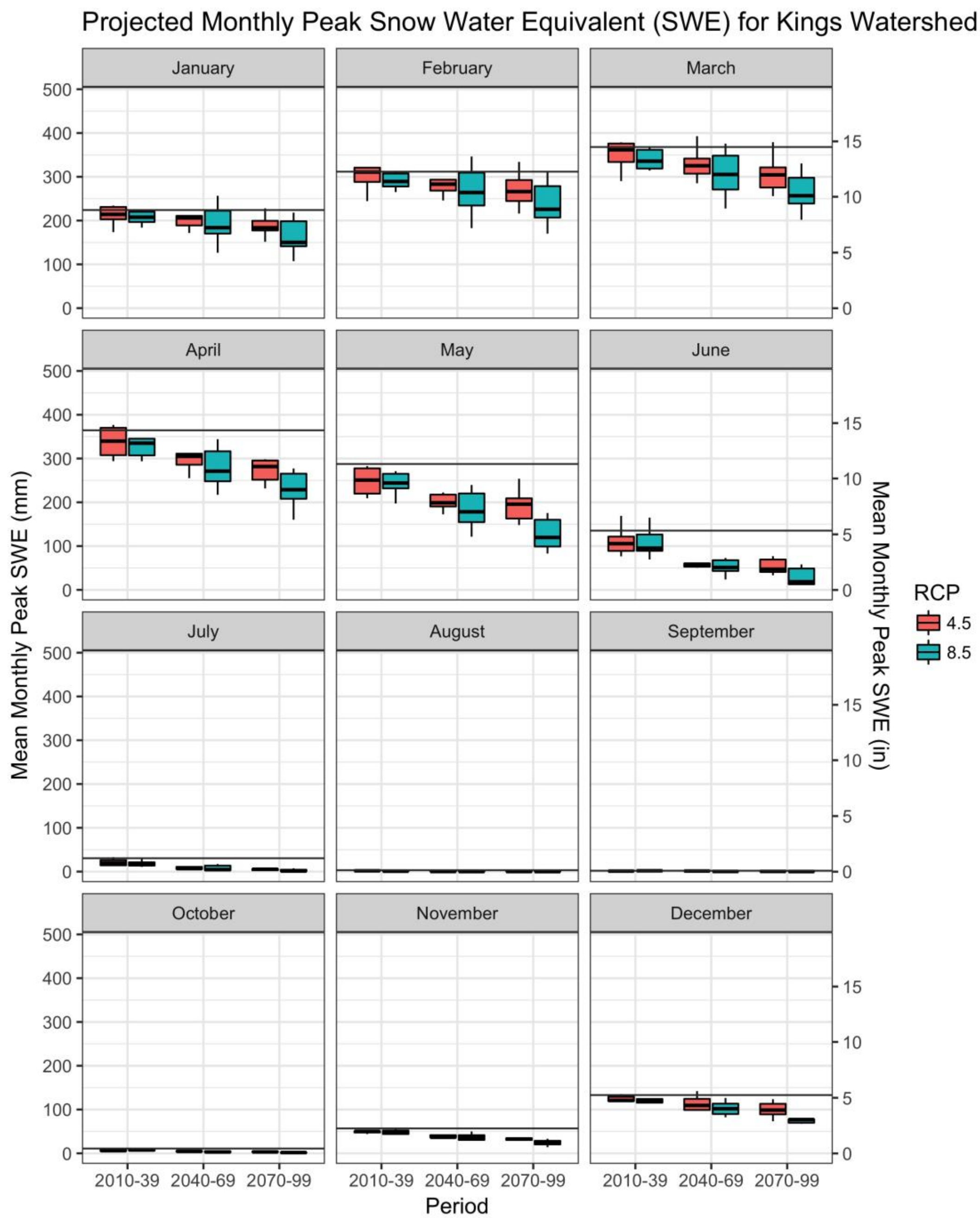

Figure 11: Projected mean monthly peak snow water equivalent (SWE) for the Kings River Watershed in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey lines represent historical mean monthly peak SWE.

Spatially, the areas within the Southern Sierra Region that are most vulnerable to changes in snowpack lie at lower elevations (Figure 12). In particular, locations near the current rain-snow transition zone are likely to become mostly snow free by the end of the century.

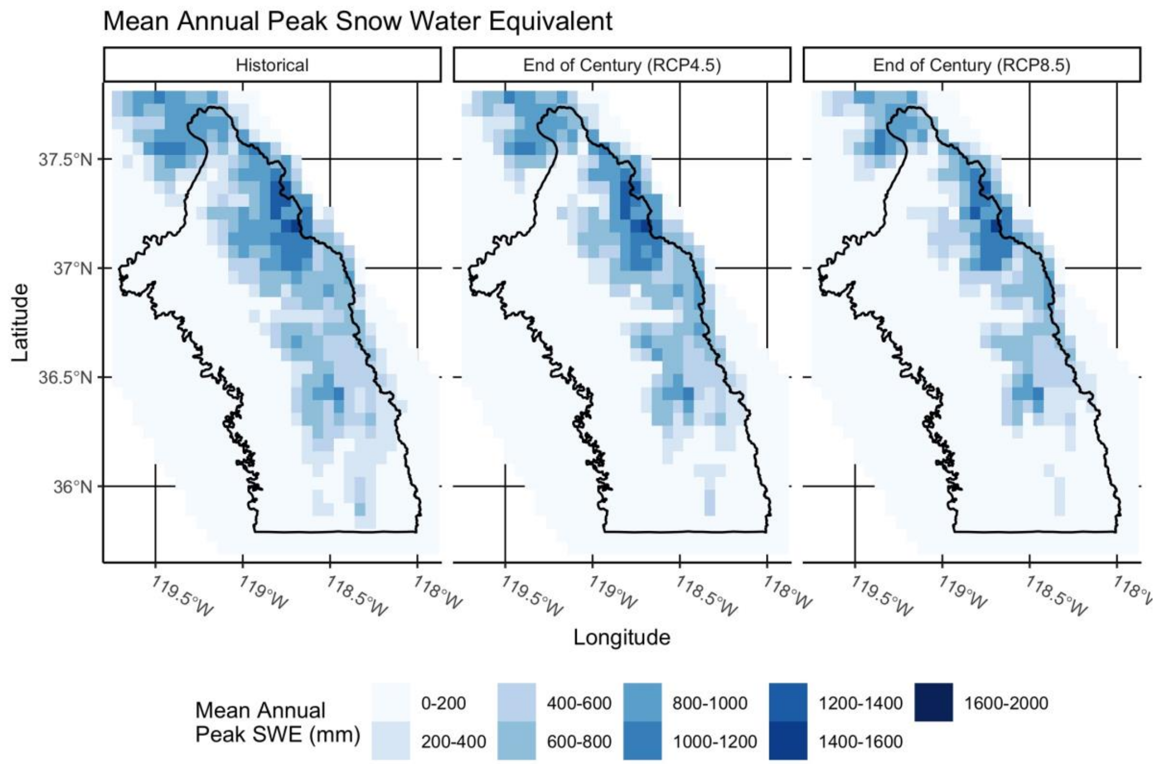

Figure 12: Map of mean annual peak snow water equivalent (SWE) in the Southern Sierra Region under three scenarios: Historical, End of Century (2070-2099) RCP4.5, and End of Century (2070-2099) RCP8.5 using downscaled output from the CCSM4 GCM.

Streamflow

Climate change is already affecting both the timing and total amount of streamflow that feeds downstream reservoirs in the Sierra Nevada and this effect is expected to grow as temperatures continue to rise [*Vicuna and Dracup*, 2007]. Reductions in snowpack and higher temperatures will shift streamflow to the winter months, leaving less water available for spring and summer flows when water resource demands are greatest. Less streamflow during the summer months will also worsen water quality, as many quality issues are flow dependent. Combined, these issues will likely strain the existing 20th century water resource infrastructure that is not equipped to handle a 21st century streamflow regime.

For the Kings River in the Southern Sierra Region, total mean annual streamflow is not expected to change substantially under future climate change (Figure 13). The range of streamflow change projections for the six GCMs used in the analysis includes both small increases and decreases in annual streamflow, with the median estimate being slightly positive. Nevertheless, while total annual streamflow is not projected to change substantially, changes in snowpack accumulation will have a major effect on the timing of streamflow.

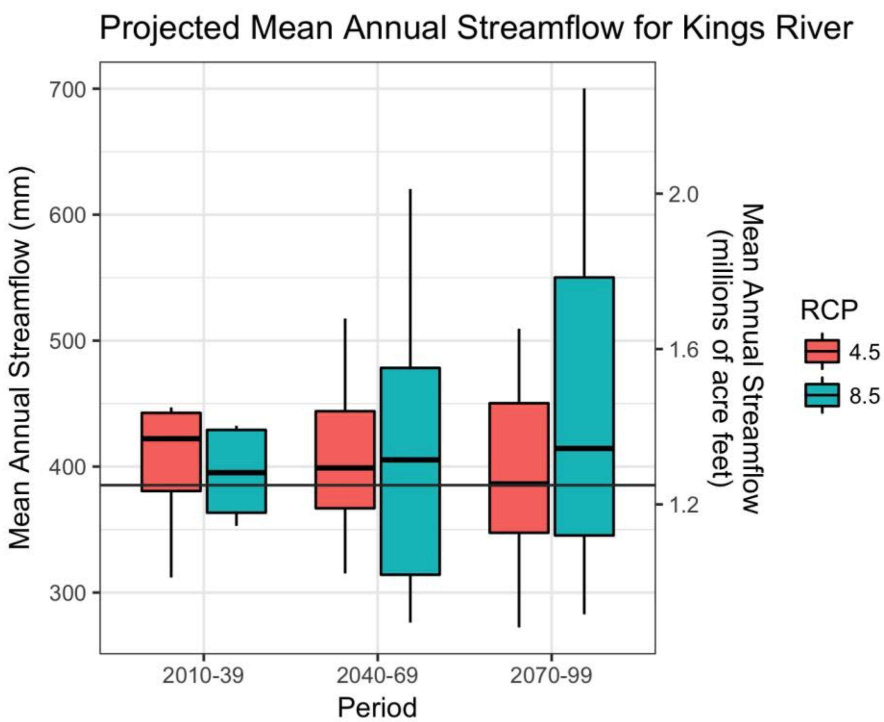

Figure 13: Projected changes in mean annual streamflow for the Kings River in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey line represents historical mean annual streamflow.

Precipitation in the Southern Sierra Region is a mix of rain at lower elevations and snow at higher elevations. Streamflow generation from rainfall occurs relatively quickly, with streamflow often peaking within hours/days of a rainfall event. Streamflow generation from snowpack, on the other hand, is delayed and depends on subsequent changes in energy inputs (e.g. temperature, radiation) to melt the snowpack. Since most precipitation in the Southern Sierra Region occurs during the winter and since the Southern Sierra Region is characterized by very high elevations, streamflow generation from snowpack has historically been the dominant control on streamflow. However, as rising temperatures shift the rain-snow transition zone to higher elevations, a higher fraction of streamflow will be generated from rainfall, increasing streamflow during the wet winter months.

Across the western U.S, Li et al. [2017] has estimated that the contribution of streamflow originating from snowpack by the end of the century will decrease by one third under an RCP8.5 scenario. This earlier shift in the timing of streamflow has already been shown to be impacting streamflow. Stewart et al. [2005] demonstrated that across Western North America, streamflow timing has shifted 1 to 4 weeks earlier since the mid-20th century. This trend will continue as temperatures continue to rise. Schwartz et al. [2017] project that by the end of the century, streamflow may shift up to 80 days earlier under an RCP8.5 scenario and up to 30 days earlier under an RCP4.5 scenario.

For the Kings River Basin, the effect of projected higher temperatures on streamflow timing can be illustrated by comparing projected changes in monthly streamflow (Figure 14). Under both RCP 4.5 and RCP 8.5 scenarios, monthly streamflow increases during the winter and early spring (January through May) due to less snowpack accumulation. Peak runoff, which has historically occurred during June, will shift to May with climate change and streamflow during the months of June and July will decrease. Other watersheds within the Southern Sierra Region are likely to show a similar pattern of streamflow change as the Kings River, although the magnitude of change may differ due to differences in watershed characteristics.

A shift towards greater winter streamflow will increase the risk of floods within and downstream of the Southern Sierra Region. Das et al. [2013] found that by the end of the 21st century, streamflow flood events with 50-year return periods in the southern Sierra Nevada would increase by 50% to 100%. These increases were attributed in part due to warm storms that produce rainfall at higher elevations, but also in part to an increase in the size and frequency of large storms events [*Das et al.*, 2011]. Many of the largest floods in the Sierra Nevada are associated with rain-on-snow events, when high snowlines cause rain to fall on previously established snowpack and streamflow contributions include both rain and melted snow. Rain-on-snow events are disproportionately associated with warm atmospheric rivers [*Guan et al.*, 2016] and atmospheric rivers are projected to become more frequent and more severe under climate change [*Dettinger*, 2011; *Hagos et al.*, 2016].

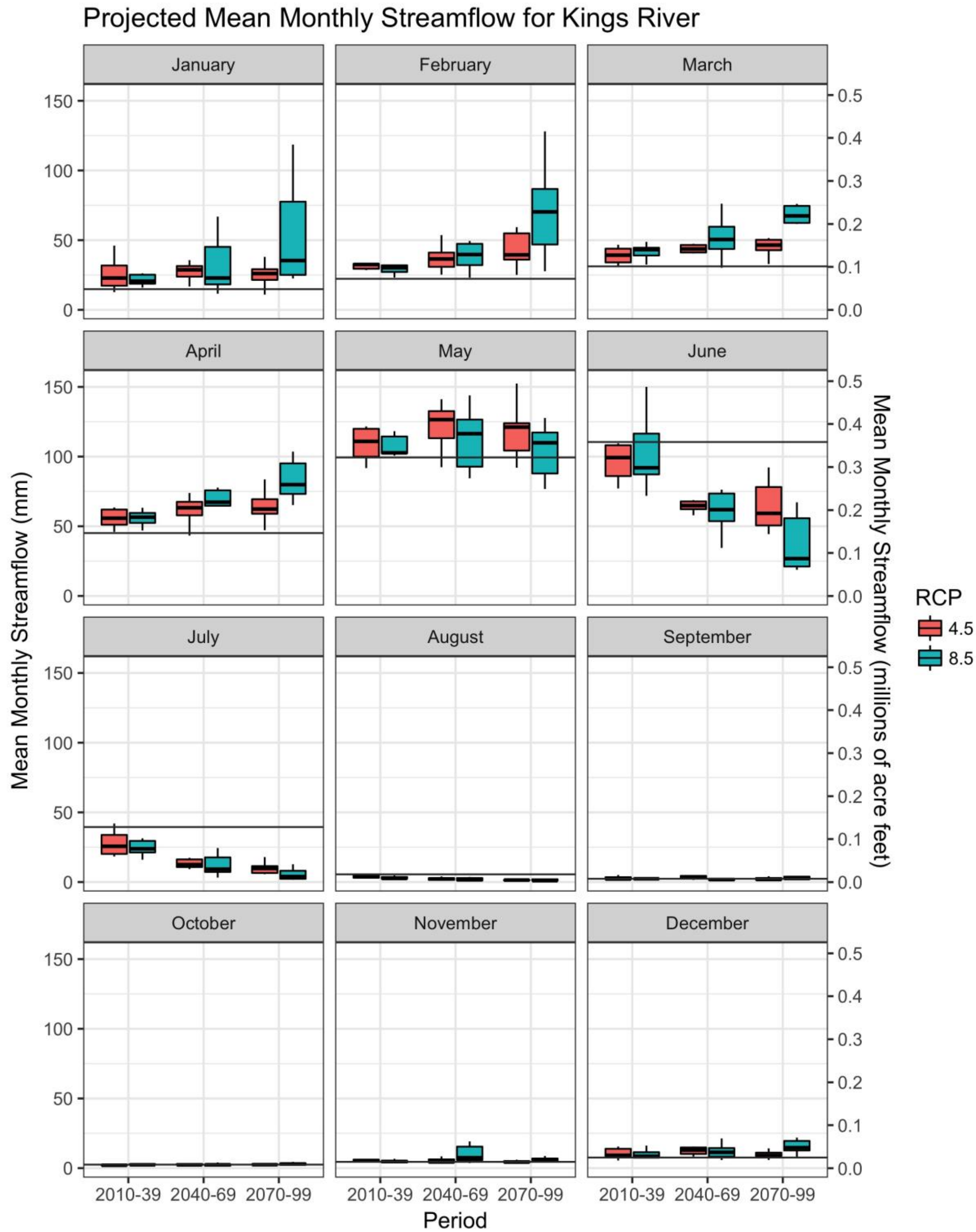

Figure 14: Projected mean monthly streamflow for the Kings River in the Southern Sierra Region. Variability in projections represents different GCMs. Horizontal dark grey lines represent historical mean monthly streamflow.

Increased flood risk will introduce additional constraints on the operation of major water supply/flood-protection reservoirs downstream of the Southern Sierra Region. To minimize flooding in the San Joaquin Valley during the winter months, reservoirs are required to draw down water levels to provide space to accommodate large runoff events, such as those associated with atmospheric rivers. As the risk of larger winter runoff events increases with climate change, the rules governing reservoir flood space may need to be revised to allow for more space, as the current rules reflect historical streamflow regimes, not future ones [*Brekke et al.*, 2009]. This would reduce the amount of water that can be stored during the winter season. In the spring, snowmelt has historically been used to fill the reservoirs. However, the reliability of snowmelt being sufficient to fill the flood reserve space in reservoirs is decreasing as the Sierra snowpack is diminished. These issues with surface storage suggest that alternative methods for storing water may need to be pursued in the Tulare/San Joaquin basins, including groundwater recharge. Changes in reservoir operations may also impact hydropower generation, which will affect energy production in California.

With more winter streamflow projected under climate change, a corresponding decrease in summer flows is also projected. These flows, which occur when seasonal temperatures are highest and water demand is greatest, are important for both riparian ecosystems and water management. In the Sierra Nevada, Godsey et al. [2014] found that for every 10% decrease in snowpack, annual minimal flows may decrease by 1% to 22%, depending on the watershed. An additional concern is that the length of the low flow season will be extended under climate change, further stressing aquatic ecosystems in the Southern Sierra Region.

<u>Water Quality</u>

Climate change will impact water quality in the Southern Sierra Region by altering stream temperatures and sediment loads. Stream temperature is a key regulator of riparian ecosystems and higher water temperatures frequently have an adverse affect on native species, affecting species distributions, growth rates and reproduction [*Isaak et al.*, 2017]. Stream temperature has been found to be sensitive to rising temperatures. Ficklin et al. [2013] projected that, depending on the watershed, spring and summer stream temperatures in the Sierra Nevada will increase between 1.0 and 5.5°C by the end of the century under a high greenhouse gas scenario. Isaak et al. [2017] found that August stream temperatures in Central California will increase by about 1.0°C by the end of the century. Using the same dataset generated by Isaak et al. [2017], August stream temperatures for the

Southern Sierra Region are projected to increase from 0.3°C to 1.6°C, with an average change of 0.9°C (Figure 15). In each of these studies, lower elevation streams showed a greater increase in temperature than higher elevation streams.

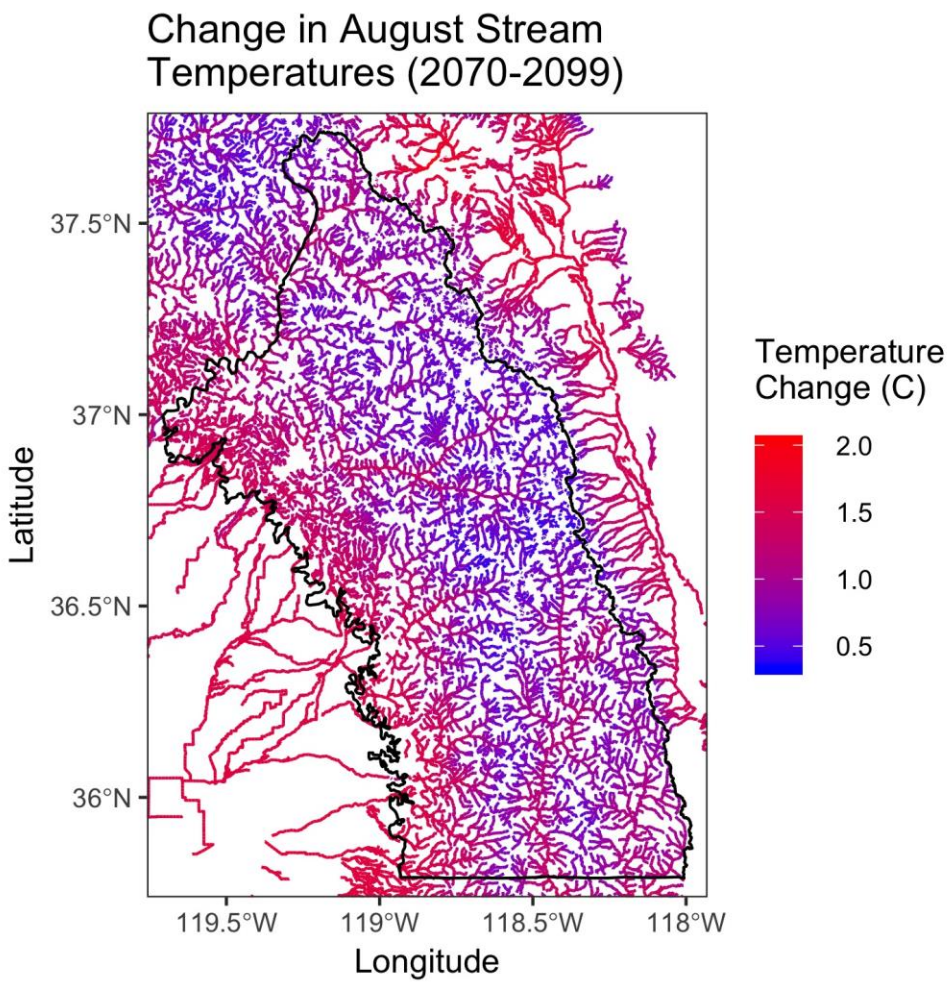

Figure 15: Projected change in August stream temperatures in the Southern Sierra Region for the period 2070 to 2099. Data from Isaak et al. [2017].

Changes in land cover and streamflow regimes may alter stream sediment load in the Southern Sierra Region. Due to granitic substrate, many rivers in the Southern Sierra Region are sediment limited [*Riebe et al.*, 2001]. However, an increase in winter flows has the potential to increase sediment erosion and transportation. During the spring and summer seasons, Ficklin et al. [2013] reported that sediment concentrations in Sierra Nevada steams should decrease under future climate change scenarios. However, the effect on sediment loads during the winter season remains unclear and points to the need for further research. The trend of increasing wildfire in a warmer climate is a special concern for sediment

CHAPTER 4: COMBINED EFFECTS OF CLIMATE CHANGE AND VEGETATION TRANFORMATION ON HYDROLOGY IN THE SOUTHERN SIERRA REGION

Vegetation affects watershed hydrology in the Southern Sierra Region through processes such as canopy interception and transpiration, which influences how much water is available for streams or groundwater recharge. Vegetation water use differs by vegetation type (e.g. forests, shrubs, grasses) as well as through time as vegetation grows. Consequently, changes in the distribution of vegetation on a landscape will have an effect on hydrology and the management of water resources. The main drivers of vegetation change on a landscape include vegetation disturbance such as drought, wildfire, and bark beetles, as well as land management activities such as forest thinning and prescribed fires. In this section, we document how climate change is altering vegetation disturbances in the Southern Sierra Region and how these changes affect both vegetation and water resources. We also develop a model that will permit the examination of land management on water resources in the Southern Sierra Region.

Approach

To examine the vulnerability of forests in the Southern Sierra Region to current and future droughts, we leveraged the forest mortality dataset generated by the Aerial Detection and Monitoring program with the United States Forest Service, Region 5 (https://www.fs.usda.gov/detail/r5/forest-grasslandhealth/?cid=fsbdev3_046696) and processed by Young et al. [2017]. The Aerial Detection Monitoring program maps tree mortality using a small aircraft with an aerial observer who visually evaluates a selection of areas throughout California for the number of trees that are stressed or dead, as well as the affected tree species and the damage type (e.g. fire, beetle, drought). Young et al. [2017] rasterized the forest mortality dataset for the year 2015 at a 3.5 km resolution, which was resampled in this study to 4 km to match the climate data resolution. In addition, all tree species were treated collectively to reduce the complexity of the study.

A multiple regression model was developed to predict tree mortality, defined as trees per hectare, from landscape and climate variables. The landscape variables included number of trees per hectare and basal area per hectare, while the climate variable was a measure of climatic water stress (*ws*). The landscape variables were obtained from the GNN dataset produced by the LEMMA group (https://lemma.forestry.oregonstate.edu) [*Young et al.*, 2017]. The climate variable was calculated using

$$ws = p - pet \quad (1)$$

where p is annual precipitation (mm) and PET is annual potential evapotranspiration (mm). Precipitation for 2015 was obtained from the PRISM climate dataset (http://www.prism.oregonstate.edu) and *pet* was estimated using the Hamon method, which computes *pet* as a function of temperature and daylight hours [*Hamon*, 1961]. Temperature for 2015 was obtained from PRISM. More negative values of water stress (*ws*) indicate that forests do not have sufficient precipitation to meet atmospheric water demands on vegetation and that stomata will likely need to be closed for longer periods of time. The model was used to predict how forest mortality might be altered at the end of the century for a drought with an identical precipitation deficit as the recent California drought, but with higher temperatures. To accomplish this, we derived end-of-century potential evapotranspiration (*pet*) values as input into the Hamon method using the average increase in the end-of-century temperatures for the RCP 4.5 and RCP 8.5 scenarios.

Wildfire projections were analyzed using a dataset provided by Westerling (2018) (www.cal-adapt.org). Future wildfire scenarios were generated by coupling two emission scenarios (RCP4.5 and RCP8.5), data from four downscaled GCMs, and three land-cover scenarios. The land-cover scenarios accounted for low, medium and high levels of land development over the 21st century. Output for the model included projected area burnt.

Predicting how hydrology and water resources in the Southern Sierra Region will change with climate change is challenging because many processes like vegetation distribution (species, functional type), carbon stock (sequestration, forage), disturbance regime (fire, insect, die offs), hydrology (evapotranspiration, storage, runoff) and land management are interdependent. Consequently, these processes cannot be studied in isolation and require numerical models that can integrate the processes at the watershed scale. For this study, a framework for investigating watershed scale changes in hydrology was set up using the Envision model [*Bolte et al.*, 2007]. The Envision model includes: 1) a geo database that manages landscape characteristic data through space and time; 2) a standard plug in interface for water, ecosystem, and socio-economic models; 3) a multi-agent modeling subsystem for representing human decision making; and 4) a GIS based system for visualizing results. The model is designed to capture all the moving parts that affect hydrology in the Southern Sierra Region in a systematic approach so that different land management priorities can be tested. Ultimately, the model is expected to help optimize water resource benefits across stakeholders in the Southern Sierra Region. Envision has been tested in a number of other contexts, including understanding the effects of climate change on the water balance of an upland forest in Oregon [*Turner et al.*, 2017] and the examining fire-prone landscapes as coupled human and natural systems [*Spies et al.*, 2014].

The Envision model was set up for the Kings River Basin upstream from Pine Flat Reservoir. The hydrologic sub-component of the model uses the Hydrologiska Byråns Vattenbalansavdelning (HBV) model, which is a semi-distributed conceptual hydrologic model [*Lindström et al.*, 1997]. Daily temperature, precipitation, specific humidity, radiation and wind inputs for the HBV model were obtained from Gridmet data, which is a gridded climate product that blends PRISM with the NLDAS-2 dataset at 4-km resolution [*Abatzoglou*, 2013]. The full natural flow (i.e. the expected flow without upstream diversion/obstructions) into Pine Flat Reservoir and snow pillow data were obtained from the California Department of Water Resources. Land cover data was obtained from the 2011 National Land Cover Database (NLCD). The Envision model will allow the examination of multiple simultaneously varying processes in the Kings River Watershed, such as the impact of fuel treatments and climate change on watershed hydrology and water resources. In this study, we tested whether the model is able to replicate the behavior of the major hydrologic processes in the Kings River Watershed and is a suitable tool for future analyses.

Forest Mortality

During the 2012-2016 California drought, an unparalleled forest mortality event produced over 129 millions dead trees in forests throughout California [*Moore*, 2017]. The Southern Sierra Region was one of the hardest hit regions in the state, with exceptionally high levels of mortality observed in the lower montane forest (Figure 16). The severity of the mortality event was a direct consequence of the severity of the drought, which combined multiyear low precipitation levels with record high temperatures. Forest vulnerability to drought is projected to increase with climate change and mortality events such as the California incident are likely to become more common and widespread [*Allen et al.*, 2015]. Young et al. [2017] found that during the California drought, mortality throughout California was concentrated in areas with higher levels of water stress. For the Southern Sierra Region, forest mortality in 2015 occurred in areas that had relatively dense vegetation for a given level of water stress (R^2 = 0.27) (Figure 17). The strength of this regression relation is comparable to Young et al. [2017], who used a slightly different definition of water stress. The model indicates a positive relation between the number of trees in a location and the likelihood of tree mortality. The model also indicates that higher levels of water stress (more negative values) lead to higher rates of forest mortality.

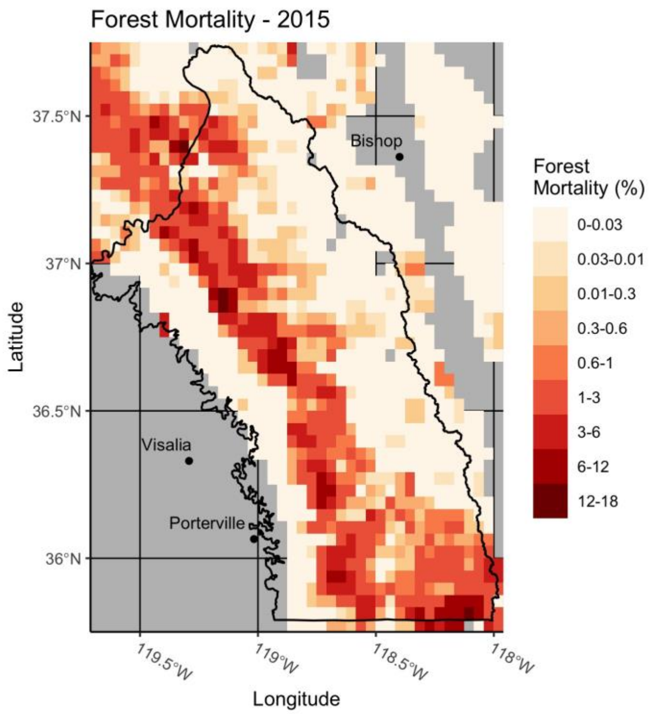

Figure 16: Map of percent forest mortality in 2015 for the Southern Sierra Region.

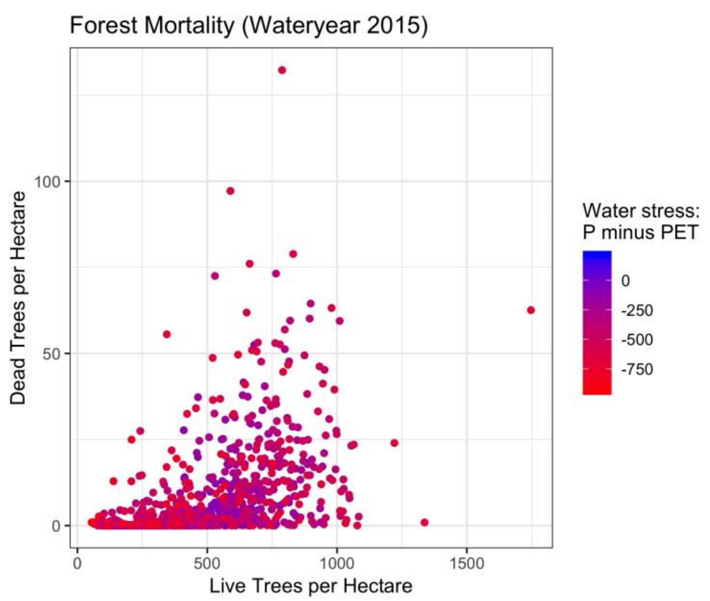

Figure 17: Relation between mortality (trees per hectare) and forest density (trees per hectare) in the Southern Sierra Region during the 2015 wateryear. Each data point represents mortality for a 4-km² pixel within the Region. More negative water stress (precipitation minus potential ET) values indicate greater water stress.

Forest water stress will continue to increase as temperatures rise with climate change, increasing mortality rates. In the Southern Sierra Region, a drought with comparable precipitation to the 2012-2016 drought but with temperature increases representative of the end-of-century RCP4.5 and RCP8.5 scenarios could be expected to increase forest mortality by 15% and 27%, respectively, compared to the 2012-2016 event (Figure 18). The effects of forest mortality can linger for decades and it will be necessary to account for mortality in the management of water resources in the Southern Sierra Region. A recent study by Bales et al. [2018] estimated that the large number of dead trees in the Kings River watershed decreased forest ET during the recent drought, which may have increased water availability for streamflow by up to 15%.

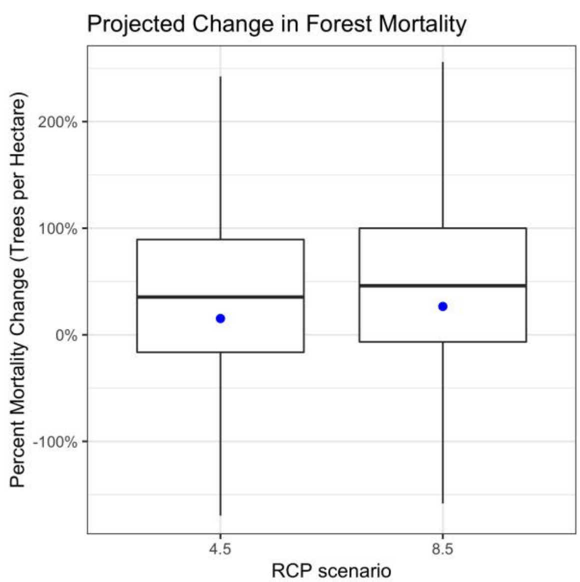

Figure 18: Boxplot showing the projected variability in percent mortality change for each 4-km² pixel within the Southern Sierra Region relative to the average percent mortality in 2015. Blue point is the average change in percent mortality (RCP4.5 – 15%, RCP8.5 – 27%).

Wildfire

Wildfires are an episodic form of land-cover change in the Sierra Nevada. Lower montane forests in the Sierra were historically characterized as having a low-severity fire regime, where the forest understory would regularly burn from wildfire but the forest canopy burned less frequently due to a lack of ladder fuels. Fire suppression over the past century has led to a build-up of understory fuels in many Sierra Nevada forests and made these forests more susceptible to high severity wildfire that affect the forest canopy. Climate change is magnifying this problem, as higher air temperatures increase fire intensities by drying out dead fuels more rapidly. In recent decades, wildfires in the western U.S. have been found to be increasing in size [*Dennison et al.*, 2014] and in total area burned [*Westerling*, 2016]. Indeed, the two largest wildfires ever recorded within the Southern Sierra Region occurred in the last two decades, the 2002 McNalley Fire and the 2015 Rough Fire. Some of this increase is likely due to the fuels buildup, but Abatzoglou and Williams [2016] have demonstrated that part of this increase can be attributed to higher temperatures associated with climate change. Stephens et al. [2018] has suggested that the recent forest mortality event in the Sierra Nevada has increased the risk of surface fires, though this is counterbalanced by a decrease in the risk of crown fire.

Wildfire is expected to become more common in the Southern Sierra Region throughout the 21st century under climate change. The mean annual percent area burned averaged over the Southern Sierra Region is projected to increase from 0.5% per year historically to between 0.75% and 1% by the end of the century under the RCP 4.5 scenario (Figure 19 and 20). The projections for mean annual percent area burned under the RCP 8.5 scenario are higher than the RCP 4.5 scenario but also more uncertain, suggesting that the Southern Sierra Region could experience substantially more wildfire than currently occurs.

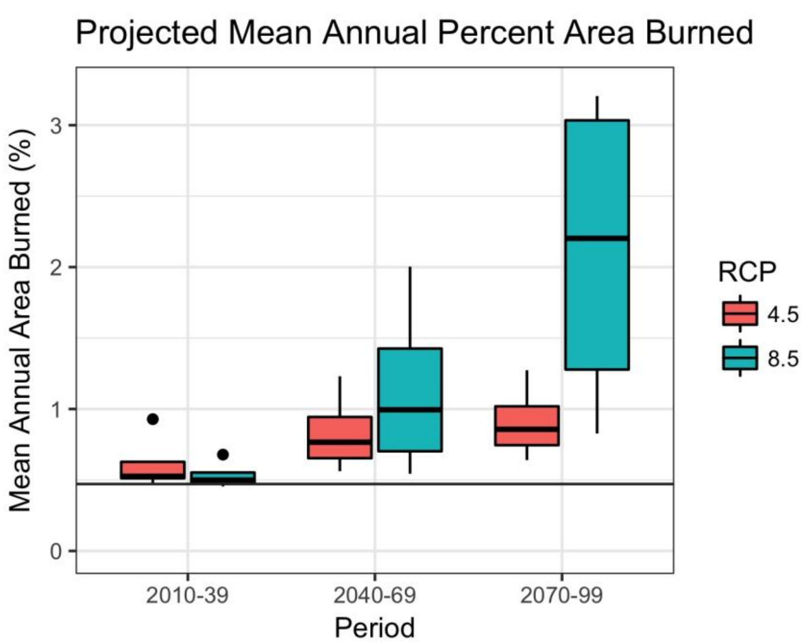

Figure 19: Projected changes in mean annual area burned by wildfire for the Southern Sierra Region under a medium population growth scenario. Variability in projections represents different GCMs. Horizontal dark grey line represents historical mean annual area burned. Data provided through www.cal-adapt.org.

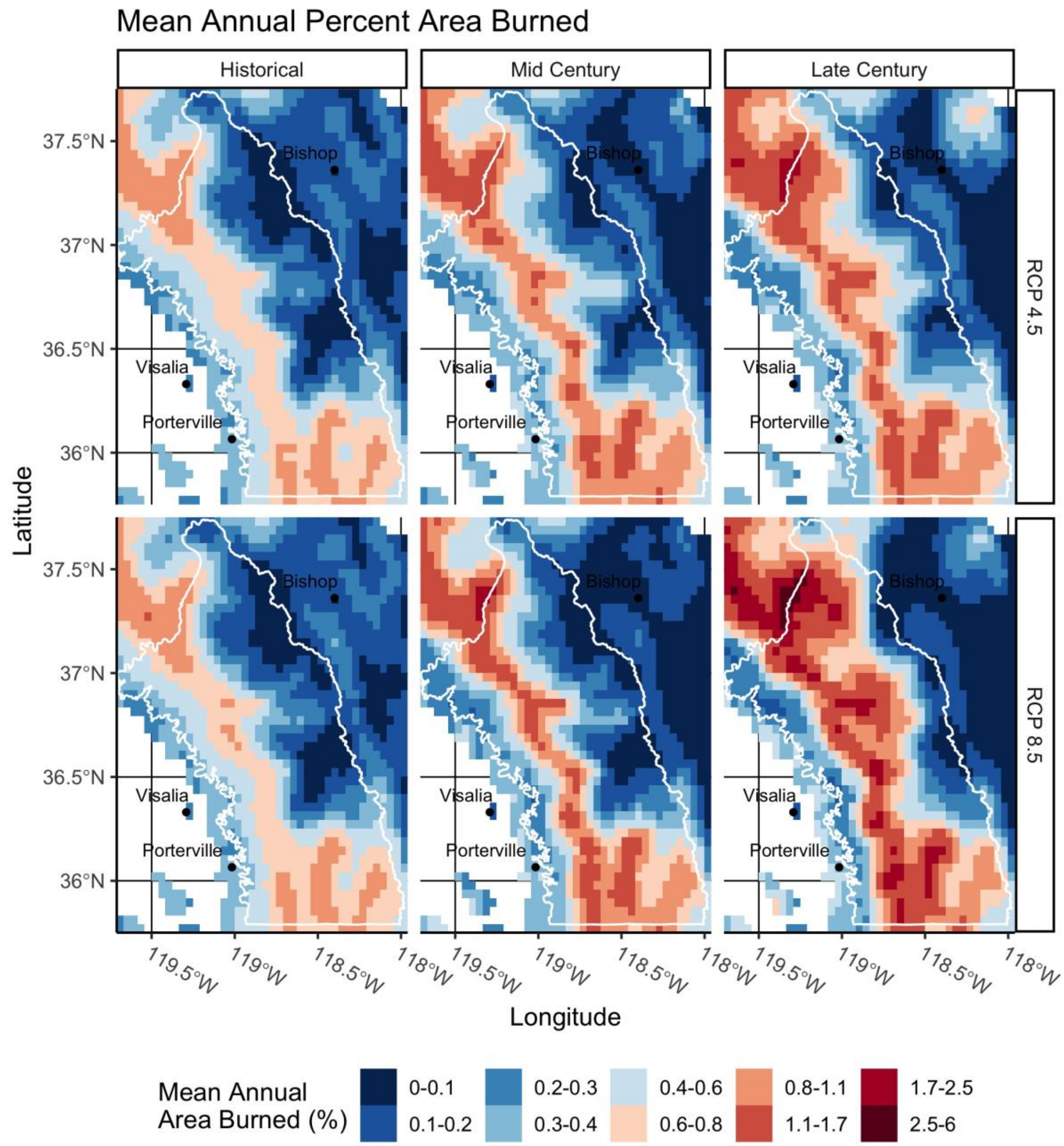

Figure 20: Map of mean annual area burned in the Southern Sierra Region under six scenarios with medium population growth: Historical RCP 4.5 and RCP 8.5, Mid Century (2040-2069) RCP 4.5 and RCP 8.5, and Late Century (2070-2099) RCP 4.5 and RCP 8.5, using downscaled output from the CanESM2 GCM.

Wildfire, through modification of vegetation and soils, affects watershed hydrology. The elimination of vegetation decreases vegetation interception and transpiration, which in the short term may increase annual streamflow. Across the Western U.S., Wine et al. [2018] estimated that 2 to 14% of long-term annual streamflow is generated from vegetation reductions brought about by wildfire. Wildfire may also increase baseflows, though the magnitude of this effect varies from watershed to watershed [*Bart and Tague*, 2017]. Wildfire also impacts soil properties through a process that increases the hydrophobicity of soils. Hydrophobicity decreases soil infiltration during rainfall events and increases overland flow. This change can increase peak flows and the potential for large erosional events [*Doerr et al.*, 2006; *Carroll et al.*, 2007]. Given that the frequency of wildfire is being altered under climate change, the modified effect of wildfire on streamflow and water resources will need to be accounted for in water management.

Bark beetles

Bark beetles are a pathogen in western U.S forests, invading vulnerable trees in order to reproduce. Although outbreaks of beetles are natural, their spread has historically been kept in check by cold winter temperatures [*Bentz et al.*, 2010]. As winter temperatures rise with climate change, outbreaks are becoming larger and more severe [*Bentz et al.*, 2010]. Bark beetles contributed to forest mortality event during the recent California drought and will likely have a larger impact on Sierra Nevada forests in the future.

Forest management

Forest management is frequently used to decrease forest vulnerability to vegetation disturbances and climate change. Forest management may include mechanical treatments such as forest thinning where individual trees are removed from a forest stand to reduce the density of the remaining forest. It may also include prescribed fire, which attempts to replicate the effects of low severity wildfires and remove understory vegetation. Managed wildfire offers perhaps the greatest potential for fuels reduction, though the outcomes are not as predictable as for fuels management by prescribed fire or mechanical thinning. Forest management can help to improve forest health by creating less competition for water resources [*Grant et al.*, 2013]. Forest management also has the potential to reduce overall forest ET, which in some cases may increase streamflow. There is evidence that increases in streamflow following forest thinning are greatest in watersheds that are not water limited and that the magnitude of streamflow change depends on the level of treatments conducted [*Saksa et al.*, 2017; *Roche et al.*, 2018]. Thus, the management of water resources in the Southern Sierra Region will necessitate accounting for forest management practices.

Type conversion

Most vegetation species in the Sierra Nevada are adapted to the precipitation and temperature range of their present distribution. In general, vegetation growth at the lower elevations of a species distribution is water-limited, as evaporative demand is greater at lower elevations due to higher temperatures. Vegetation growth at higher elevations of a species distribution, conversely, is generally cold-limited. As temperatures rise with climate change, an upslope shift in vegetation is expected in the Sierra Nevada. This shift is not expected to be uniform, however, as some species are likely to migrate more easily than others. Also, in many cases, invasive vegetation may replace former species. At lower treeline in the Sierra Nevada, recent evidence has shown that a transition from forest to shubland and/or grasslands is already occurring in some regions [*Collins and Roller*, 2013; *Stevens and Latimer*, 2015]. Likewise, increased vegetation growth in the high elevation sub-alpine forest in the Sierra Nevada has also been observed in the last decade [*Millar et al.*, 2004]. The effect of vegetation transformations on watershed hydrology is likely to vary based on watershed characteristics and the extent/timing of vegetation transformation. In the lower montane forest of the Southern Sierra Region, Bart et al. [2016] found that tree-to-shrub type conversion may increase streamflow up to 40%, depending on the species and size of invading shrubs. This contrasts with the effect of vegetation expansion at higher elevations, as Goulden and Bales [2014] reported that vegetation expansion could decrease streamflow by up to 26% in the Kings River watershed. The ultimate effect of vegetation transformations on streamflow in the Southern Sierra Region will depend on the balance of vegetation changes across the full elevational gradient of the Sierra Nevada.

Envision modeling

The results from testing the Envision model in this study demonstrated that the model could replicate many of the major hydrologic processes in the Kings River Watershed. Distributed output for a selection of key hydrologic variables including mean annual precipitation, mean annual ET, mean April 1 snowpack, and mean annual runoff are shown in Figure 21. The spatial distribution of these variables reveals patterns that are consistent with current understanding of hydrology in mountainous watersheds. Mean annual ET is highest in the lowest part of the Kings River watershed, as this area has the highest atmospheric demand combined with sufficient precipitation to satisfy much of the demand. This is also consistent with the results using VIC to model ET in the Kings River Watershed. April 1 snowpack is generally greater at higher elevations, in part because these areas are the coldest and have the least amount of winter snowmelt. However, the model shows an area between the North and Middle Forks of the Kings River that is lower in elevation than the Sierra Crest, but has a large April 1 snowpack due to very high precipitation rates in that area. Mean annual runoff is the proportion of precipitation that immediately flows over the surface during a rainfall event towards a stream. It does not include water that infiltrates or remains on the surface as snow. The runoff map in Figure 21 shows that runoff is greatest in the mid-elevational range of the watershed. Runoff at low elevations is limited by low amounts of precipitation, whereas runoff at high elevations is limited by the large proportion of snowfall compared to rainfall.

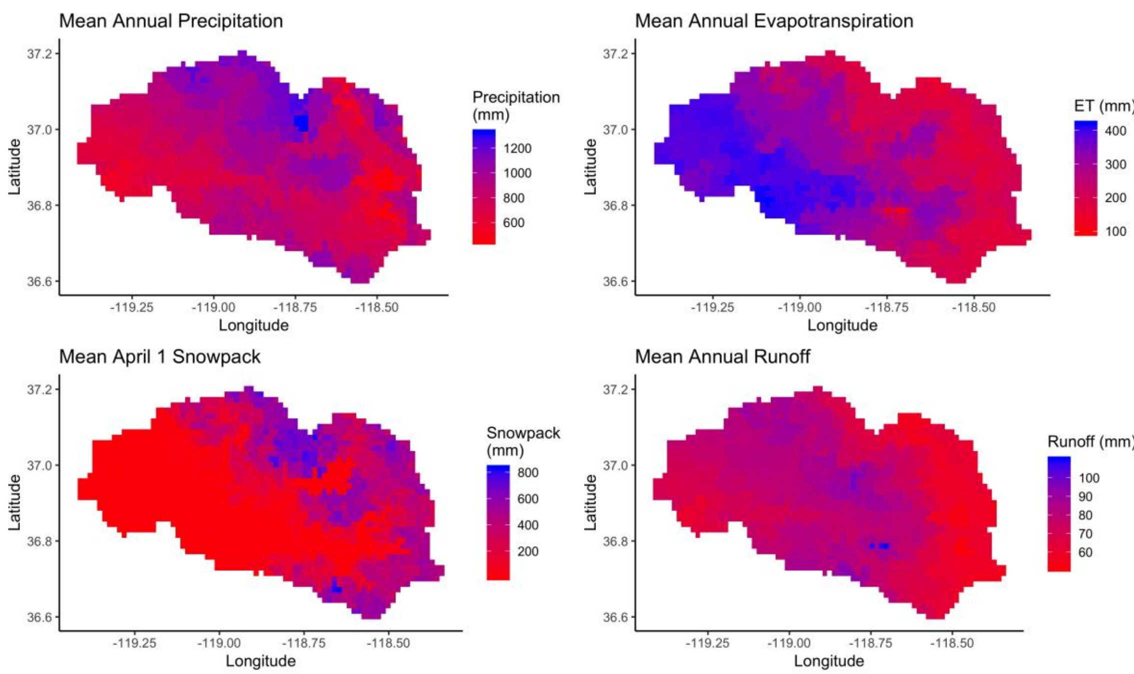

Figure 21: Modeled distribution of the mean annual precipitation, mean annual ET, mean April 1 snowpack, and mean annual runoff in the Kings River Watershed.

The Envision model was also evaluated for how well it was able to replicate temporal variability of hydrologic variables in the Kings River watershed. One of these variables, snow depth, was examined at multiple point locations within the watershed. Time-series for two of these locations, Bishop Pass and Big Meadow, are shown in Figure 22. Bishop Pass is a high elevation snow pillow located at 11,200 feet in elevation. Big Meadow is a middle elevation snow pillow at 7,600 feet, which is just above the rain-snow transition zone. For Bishop Pass, the model captured the timing of snow accumulation during the winter and snowmelt during the spring, as well as the overall magnitude of snowpack very well. For Big Meadow, the model consistently underpredicted snow depth. Further, the timing of snowpack accumulation and melt was inaccurate for Big Meadow, with the model repeatedly accumulating snowpack too slowly during the winter and retaining the snowpack for too long in the spring. Overall, these results suggest that Envision can model high elevation snowpack well but needs further refinement to correctly replicate a mid-elevation snowpack.

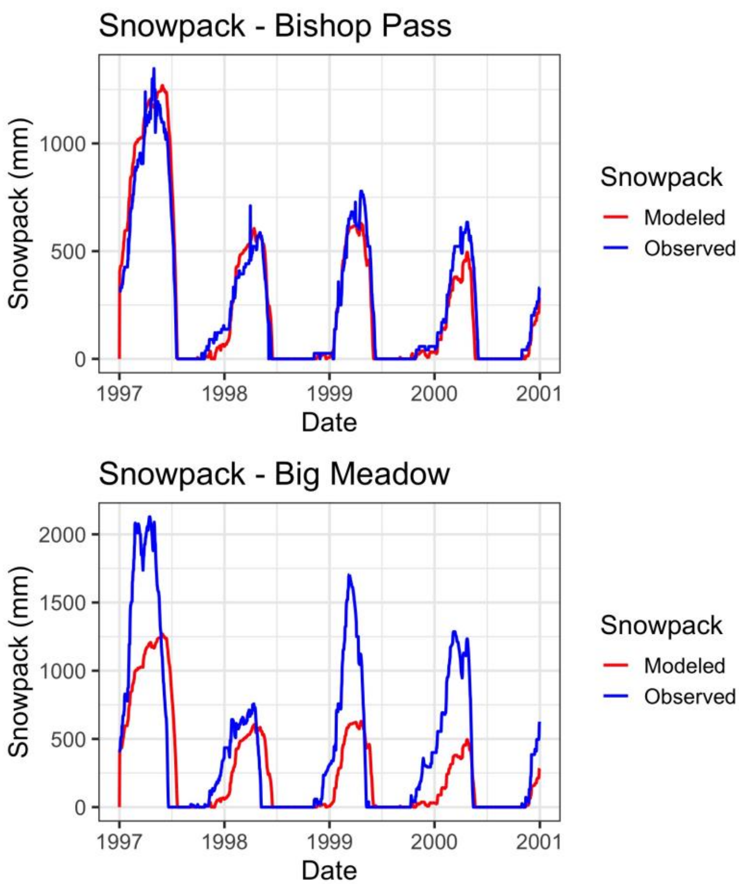

Figure 22: Comparison of modeled and observed snowpack depth through time at Bishop Pass (elev 11,200 ft) and the Big Meadow (elev 7,600 ft).

Envision was partially able to replicate streamflow for the Kings River watershed above Pine Flat Reservoir, but disparities exist in both the magnitude and timing of streamflow. A comparison between modeled and observed streamflow at the Kings River outlet is shown in Figure 23. In two of the years, 1997 and 1999, the model overpredicted streamflow during the winter and underpredicted streamflow during the spring. This is due to inaccuracies in the models estimation of snowpack, particularly at mid-elevations near the rain-snow transition zone, as observed at Big Meadows. In this case, the model misclassified precipitation as rain instead of snow, producing higher winter flows than actually observed. The opposite effect occurred during the spring snowmelt, where modeled streamflow was less than observed due to the presence of a smaller snowpack in the model. Correctly partitioning precipitation to rain and snow near the rain-snow transition zone is one of the primary challenges for modeling high topographic relief watersheds such as the Kings River. A better characterization of water resources for this watershed, and the Southern Sierra Region as a whole, will require both additional refinement of the Envision model, but perhaps more importantly, new resources to measure and monitor hydrologic fluxes across mountainous terrain.

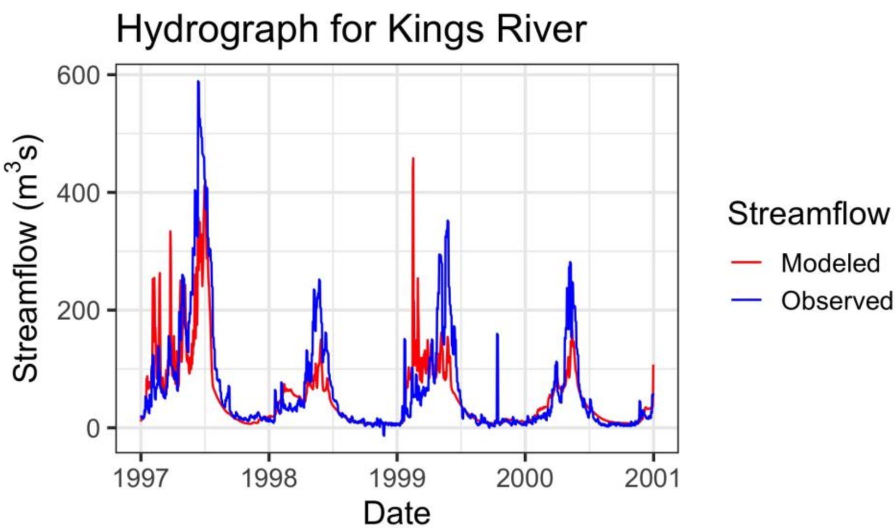

Figure 23: Hydrograph comparing modeled and observed streamflow just above Pine Flat Reservoir. Observed streamflow is the corrected full natural flow into the reservoir.

The Envision model was able to model many of the watershed processes in the Kings River watershed. Still, further analysis will be needed to understand how forest management and climate change affect these processes. Key biophysical mechanisms that still need to be incorporated into the model analysis include representations of forest structure/functioning change such as wildfire, bark beetles, forest mortality and type conversion. One advantage of Envision is that it was developed with an explicit objective to couple stakeholder and land-manager decision-making into simulations. Incorporating these types of actions with the dynamic biophysical processes operating within a watershed will allow economic, political and social tradeoffs to be evaluated. The model can also be coupled to a downstream reservoir model in order to couple management and climate change affects to water supply and energy production. Overall, this study demonstrates that Envision will provide a solid foundation for future research in the Kings River watershed, as well as other major watersheds in the Southern Sierra Regional Water Management Group region, for evaluating climate change effects on the hydrology of Southern Sierra Nevada watersheds.

CHAPTER 5: CONCLUSIONS

Climate change will have a substantial effect on the hydrology and water resources in the Southern Sierra Region over the 21st century. Most of these changes have already begun. 1) Higher temperatures are producing less snowfall during the winter wet-season, causing the Sierra snowpack to be diminished. A higher proportion of rainfall compared to snowfall is increasing winter season streamflow when there is limited storage available to store the flows due to winter flood control operations of most Sierra Nevada reservoirs. 2) An earlier depleting snowpack decreases streamflow during the late spring and summer period, when demands for water use are greater. 3) Precipitation in California is becoming more variable. Wet years are becoming more extreme and droughts becoming longer and more entrenched. 4) Higher temperatures in the Southern Sierra Region are also making forests more vulnerable to drought mortality while increasing risk from disturbances such as wildfire. As vegetation is a major control on how much precipitation is partitioned to streamflow and how much returns to the atmosphere, vegetation transformation will be a key control on water availability in the future. 5) Stream temperatures are increasing simultaneously with higher atmospheric temperatures, further stressing aquatic ecosystems.

Many management practices that were appropriate during the 20th century will prove to be inadequate for the 21st century due to the hydrologic changes produced by climate change. Proactive adaptation will be necessary by all groups, including urban, agricultural and environmental users, and special protections will be required to ensure that the negative consequences of climate change are minimized for the most vulnerable populations within and downstream of the Southern Sierra Region. Adaptation will likely take on many forms, including changes in reservoir management, forest management, and conservation. Adaptation will also need to be place specific. For example, vulnerabilities may be different for communities downstream of high elevation basins like the Kings River compared to lower elevation basins like the Kaweah and Tule, where changes in snowpack are likely to be relatively greater. While much is known about the general effects of climate change on Sierra Nevada hydrology, predictions for specific locations, time-periods and scenarios will require better science.

Informed, science-driven adaptation planning has the potential to mitigate some of the negative consequences of climate change, freeing up water that can be used by SSRWMG stakeholders. Improved forest management can not only increase the health of Southern Sierra forests and decrease wildfire risks, but it may also increase the total amount of streamflow flowing out of Southern Sierra Region watersheds. However, more research is needed to understand which locations within Southern Sierra watersheds have the greatest potential to increase forest health and increase water yields, as management effects are effected by topography, soils, geology and vegetation cover. Forest management effects also vary through time depending on climate conditions.

New tools are available to help predict vulnerabilities to climate change and the adaptations necessary to mitigate the consequences. Improvements in remote sensing are providing better spatial and temporal estimates of precipitation, snowpack, evapotranspiration, forest health, forest structure and disturbance. Advances in geophysics can provide unprecedented views up the subsurface structure and water storage. Coupled models, like the Envision model highlighted in this report, allow for exploration of the interactions between different systems that previously could only be studied independently, leading to deeper and more nuanced understanding of how climate change will affect water resources in the Southern Sierra Region. Together, these tools will be important for establishing resiliency in the Southern Sierra Region under climate change.

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Appendix N

Stakeholder Outreach Plan

COMMUNICATION AND OUTREACH PLAN

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP AND IRWMP

Southern Sierra Regional Water Management Group and Bobby Kamansky, Kamansky's Ecological Consulting

5/30/2018

I. Purpose and Overview

- This plan serves as a guide for the public communication and outreach activities of the Southern Sierra Regional Water Management Group (RWMG).
- The goals of the plan are to:
  - 1) ensure that interested parties (e.g., members of the public, non-government organizations, and public agencies), and residents in the participating counties are well-informed of the deliberations and activities of the RWMG and the development of the Southern Sierra Integrated Regional Water Management Plan (IRWMP), and;
  - 2) encourage participation in the RWMG and IRWMP process from interested parties and residents
- Foundational elements of this plan include objectives and principles, audiences and potential partners, and messages. A series of communication and outreach strategies follow. The last element is an evaluation of plan implementation. An appendix lists names of potential partner agencies and organizations.

II. Objectives and Principles

1. SSRWMG Communication/Outreach Plan Objectives:

- Ensure that interested parties and residents of participating counties are aware of the work, schedule, progress, and programs of the RWMG;
- Ensure that interested parties and residents have opportunities to provide input to the RWMG's process and programs;
- Support and engage disadvantaged communities and tribes, two of the highest priority stakeholders in the Region
- Build the RWMG's network, solicit greater feedback and participation in planning, project development and implementation process;
- Communicate successes and goals to stakeholders, the general public, and funders;
- Showcase the beauty and diversity of the region.

2. Principles

- The RWMG will proactively develop and nurture relationships with new and existing partners by conducting outreach and education activities (see Strategies in Section V);
- The RWMG will partner with interested parties to leverage existing networks and outreach efforts, in an effort to stretch resources;
- The RWMG will make information and materials (e.g. meeting agendas, materials, requests for proposals, other action items) available to stakeholders and the general public on a timely basis to provide ample time to consider information and, as appropriate, provide input and participate;

» The RWMG will employ consistent messaging in its outreach efforts, guided by the group's mission to provide a forum to discuss, plan and implement creative, collaborative, regional, integrated water/natural resource/watershed management actions that enhance the natural resources and human communities of the Southern Sierra Region;
» The RWMG strives to include participation from the Region's many diverse geographical and interest-based audiences and may apply different communication strategies to target different groups in an effort to attract participation representative of the Region's diversity, e.g. land managers/owners, water management entities, non-profits, RCDs, PUDs;
» The RWMG plans to keep pace with the rapid evolution of information distribution, particularly through online outlets and social media.

III. Audiences and Partners

Water resource issues affect the entire population in a region. Some of the many diverse, geographical and interest-based audiences in the Region include:

» Disadvantaged communities;
» Landowners;
» Farmers and growers;
» Environmental groups;
» Recreational users;
» California Native American Tribes;
» Developers;
» Community organizations;
» Public agencies;
» Elected officials.

The RWMG began developing lists of specific groups, organizations, and agencies to participate in an integrative regional management effort in 2008, and continues to seek ways to expand the collaborative network. See Appendix 1, for groups contacted to participate between 2014 and 2018.

The RWMG's outreach and communication strategies have been successful, to date, in building a good core of partners and participants. These partnerships are critical to maximizing the efficiency and effectiveness of ongoing communication and outreach efforts aimed at expanding the group's network of participants. Additional partners will be solicited as activities are developed.

IV. Messages

1. Universal Messages: The SSRWMG will widely distribute the following key messages across many communication outlets and to broad audiences

A. The Southern Sierra is an important source of clean water for the San Joaquin Valley's communities, agriculture and environment. The Region supplies water for abundant recreational opportunities, scenic beauty, irrigation for hundreds of thousands of the nation's riches farmlands, habitat for plants and animals, drinking water, and groundwater replenishment;
B. The SSIRWMP and the SSRWMG represent a unique opportunity to protect and conserve this unique Region's resources with science-based, integrated regional water management;
C. The SSRWMG utilizes a consensus-based process to address regionally significant issues;
D. By collaborating as a group, we can develop solutions to issues and challenges that protect and improve the Region, as a whole. Working together, the group can achieve more than the sum of contributions from its individual participants;
E. The group seeks solutions through project planning and development, attracting grant funds, and implementing projects that contribute to the Region's sustainability. The group aims to increase the Region's capacity to respond positively to social, economic and environmental challenges, and ultimately, reduce and prevent the need for reactive problem-solving;
F. The RWMG aims to enhance the environment's ability to naturally provide services that benefit humans and the natural world. These processes and resources are called "ecosystem services," and extremely important to the RWMG's goals and work.

2. Messages for Specific Objectives or Projects

Examples of messages or methods for specific projects or objectives:

1. Objective: Rolling out the IRWMP (draft publication in July 2013, follow-up publication in October, 2014):
    a. The RWMG issued a press release about the intent to prepare the IRWMP. In addition to many messages, already stated above, the release provided the following information:
        1. Contact information to get involved and/or ask questions;
        2. Number of participants and members;
        3. Upcoming meeting date, time, and location;
        4. Statement that a notice of intent to prepare and notice of intent to adopt the IRWMP will be made public once the IRWMP is completed.

b. The RWMG published formal notices in regional/local press in 2014 and 2018 before and during the preparation of the IRWMP and near the completion, for adoption.

2. Objective: Announce project implementation solicitation to potential project proponents:
   a. The RWMG distributes solicitation via email with attachments to members and stakeholders, and references website materials, which are also published to provide additional information to the RWMG. In addition to key message identified above, other information accompanying project solicitations/announcements include:
      1. Description of the IRWMP process;
      2. A template/model for grantee/project proponents and grant writing examples for the implementation program;
      3. Description of the benefits of supporting or being involved in the process.

   These materials are available on the website, www.southernsierrarwmg.org.

3. Special Messages

1. Special Message for potential RWMG members/MOU signatories:

   a. Signing the SSRWMG Memorandum of Understanding has attractive benefits:

      1. Decision-making in the RWMG;
      2. Help to decide regional priorities;
      3. Ability to submit project for implementation funding;
      4. Project integration and development to make them more competitive.

V. Communication and Outreach Strategies

This section identifies communication and outreach strategies. Each strategy includes information on supporting materials, audiences that would benefit, next steps and a timeline of when strategies would be implemented, and constraints that will need to be managed.

1. SSRWMG website (www.southersierrarwmg.org): clearinghouse for all information and materials associated with RWMG meetings, information, education, and any other communication and outreach efforts/needs.

Materials and Media: Developed a complete, user-friendly, and aesthetically appealing website that hosts all past and upcoming meeting materials, other documents and information, videos, scientific publications, maps, projects, member information, contact information, and more.

Special Target Audiences: All — General public, Disadvantaged Communities, tribal entities; stakeholders, future members/stakeholders.

Next Steps & Timelines: The first version of the website was established in 2008, as part of the Sequoia Riverlands Trust website. However, in May of 2014, the RWMG launched an independent website,www.southernsierrarwmg.org, which contains even more resources and a more user-friendly format.

Constraints: Management of documents and designation of individual to keep the website current.

Lead: Kamansky's Ecological Consulting

Potential partners: Kamansky's Ecological Consulting, Tulare Basin Wildlife Partners, Sequoia Riverlands Trust, Provost and Pritchard Consulting Group

2. **Email correspondence:** Develop and maintain an email distribution list for all interested parties; this comprehensive list would also have a segmented list of only those parties who have expressed interest in partnering.

Materials and Media: Email and address data management software; existing news, promotional, and educational materials (see below).

Special Target Audiences: Individual interested parties and agencies.

Next Steps & Timelines: Differentiate the existing list into RWMG members and interested parties.

Constraints: Maintaining up-to-date entries in contact database.

Lead: Facilitator, or Stakeholder Coordinator.

Potential partners: Facilitator and/or Grantee Project Manager, implementation partners,

3. **Press relations:** Proactively develop and regularly utilize relationships with key press and media outlets for the purpose of sharing news and information.

Materials and Media: Joint statements developed by the SSRIWMP, telephone calls, emails, written articles.

Special Target Audiences: Utilizing the press to reach county residents as a whole.

Next Steps & Timelines: RWMG members identified and established relationships with major press and media outlets during the summer of 2014. This strategy will be utilized as needed to publish articles, release key information, draw attention to specific topics or issues, funding, research or other RWMG programs.

Constraints: Inability to control final products, need to adhere to RWMG Media Protocol, designating someone to write press releases.

Lead: Communication/Outreach Work Group.

Potential partners: RWMG

An Outreach Workgroup assisted with outreach, media and external relations with major DAC funding efforts under Proposition 1 during the IRWMP-update process, 2017-18**.**

4. **Outreach materials:** Develop a standardized series of general promotional and outreach materials, as well as activity-specific and topic-specific materials as needed.

Materials and Media: Trifold and booklet brochures, FAQs, annual newsletter (electronic and hard copy) project development handouts, videos and articles posted to website and social media.

Special Target Audiences: Stakeholders, audiences who may be directly impacted by RWMG activities, new members/partners/stakeholders, social media and website audiences.

Next Steps & Timelines: Developed general promotional material during summer of 2012. Refinements will be made as needed over time; developed activity- and topic-specific materials in coordination with the RWMG's work plan, see topic and programs specific materials in appendix and on website.

Constraints: Need for subject matter expertise, cost of paying for designed materials, cost of printing.

Lead: Grantee and/or Communication Work Group.

Potential partners: Local media, UC Merced, social media platforms.

5. **Networking:** RWMG members will periodically (e.g., twice a year) brief the geographical or interest-based groups that they serve on, participate in, or recommend, as applicable.

Materials and Media: Standard promotional materials; short PowerPoint presentation with talking points about work plan, progress, and milestones; website, FAQs.

Special Target Audiences: Constituencies represented in the SSIRWMP, regional and sub-regional groups, community-based groups, potential signatories to the MOU.

Next Steps & Timelines: identify initial dates for briefings, prepare materials, develop a priority list for briefings.

Priority list for briefings in 2018-2019 (in order of priority):

1. Disadvantaged Communities - see entities and materials, below;
2. Tribes – Tule River Tribal Council outreach, Big Sandy Rancheria water supply, Cold Springs water supply projects;
3. Counties – Tulare and Fresno;
4. Federal Agencies – Regular briefings (bi-annually or quarterly);
5. Non-governmental Organizations – Regular briefings (bi-annually or quarterly).

Previous Constraints: Need for consistent messaging and characterization of the RWMG's activities, outreach materials. This was addressed through the planning process, developing the outreach materials and the social media-website integration.
Lead: Communication Work Group and all RWMG members.

Potential partners: Organizations in which RWMG members participate.

6. **Communication to elected officials:** RWMG members conduct an annual round of briefings for elected officials and agency executive officers.

Materials and Media: Standard promotional materials, invitation and briefing papers.

Special Target Audiences: State legislative representatives, county supervisors, mayors and councilmembers, federal and state agency executive officers.

Next Steps & Timelines: Develop talking points and memo for invitation to participate or sign MOU, identify appropriate period for briefings and schedule well in advance, identify appropriate briefing format and appropriate group to conduct briefings, develop needed promotional materials and priority list for briefings.

Constraints: Limited availability of elected officials and agency executive officers.

Lead: Communication Work Group and then all RWMG members.

Potential partners: None.

7. **Events:** The RWMG hosts and participates in public workshops or other public events to support the kickoff of the planning process, project development workshops, and the rollout of key deliverables.

Materials: Special announcements; materials to support the event activities.

Special Target Audiences: General public, disadvantaged communities.

Next Steps & Timelines: The RWMG created materials for the October 11, 2012 public kickoff event; briefings and the 2014 Climate Change Workshop, project development workshops and general outreach meetings and briefings.

Constraints: Need for advance scheduling and publicity to ensure turnout, significant logistical and administrative work, and associated costs.

Potential partners: Local organizations, UC Merced, tribes, communities.

8. **Social media:** Distribute news, educational materials, meeting, event, Region, IRWMP-update, website links, and information via Facebook, Twitter, and/or LinkedIn

Materials: Set up SSRWMG accounts for Facebook, Twitter, and/or LinkedIn; develop posts.

Special Target Audiences: General public, stakeholders, future members/stakeholders.

Next Steps & Timelines: Facebook account is established and RWMG will begin adding posts in July 2014. Will explore Twitter and LinkedIn potential in summer 2014.

Constraints: Keeping a consistent, current, and relevant flow of content; leadership.

Potential partners: UC Merced, Tulare Basin Wildlife Partners.

VI. Evaluation

As part of its normal business, the RWMG will evaluate the effectiveness of its communication and outreach efforts on an annual basis, and revise this plan accordingly.

Evaluation Keys:

A. Check in on progress being made toward objectives, and identify and address obstacles to achievement of the objectives;

B. Evaluation must be based on measurable progress towards objectives or tasks that have been identified.

The following metrics are offered to track progress toward reaching objectives:

a. Number of stakeholders on the email list;
b. Website traffic;
c. Feedback from the process;
d. Meeting participation;
e. Media interactions: number of stories and articles published in various media outlets;
f. Number of collaborative, inter-regional projects.

Evaluation Results - 2018

Please see annual reports on the website for specific IRWMP monitoring and metrics tracking.

Evaluation Keys:

A. Check in on progress being made toward objectives, and identify and address obstacles to achievement of the objectives;

B. Evaluation must be based on measurable progress towards objectives or tasks that have been identified.

Objectives:

1. Ensure that interested parties and residents of participating counties are aware of the work, schedule, progress, and programs of the RWMG;
2. Ensure that interested parties and residents have opportunities to provide input to the RWMG's process and programs;
3. Support and engage disadvantaged communities and tribes, two of the highest priority stakeholders in the Region
4. Build the RWMG's network, solicit greater feedback and participation in planning, project development and implementation process;
5. Communicate successes and goals to stakeholders, the general public, and funders;
6. Showcase the beauty and diversity of the region.

Metric Results:

a. Number of stakeholders on the email list - 106;
b. Website traffic – approximately 500 page views and 150 unique website visits each week;

c. Feedback from the process – we have received positive feedback regarding the need for continued efforts and financial assistance;
d. Meeting participation – meeting participation is steady, ranging from 10-18 participants at RWMG meetings;
e. Media interactions: number of stories and articles published in various media outlets – two articles have been published in local/regional news outlets, partners have published two articles on the SSWMG Region;
f. Number of collaborative, inter-regional projects – the RWMG has compiled a list of six project types which are common in the San Joaquin River Watershed (across both Madera and SSRWMG regions):
    a. Septic system maintenance and water treatment;
    b. Wildfire risk reduction;
    c. Water supply/drought;
    d. Fisheries improvement/access;
    e. Water quality improvement;
    f. Floods.

   Therefore, while conceptually thus far, the RWMG has initiated a process to determine which specific projects cross the Madera-SSRWMG boundaries and are interregional. The most promising are water supply studies through partnerships with UC Merced and septic/water treatment systems in communities.

Appendix 1: Potential Audiences and Partners

Audiences:

A. State Agencies
   a. California Department of Water Resources
   b. California Department of Fish and Wildlife
   c. Regional Water Quality Control Board
   d. State Department of Public Health

B. Federal Agencies
   a. Sequoia National Forest and Sequoia and Kings Canyon National Parks
   b. Bureau of Land Management
   c. Army Corps of Engineers
   d. Bureau of Reclamation
   e. US Fish and Wildlife Service

C. Sovereign Nations

D. General Public

E. Communities and NGOs

F. Local and regional media

Partners:

A. RWMG;
B. California Department of Water Resources;
C. Provost and Pritchard Consulting Group;
D. Sierra Nevada Alliance;
E. Sierra Nevada Conservancy;
F. Tulare County;
G. Fresno County;
H. Sequoia National Forest;
I. Sierra National Forest;

J. Springville Public Utility District.

Appendix 2: Potential Press and Media Partners

A. Newspapers

a. **The Porterville Recorder,**
Judy Hall, Ad-Visor
(559) 784-5000 Ext. 1031
jhall@portervillerecorder.com
Donna Copeland, Ad-Visor
(559) 784-5000 Ext. 1030
dcopeland@portervillerecorder.com

b. **Upper Tule River Association Newsletter**

c. **Springville Chamber of Commerce Newsletter**
chamber@springville.ca.us

d. **Kaweah Commonwealth**
The Kaweah Commonwealth
P.O. Box 806
Three Rivers, CA 93271
(559) 561-3627

e. **Visalia Times-Delta**
P. O. Box 31
330 N. West Street
Visalia, California 93279
(559) 735-3200

f. **Mountain Press**
Auberry (no longer in press)

g. **Fresno Bee**
1626 E Street
Fresno, CA 93786
(559) 441-6111

h. **Business Journal**
P.O. Box 126
Fresno, Ca 93707

B. Radio Stations

a. KTIP
b. Valley Public Radio

Appendix 3: Disadvantaged Community and Tribal Outreach and Feedback Strategy

Approximately 50% of the population in the Southern Sierra Region qualifies as Disadvantaged Communities or Economically Distressed Areas. Consequently, assisting DACs has always been a primary goal of the RWMG. These efforts will be further expanded in the updated 2018 IRWMP Chapter on Disadvantaged Communities (described below), and outreach to DACs described later.

The new DAC chapter will include the following:

- Definition of DACs and EDAs;
- Physical location of DACs and EDAs in the region;
- Social and cultural makeup of the region including demographics, income distributions, and other relevant social and geographic data;
- Environmental justice concerns;
- Long-Term Outreach Plan including protocols, goals, practical factors (such as lack of internet access or transportation to attend meetings), outreach methods, metrics for success, and Non-Governmental Organizations that assist DACs (this document is the long-term outreach plan);
- Problems and priorities in DACs and EDAs.

Because of the nature of the Region and the data collection methods, census, income and population data is difficult to integrate into the Region's geographic boundaries and there are therefore several methods for acquiring and analyzing the data. The primary data sources for the DAC determination were the Disadvantaged Community Place, Tract and Block Group shapefiles downloaded from the Disadvantaged Communities Mapping Tool established by DWR (used for the RWMG DWR proposal in 2016). Similarly, the DWR EDA Mapping Tool web page was used to indicate which block groups were considered Economically Distressed. The RWMG and consultants confirmed that the newly identified EDA communities met the combinations of criteria for income, total population, and unemployment (EDD). Geographic areas were included in our counts if they met either the DAC or EDA criteria. DACs identified at the block group, tract and place levels were all combined as they did not overlap geographically (preventing double counting). Finally, the population estimates for DACs/EDAs were compared to those for the entire SSIRWMP boundary to obtain a percentage of approximately 50%.

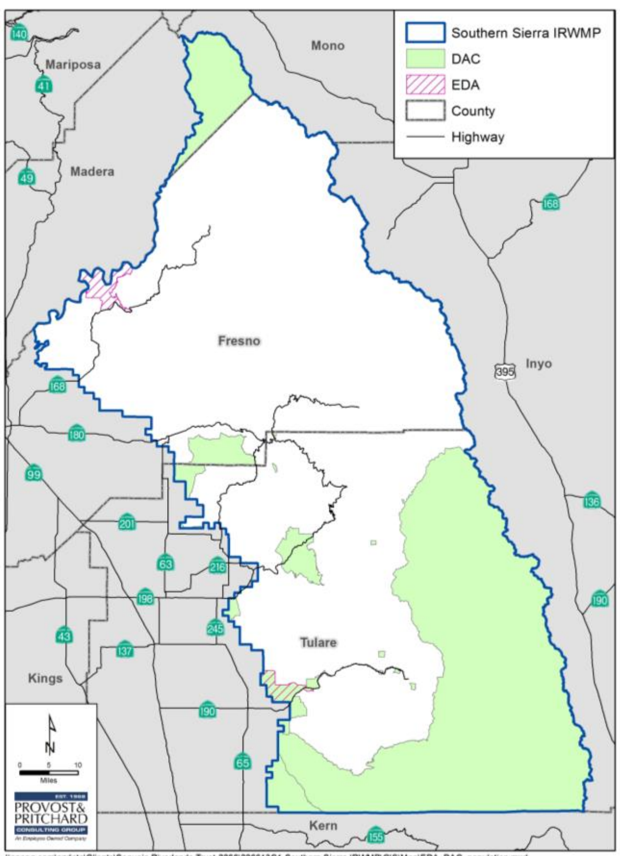
Some large areas in the region (white areas in the map in Figure 1) are not classified as DACs or EDAs, but these are primarily National Park and National Forest lands that have very low population density or no permanent residents.

The DACs and EDAs cover areas with a total population of 16,084. This represents 50.2% of the permanent regional population of 32,040. These areas will be targets in outreach efforts as part of the Planning Grant and after planning is complete. The Region has a relatively low permanent population due to its rural and mountainous nature, but does accommodate millions of seasonal and part time visitors each year.

DACs have been an integral part of the planning and implementation process. Springville, an EDA and DAC, represented by the Springville Public Utilities District has participated in the RWMG since its inception in 2008 and sponsored and proposed projects and provided essential information in the initial IRWMP. Big Sandy Rancheria, a Severely Disadvantaged Community, current is implementing a project in the RWMG Region.

DACs will continue to be an integral part of planning and the RWMG seeks to improve project implementation in DACs in the Region. Supporting and planning projects and adapting to drought and climate in DACs will be a major focus of the IRWMP update. The RWMG seeks to continue to identify specific planning and project needs in these communities and participate in the Tulare Lake and Mountain Counties regional DAC efforts. The RWMG participates in both efforts and will apply information learned since 2008 about the needs in these communities as well as apply information from other DAC-active groups such as the Inyo-Mono RMWG's DAC work to the IRWMP update to best engage and partner with DACs.

Figure 1. General geographic layout for DACs and EDAs in the SSRWMG Region.



DAC and Tribal Outreach Strategy

This section identifies the communities in the Region which are priorities for outreach and engagement and prescribes actions based on overall and specific outreach strategies. The overall goal is to identify all possible communities, and contact points, including those communities adjacent or on the regional boundary. Once these communities are identified with appropriate contacts, materials are regularly sent to stakeholders, the materials relate to meetings, programs, projects or funding and are posted and linked/cross-linked to website and also cross-referenced and linked via social media. Then, social media visits, views and website visits and views can be tracked. Meeting participation, briefings and other items are also utilized to track responses, engagement and refine future actions.

Direct engagement is very important in the Region. Direct engagement in the many locations in remote areas (see figures 2, 3) in the Region includes:

1. Flyers, materials and articles posted and written in relevant communities;
2. Presentations and discussions at chambers of commerce mixers, community events and town halls;
3. Incidental contacts and discussions in communities;
4. Discussions with landowners and agencies;
5. Formal and informal briefings;
6. Responses to agency or other outreach efforts.

During direct engagement and contact activities, participants will be asked to respond to some simple questions which may be standardized into a questionnaire. These data will be utilized to encourage, facilitate and track issues, needs and engagement from the communities.

Educational Materials and Distribution Plan

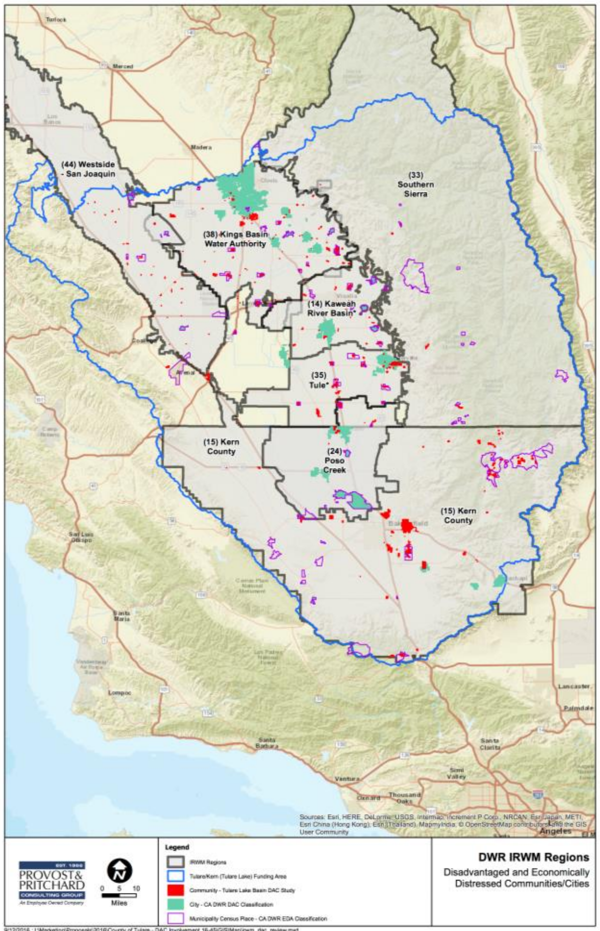
Aside from the general watershed education and IRWMP information, the RWMG developed and distributed the following materials for work with project proponents, DACs and tribal entities:

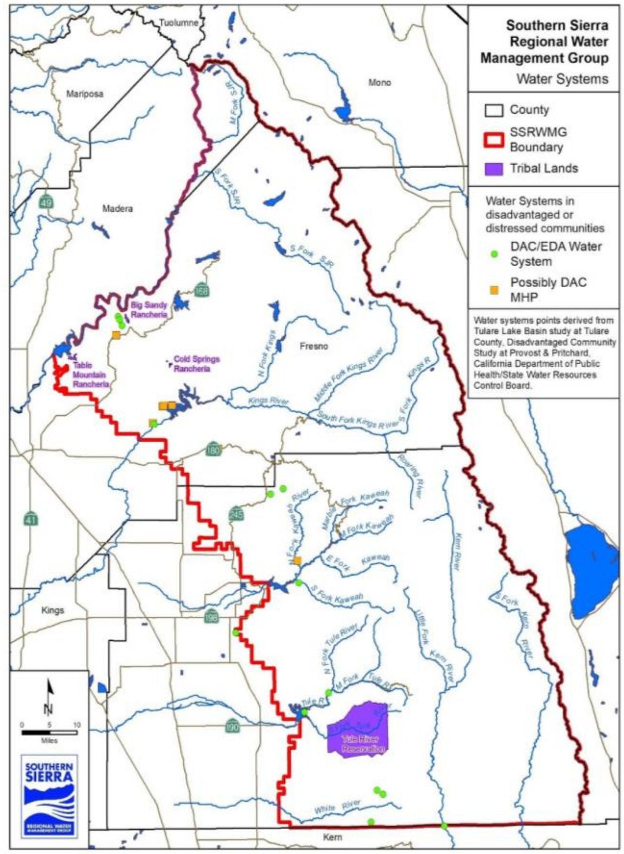
1. Regional Projects handout;
2. Integrated Projects Handout;
3. Climate Change Handout;
4. Funding and proposal-specific materials.

The objectives for the material distribution include:

A. Distribute materials to the public and stakeholders in a variety of formats during and after the IRWMP-update process;
B. Develop standardized tracking, data, and outreach forms and tracking 2018-19 to track locations, responses and numbers.

The RWMG has compiled the communities, tribal entities, the majority of their reported incomes and their DAC status, where possible (see tables 1-3).





Figures 2-3 - Disadvantaged Communities, Tribal Areas, and Economically Distressed Areas in the Southern Sierra Region.

Table 1. Tribal Entities and Outreach in the SSRWMG Region.

Tribal Entity	Population	Income	Status	Outreach Summary/ Member Status
Big Sandy Rancheria	Unk	Unk	SDAC	Member, adopted IRWMP
Tule River Indian Reservation	1,200	Unk	SDAC	Member, need projects

Dunlap Band of Mono	Unk	Unk	Unk	Contacted
Cold Springs Rancheria	Unk	Unk	SDAC	Contacted
Table Mountain Rancheria	Unk	Unk	Unk	Contacted

Table 2. Census Designated Places identified for the Planning Grant Proposal, 2016, and associated outreach/member status.

Place ID Number	**Name**	**Population**	**Median Household Income**	**Status***	**Outreach Summary/ Member Status**
678638	Three Rivers CDP	2142	38,988	DAC	CSD contacted
641110	Lemon Cove CDP	195	21250	SDAC	No contact
673710	Springville CDP	824	35,313	SDAC	Member
670966	Sequoia Crest CDP	28	0	SDAC	No contact
658134	Ponderosa CDP	23	0	SDAC	Contacted
657011	Pierpoint CDP	24	0	SDAC	No contact
638076	Kennedy Meadows CDP	18	0	SDAC	Contacted
657134	Pine Flat CDP	142	20,208	SDAC	Contacted
609822	California Hot Springs CDP	119	38,875	DAC	No contact
644770	McClenney Tract CDP	6	0	SDAC	No contact
658422	Posey CDP	10	0	SDAC	Contacted
636168	Idlewild CDP	31	0	SDAC	No contact

675596	Sugarloaf Village CDP	11	20,625	SDAC	No contact

* DAC Mapping Tool and Data:

http://www.water.ca.gov/irwm/grants/resources_dac.cfm

The table below identifies 21 communities/water companies that are likely DAC or EDA according to the definitions provided above and pursuant to DWR Mapping Tool, with some further refinement based upon data collected for the Tulare Lake Basin Disadvantaged Community Survey, and some local knowledge. However, of these 21 locations, 11 [9 mobile home parks (MHP), and 2 small mutual water company service areas] lie within very large block groups with other scattered SFR homes – potentially second homes and vacation homes – resulting in the MHI for that large block group to be above the State MHI. Therefore, although they are suspected of being DAC and/or EDA based upon local familiarity, data is not available for the specific location to confirm DAC and/or EDA status. (See figures 2, 3 for locations)

Table 3. - SS IRWMP Region Disadvantaged Communities with Less than 80% of Statewide Median Household Income and Economically Distressed Areas with Less than 85% of Statewide Median Household Income

Location Name	Population	Median Household Income (MHI) 2014	Percent of Statewide MHI ($63,783) 2014	Severely Disadvantaged < 60% of Statewide MHI ($38,270)	Outreach Summary/ Member Status
Doyle Mobile Home Park	22	NA	-	-	No contact
Lake Success Mobile Lodge	20	$38,393	60%	no	No contact
Tooleville Water Company	350	$29,354	43%	yes	No contact
Pine Flat Water Company	110	$23,558	37%	yes	No contact
Community of Posey	79	$23,558	37%	yes	No contact
Springville Public Utility District	1300	$35,682	57%	yes	Member
Riverkern Mutual Water Company	336	$38,139	59%	yes	Contacted

Sierra Glen Mobile Home Park	22	$35,341	55%	yes	No contact
California Hot Springs Water Company	75	$23,558	37%	yes	No contact
Community of Hartland	36	NA	-	-	No contact
Mary Lou Mobile Home Park	52	$41,379	65%	no	No contact
Mt. Ararat Mobile Home Park	41	$41,379	65%	no	No contact
New Auberry Water Association	200	$41,379	65%	no	Contacted
Rio Vista Mobile Home Park	20	$42,188	66%	no	Contacted
River Retreat Mutual Water Company	100	$74,375	1.66%	no	No contact
Sandy Creek Village Mobile Home Park	135	$58,158	91%	no	No contact
Note: The 5 locations listed below could be DACs, but because they lie within very large block groups with other SFR homes – potentially second homes and vacation homes – the block group MHI is above the Statewide MHI. Data is not available for the specific locations to confirm DAC status. The Tulare Lake Basin DAC study did not make a DAC determination for these 5 locations.					
Biggers Ponderosa Trailer Park					No contact
Driftwood Mobile Home Park					No contact
Kings Canyon Mobile Home Park					No contact
Oak Knolls Trailer Park					No contact
Trailer Isle Park					Contacted

Source: U.S. Census, American Community Survey, 2014 (most recent data). Median income is for all households, regardless of household size.

The locations with "No contact" noted in tables 2, 3 indicate the need for engagement and feedback during outreach activities. The larger entities with lowest capacities are the highest priorities, generally. Feedback from these entities and others who were already contacted will form the basis for additional outreach, funding, projects, programs and future IRWMP updates.

Appendix 4: Educational Materials

1. RWMG Brochure;
2. IRWMP Overview Presentation;
3. Regional Projects handout;
4. Integrated Projects Handout;
5. Climate Change Handout;

Appendix 5: 2014-2018 Outreach Summary

Year	Date	Group or Event	Type	Category	Time	Outcome
		Springville PUD Board Meeting	Presentation	Agency/DAC	4	Requested Board adopt and utilize IRWMP
		Tribal Forum	Presentation	Tribal/SDAC	16	Requested Projects and provided overview
		Yosemite/Sequoia RC & DC	Presentation	Agency/DAC	6	Presented and participated in meadows implementation and design workshop
2014	Sep-14	Sequoia-Kings Canyon	Presentation	Agency	3	Briefed management team on process and projects
	Oct-14	Collaboration and Water Mangement	Article	all	6	Op-ed/article published in Visalia Times Delta
	Nov-14	Big Sandy Rancheria Board Meeting	Presentation	Tribal/SDAC	6	BSR Adopted IRWMP
	Nov-14	Sierra Nevada Conservancy	Phone call	Agency	1	Provided briefing on IRWMP
	Oct-14	Sierra Club	Presentation	Non-profit	2	Provided briefing on IRWMP
	Oct-14	Springville Landowners	Briefing	DAC	2	Provided briefing on IRWMP
2014	Aug-14	Three Rivers Community Services District	Presentation	EDA	4	Briefing to Board regarding particpation, benefits.
2014	Sep-14	USFS - Sequoia National Forest, Springville PUD	Briefing	Agency/DAC	8	Briefing to staff officers and Board members regarding projects and process.
2014	Dec-14	Meeting and general outreach	Phone call	all	2	Reached 12 members
2014	Dec-14	Central Sierra Watershed Committee	Presentation	DAC/EDA	4	Provided briefing on IRWMP
2015	Jan-15	Springville PUD Board Meeting	Presentation	DAC	4	Briefing to Board regarding particpation, benefits, projects.
2015	Feb-15	Tribal Forum	Presentation	Tribal/SDAC	6	Provided briefing on funding, projects, reached out to Big Sandy R, Tule River Tribe, North Fork Mono.
2015	Mar-15	Meeting and general outreach	Phone call	all	2	Reached 10 members
2015	Apr-15	Sierra RCD, Madera IRWM, Y/S RC&DC	Workshop	all	4	Workshop/brainstorm session regarding SJ & Kings River Watershed Action Plans.
2015	May-15	SPUD Board Meeting	Briefing	DAC	3	Provided briefing on funding, projects
2015	Jun-15	Big Sandy Rancheria Board Meeting	Projects Presentation/Planning Discussion	Tribal/SDAC	6	BSR Pre-application form, request for assistance.
2015	Jun-15	Meeting and general outreach	Phone call	all	1	Reached 12 members
2015	Jun-15	Project Development Workshop	Workshop	all	6	Two new projects/ideas were proposed.
2015	Jul-15	Tulare Basin JPA meeting	Projects Presentation/Planning Discussion	Agency/DAC	4	Received feedback regarding projects and collaboration.
2015	Aug-15	Three Rivers Town Hall Meeting	Presentation	EDA/DAC	3	Presentation on water supply project for Three Rivers with DWR.
2015	Sep-15	Meeting and general outreach	Phone call	all	1.5	Reached 10 members
2015	Dec-15	Meeting and general outreach	Phone call	all	1.5	Reached 12 members
2016	Jan-16	UC Merced	Meeting	all	2	Briefing regarding projects and process.
2016	Feb-16	Water Quality Partners Collaborative Meeting	Workshop	all	5	Collaboration for water quality after the Rough Fire
2016	Mar-16	Meeting and general outreach	Phone calls	all	2	Reached six members.
2016	Apr-16	USFWS	Meeting/workshop	all	12	Workshop on SJV/Sierra Climate Adaptation and Resiliency.
2016	May-16	Big Sandy Rancheria Board Meeting	Projects Presentation/Planning Discussion	SDAC	6	Technical Assistance application and follow-up conference call with State Water Resources Control Board
2016	Jun-16	Meeting and general outreach			2	Reached 12 members/stakeholders
2016	Jul-16	Mountain Counties FA Funding, collaboration, DAC workshop	Presentation/workshop	DAC	32	Provided presentation on SSRWMG, program, projects, DAC.

Year	Date	Group or Event	Type	Category	Time	Outcome
2016	Sep-16	Climate Change Impacts and Adaptation in the Tulare Basin Watershed	Presentation	Agency/DAC	6	Presented Sierra Climate to Ag and Agencies, DAC
2016	Oct-16	Big Sandy Rancheria	Phone call	SDAC	1	Follow-up phone call regarding project application and funding
2016	Nov-16	State Water Resources Control Board	Meeting/workshop	DAC/EDA	4.5	Meeting/workshop with SRCD, Big Sandy Rancheria, SWRCB, Y/SRC&DC.
2016	Dec-16	Three Rivers Water Supply Study	Memorandum/ Communique	DAC/EDA	2	Provided data and contacts regarding the final report from the study
2017	Jan-17	DAC outreach involvement memo	Memorandum/ Communique	DAC	2	Prepared and delivered DAC outreach involvement memo to Tulare County
2017	Feb-17	Foothill erosion control best management practices	BMPs	DAC	2	Provided guidance on BMP materials format and distribution, received BMP Powerpoint Presentation
2017		Dinkey Collaborative Meeting	Meeting/workshop	all	6	Provided briefing on funding, projects
2017		Watershed Connections	Memorandum/ Communique	Agency	3	Provided briefing on funding, projects
2017		Project Development Workshop	Meeting	Agency/DAC	6	Three new projects in the San Joaquin, Kings River watersheds
2017	Mar-17	Project Development Workshop	Meeting	Agency/DAC	8	Toured several projects, invited funding organization
2017	Apr-17	USFS - Sequoia National Forest, Springville PUD	Phone calls	Agency/DAC	1	Outreach regarding projects, programs, meeting sponsorships.
2017	Jun-17	Tulare Basin DAC meetings, outreach.	Meeting	DAC	10	Provided primary and alternate reps, feedback on proposal, process, participated in collaborative meetings.
2017	Jun-18	Meeting and general outreach	Phone calls	all	1	Reached five members.
2017	Jun-18	Dinkey Collaborative Meeting	Meeting	Agency/DAC	4.5	Discussed current projects, process, data for IRWMP, funding for three meadows.
2017	Aug-17	Mountain Counties FA meetings	Meeting	DAC	20	Provided primary and alternate reps, feedback on proposal, process, participated in collaborative meetings.
2017	Aug-17	Sequoia National Forest	Briefing	Agency	4.5	Provided briefing on funding, projects, solicited info on data, regional planning.
2017	Aug-17	Sierra RCD	Briefing	Agency/DAC	2	Discussion regarding projects, program, represenation.
2017	Sep-17	Meeting and general outreach	Phone calls	all	2	Reached 10 members
2017	Oct-17	Yosemite/Sequoia RC & DC meeting	Meeting	all	6	Provided overview to Council and reached out to Fresno District Supervisor at meeting.
2017	Oct-17	UC Merced Project Workshop/Tour	Workshop/Tour	all	8	Tour and project workshop of Upper Kings River Watershed to view recent research, drought, fire and other impacts on water supply, quality.
2017	Oct-17	Watershed Connections	Headwaters to Groundwater Symposium	Symposium/Agency	8	Participated in Collaborative meeting, performed outreach to communities, irrigation districts and groundwater associations.
2017	Nov-17	Fresno County	Phone call	Agency/DAC	2	Provided briefing on funding, projects
2017	Nov-17	Blue Forest Conservation/National Forest Foundation	Meeting	all	2	Project funding and phasing meeting, data, proposal, etc.
2017	Nov-17	Three Rivers Town Hall Meeting	Meeting	EDA/DAC	4	Participated in land-use and water planning discussion, flood preparedness, biology/ecology.
2017	Dec-17	Fresno Economic Development Corporation	Projects Presentation/Planning Discussion	DAC/EDA	2	Provided briefing on funding, projects
2017	Dec-17	Sierra RCD	Projects Presentation/Planning Discussion	Agency/DAC	3	Project funding and phasing meeting, planning discussion on DAC.

Year	Date	Group or Event	Type	Category	Time	Outcome
2017	Dec-17	Tulare County	Projects Presentation/Planning Discussion	DAC/EDA	2	Meeting/briefing with Tulare County re: DAC, planning process, funding.
2017	Dec-17	Meeting and general outreach	Phone calls	all	1	Reached 10 members
2017	Dec-17	Meeting and general outreach	Phone calls	all	2	Reached two members who couldn't attend.
2017	Dec-17	Watershed Connections	Presentation/Planning Discussion	Collaborative /Agency/DAC	2	Article published in the Tulare Basin Watershed Series
2018	Jan-18	Outreach to SRCD	Projects Presentation/Pl	Agency/DAC	2	Discussed current projects, process, data for IRWMP.
2018	Feb-18	DAC mapping and census block memo	Memorandum/ Communique	DAC	4	Met with DAC representatives and provided mapping and community information.
2018	Mar-18	Dinkey Collaborative Meeting	Meeting	all	7	Participated in Collaborative meeting.
2018	Mar-18	Tulare Basin IRWMP Meeting	Meeting	all	3.5	Participated in Collaborative meeting, performed outreach to communities, irrigation districts and groundwater associations.
2018	Mar-18	Cold Springs Rancheria	Phone call	Tribal/SDAC	1	Follow-up phone call regarding project application and funding.
2018	Mar-18	Watershed Connections, collaboration and watershed planning and implementation	Article	Agency/DAC	3	Article published in the Tulare Basin Watershed Series
2018	Mar-18	Meeting and general outreach	Phone calls	all	2	Reached six members.
2018	Mar-18	SRCD Board Meeting	Meeting	Agency/DAC	4.5	Provided briefing on funding, projects, DAC process.
2018	Apr-18	Website/social media	Website postings update	all	4	Transferred info from files to website, updated, calendar, photographs, site design, layout, added outreach materials
2018	Apr-18	Three Rivers Town Hall Meeting	Meeting	EDA/DAC	4	Participated in land-use and water planning discussion, flood preparedness, biology/ecology.
2018	May-18	Website/social media	Website postings update	all	10	Updated website with meeting information, plan chapters, calendar items. Posted public notices
2018	May-18	Public noticing	Public Notices	all	2	Prepared and delivered public notices to publishers.
2018	Jun-18	Website/social media	Website postings update	all	12	Updated website with 2017 field trip information, videos, added meeting notes, education materials.
2018	Jun-18	Meeting and general outreach	Phone calls	all	2	Reached five members.
2018	Jun-18	Tulare Basin DAC	Committee meeting	DAC	4	Participated in DAC steering committee meeting and direction of DAC needs assessment.
2018	Jul-18	Tule River Tribal Council	Presentation	Tribal/SDAC	6	Provided overview to Council and toured projects, sites
2018	Jul-18	Website	Website postings update		12	Posted field trip videos, presentations, meeting, educational and project information
2018	Aug-18	Tule River Tribal Council	Presentation/projects tour/discussion	Tribal/SDAC	6	Outreach on funding, projects, toured projects.

Appendix O

Regional Water Management Group Brochure

Get Involved!

The IRWM planning process is under way *now*. Become a part of the process, contribute to integrated water management in the Sierra Nevada, and ensure your agency goals and projects are represented!

Ways to stay informed and be involved:

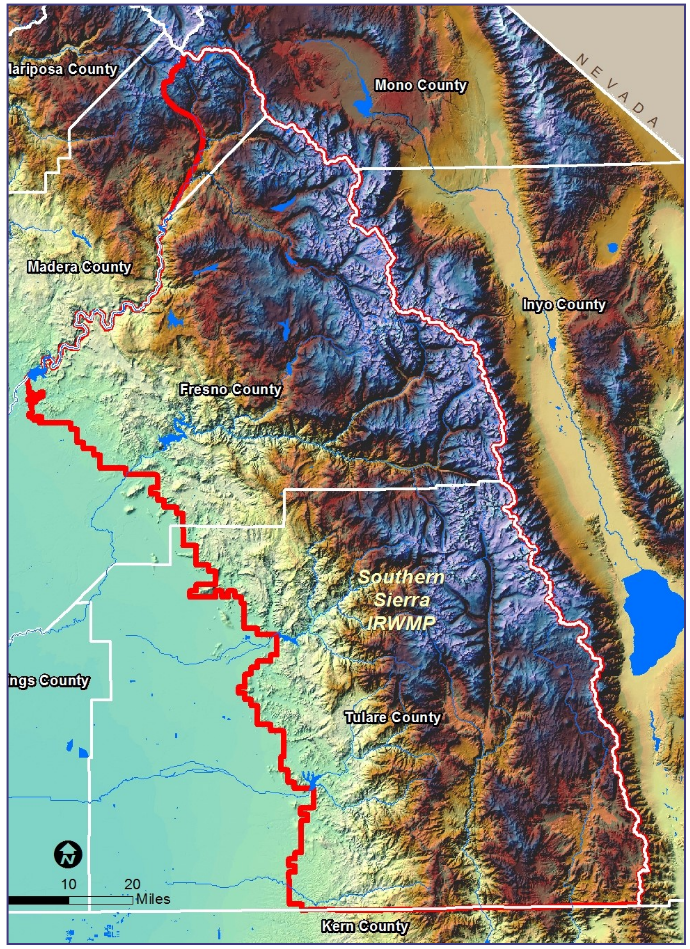
1. Attend Regional Water Management Group Meetings. The group meets on a bi-monthly basis in 2014;
2. Have your organization review and sign the Memorandum of Understanding which guides the process and ensures broad stakeholder involvement;
3. Submit projects and project ideas to the group for integration, development and potential funding;
4. Help write a grant, fund a project or assist with reaching other organizations with interests in water management;
5. Lend you or your agency's expertise!

Contact:

Chris Moi, Project Manager,
Sequoia Riverlands Trust
(559) 738-0211
chris@sequoiariverlands.org

Visit www.southernsierraRWMG.org for more information and to view a calendar of upcoming meetings and events.

The Southern Sierra RWMG Region



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SOUTHERN SIERRA

REGIONAL WATER MANAGEMENT GROUP

Collaborating for Science-based Integrated Regional Water Management in California's Southern Sierra

An Integrated Approach to Regional Water Management

The Southern Sierra Regional Water Management Group (RWMG) is a voluntary collaboration of nonprofits, government agencies, and landowners committed to creating better water management outcomes for the Southern Sierra region – from the headwaters of the San Joaquin River south to the source of the Kern River, from the grand peaks of the Sierra Nevada east to the Valley foothills. The Southern Sierra RWMG is recognized by the state of California as an Integrated Regional Water Management (IRWM) group that has the authority to apply for project planning and implementation grants. As a group, they:

- Utilize sound science, best available data, and local knowledge to inform project decisions
- Foster a broad, long-term approach to increasing regional self-sufficiency and sustainable resource management
- Promote broad public engagement, coordination, and collaboration to leverage benefits across the region and reduces costs.

What is an Integrated Regional Water Management Plan (IRWMP)?

An IRWM Plan is a region-wide, voluntary planning document that identifies broadly supported, multiple-benefit water resource projects and programs. It is:

- Non-regulatory
- Collaborative
- Non-binding
- Consensus-based
- Generates multiple-benefit projects
- Integrates land use and water planning

An IRWM Plan is developed regionally and includes input from many diverse, local stakeholders. It investigates a broad spectrum of water resource issues, including water supply, flood and stormwater management, water quality, environmental ecosystem protection and restoration, recreation, land use and stakeholder involvement.

IRWM Plans integrate a variety of water management strategies to solve multiple challenges. IRWM Plans can attract state and other funding to support regional projects.

Proposition 84, approved by California voters in 2006, allocated $1,000,000,000 in funds for IRWM planning and the water-related project implementation. The IRWM program is entering into its third and final project implementation grant cycle.

Southern Sierra Regional Water Management Successes

The Southern Sierra IRWM planning effort began in 2008 when the Sierra Nevada Conservancy awarded Sequoia Riverlands Trust (SRT) $50,000 to identify stakeholders and organize public meetings.

After successfully forming the SS RWMG, SRT received $50,000 in facilitation support funds from DWR in 2010 and 2012 to continue engaging stakeholders in the IRWM process. In 2012, the SS RWMG applied for and received $520,000 to write its IRWMP.

In 2013, the SS RWMG submitted applications to implement three projects, of which two have been funded. The National Fish and Wildlife Foundation will fund the Long Meadow Restoration Project and DWR will conduct a hydrologic capacity study for the town of Three Rivers.

The SS RWMG is currently in the process of developing its IRWMP with support from Provost & Pritchard Consulting Group. The group is also considering projects to submit for funding through Round 3 of the IRWM grant cycle. Proposals are due in the fall of 2014.

Appendix P

Public Outreach Presentations

Integrated Regional Water Management in the Southern Sierra

By Owen Kubit, PE and David Norman
Provost & Pritchard Consulting Group

AWRA Conference on Integrated Water Resources Management
July 2, 2014

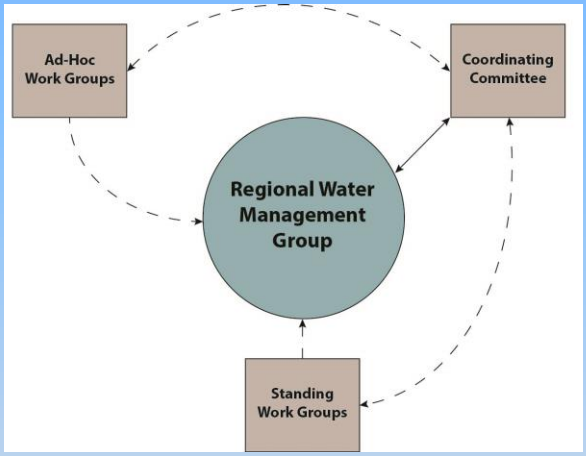
History of Southern Sierra Regional Water Management Group

- 2008 – Regional Water Management Group formed
  - Launch grant from Sierra Nevada Conservancy
  - No true regional or integrated planning before 2008
- 2009 - Memorandum of Understanding
- 2008 – 2014 - Meetings / public outreach / integration efforts
- 2012 - Received grant to prepare Regional Water Management Plan
- 2014 - Will complete Regional Water Management Plan

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Membership and Governance

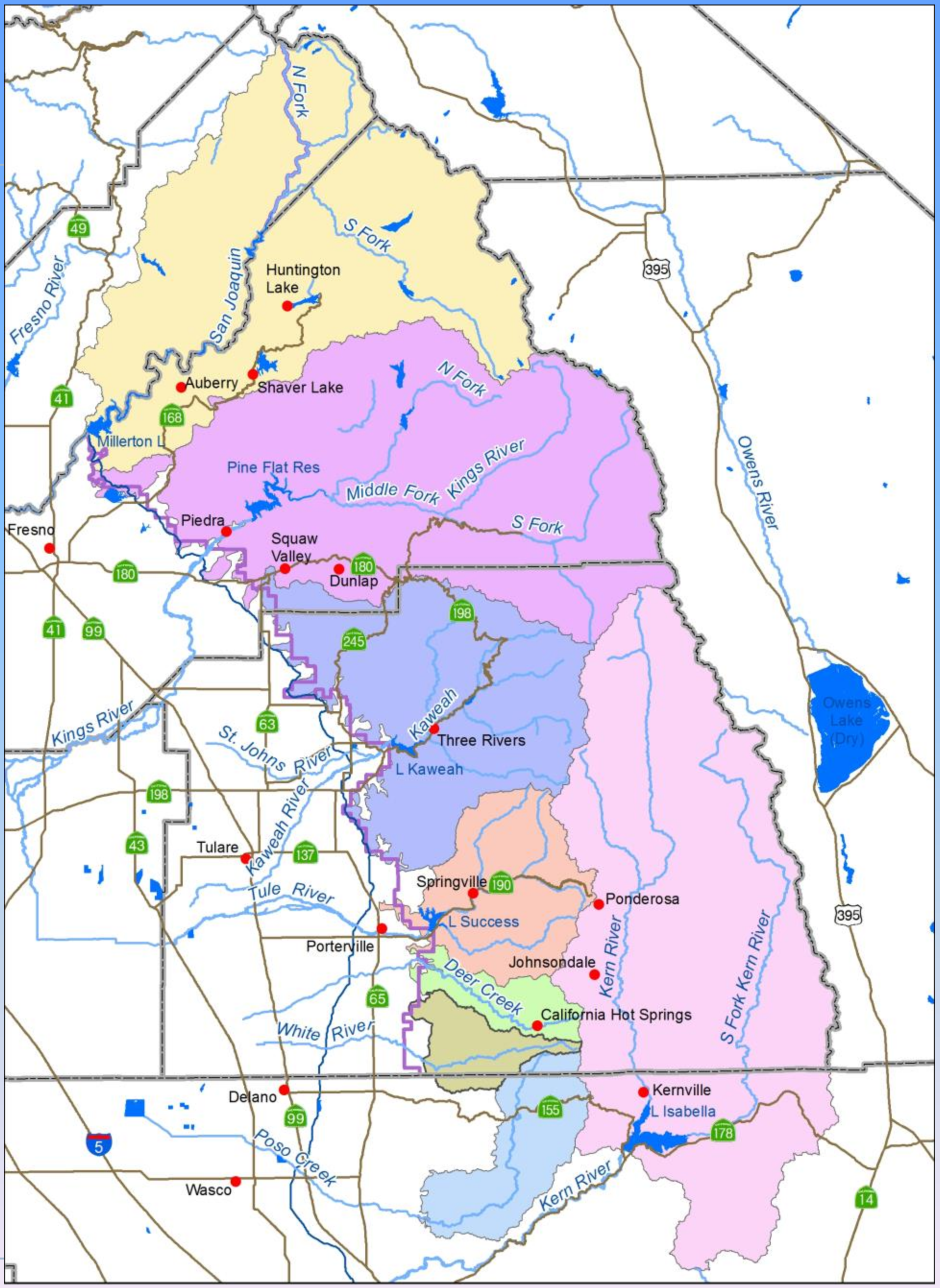
- Regional Water Management Group
  - 18 Members / Numerous Interested Parties
  - Open to any organization with interest in local water management
  - Organized under MOU
  - No annual dues (good and bad)
  - Meet bi-monthly
  - Voluntary / non-binding / non-regulatory
- Committees and Work Groups
  - Regional Water Management Plan preparation
  - Financing
  - Project selection



SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Watershed Map

- Eight different watersheds
- Small creeks to large rivers
- Only includes upper portion of watersheds
- Base of foothills to crest of Sierras
- Watersheds to vast agricultural lands in San Joaquin Valley

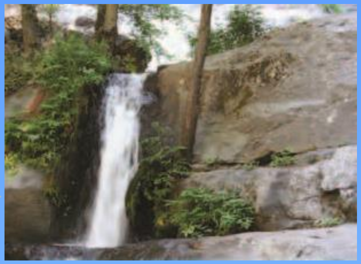


Principal Features of Region

- 4 million acres (6,200 square miles)
- Entirely within foothills and mountains
- Topography 600 to 14,000 feet
- Primarily granitic rock
- Covers three different counties in Central California

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Unique Features of Region

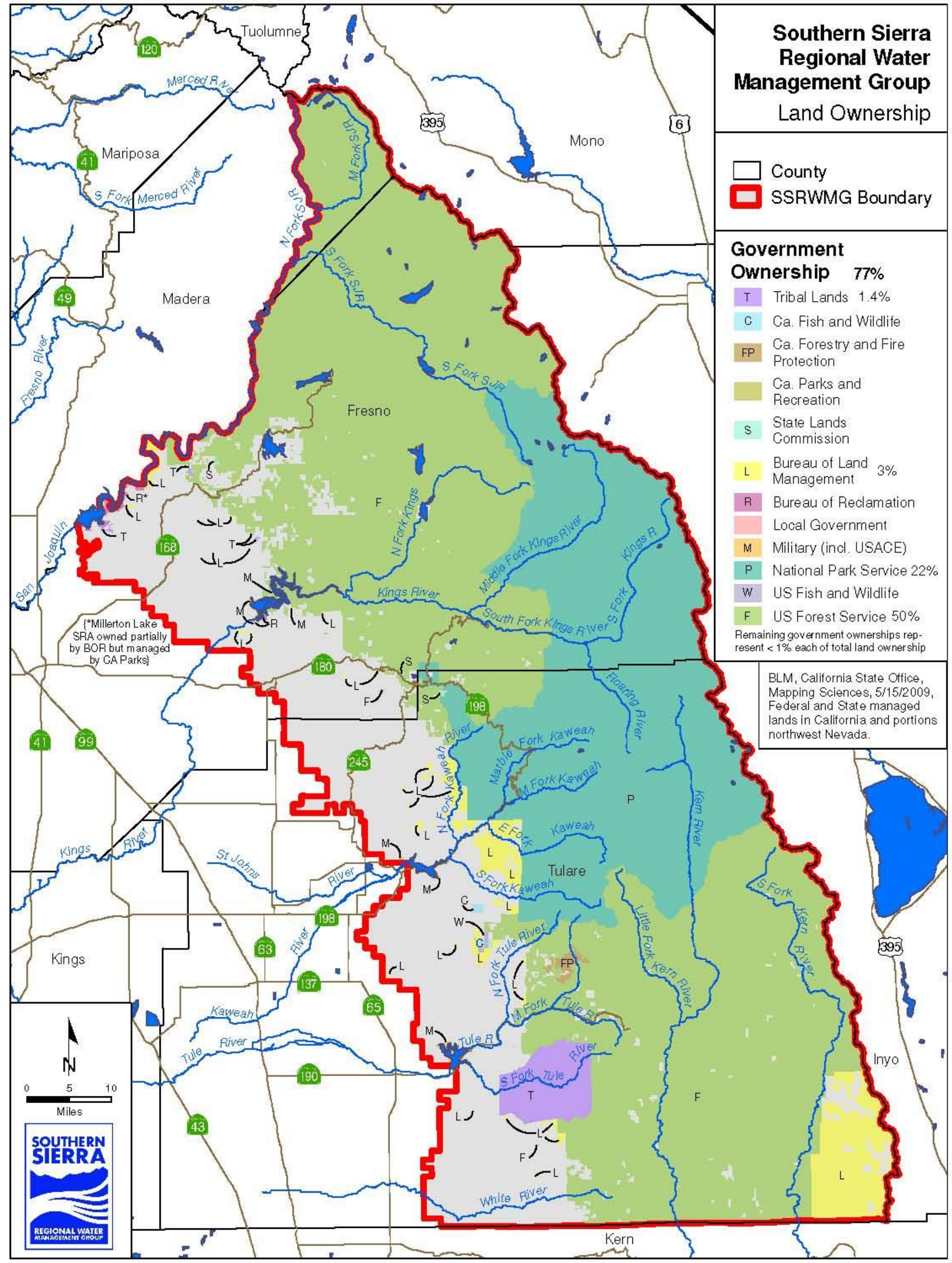


- Lack of defined groundwater basins
- Vast quantities of surface water used outside of region
- Sequoia and Kings Canyon National Parks
- Giant Sequoia groves (including world's largest tree)
- Almost all wilderness / semi-wilderness areas

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

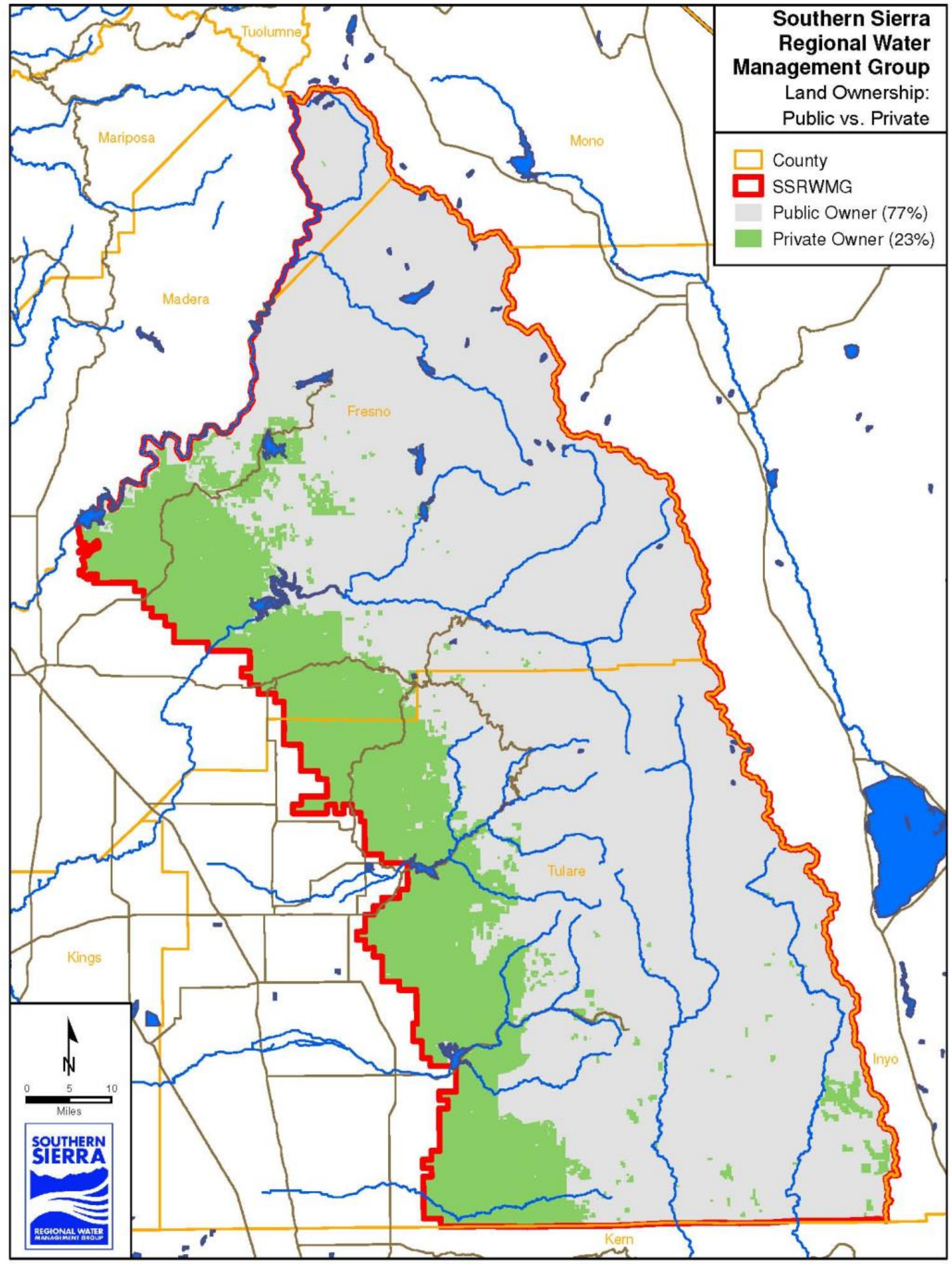
Land Ownership

- Large areas covered by National Forests or National Parks
- Three recognized Native American Tribes



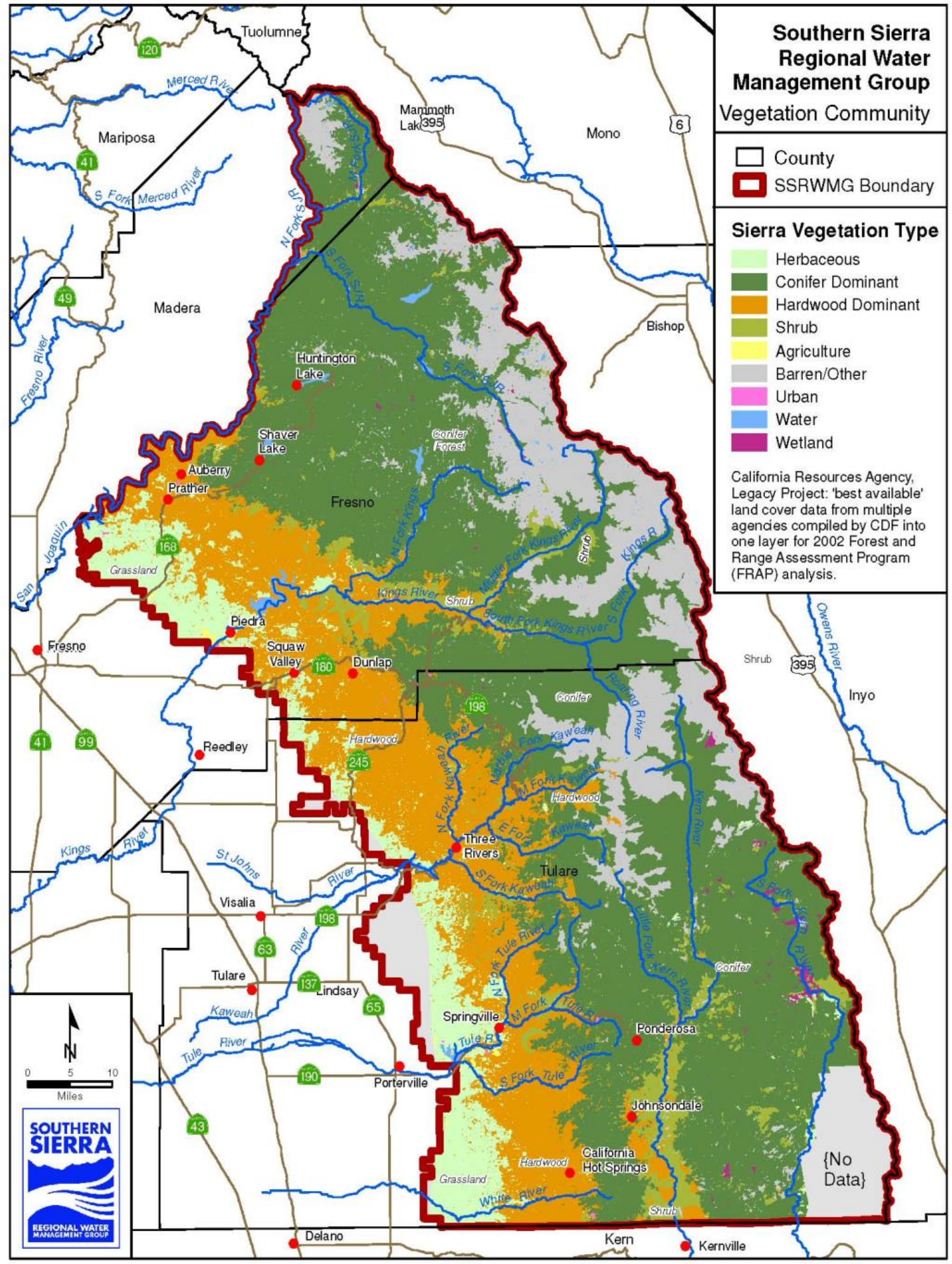
Federal / Private Land Ownership

- Primarily public lands
- Most public lands managed with water supply in mind
- Foothill areas largely privately owned ranches and farms.



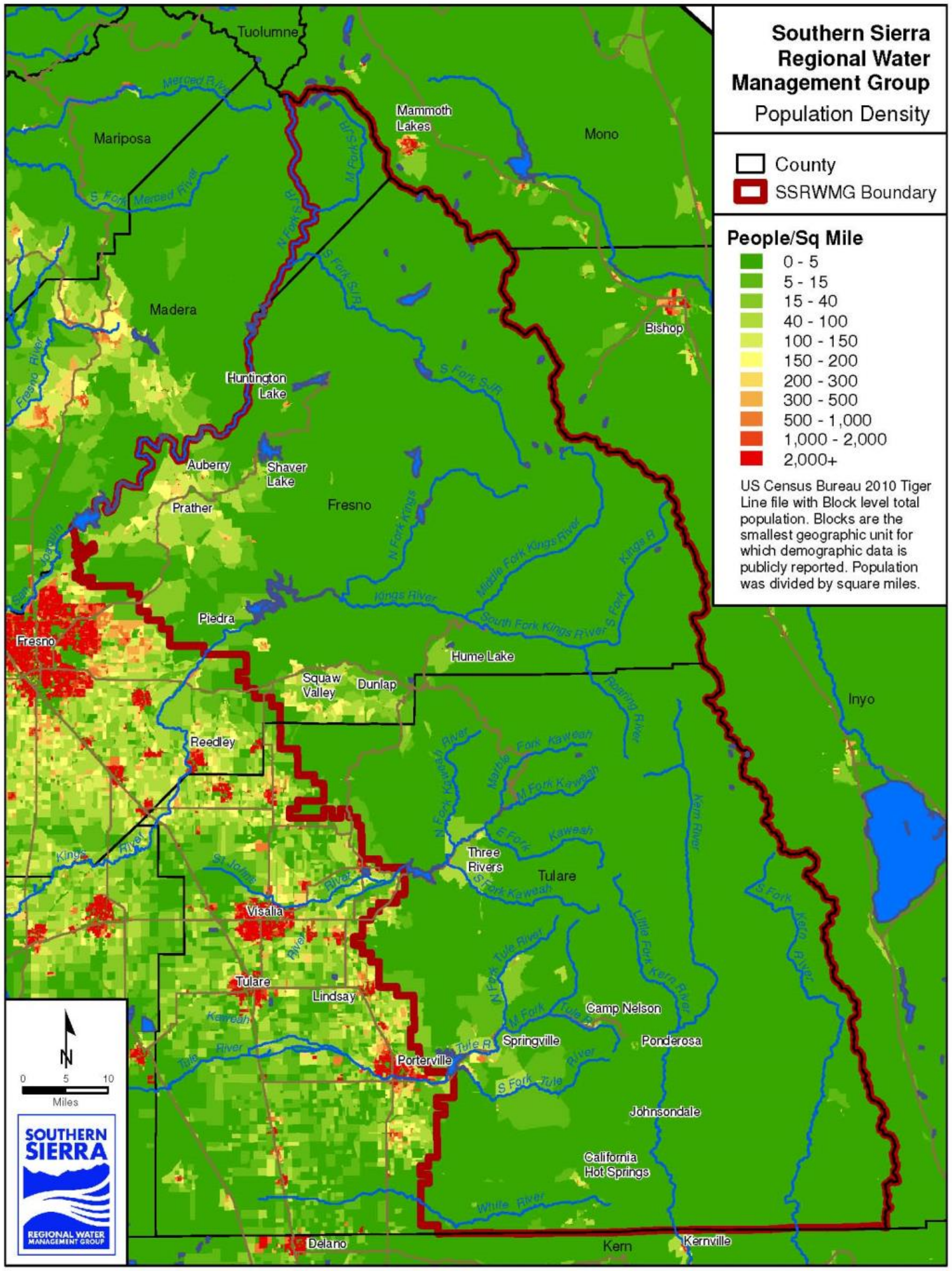
Land Uses

- Range from brush to forest to alpine
- Largely hardwood and coniferous forest
- Small areas of agricultural / urban lands



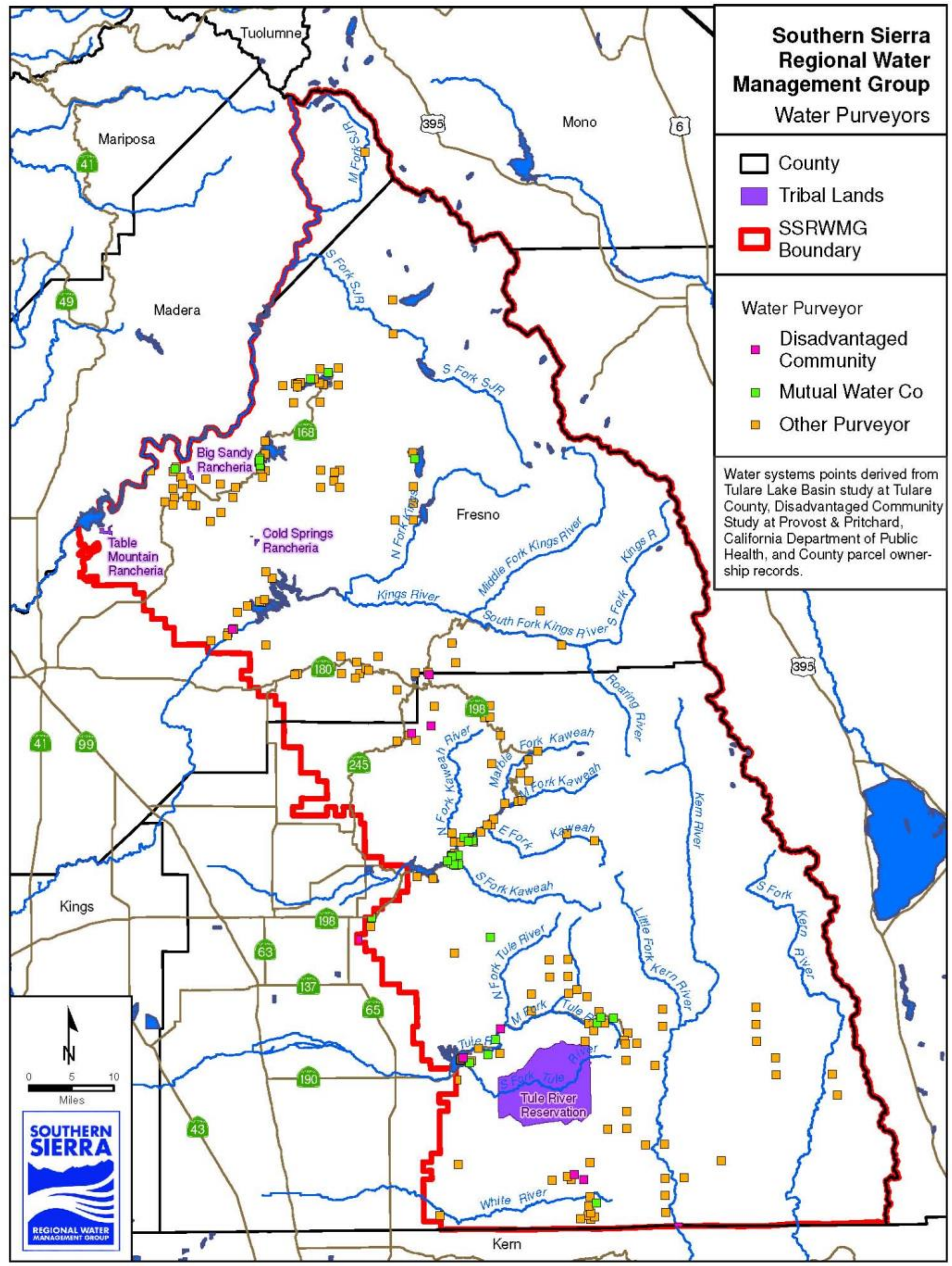
Population Density

- Entire area low population density
- No incorporated cities
- High population density downstream
- < 50,000 residents
- > 1.6 million visitors annually (stress on groundwater supplies)



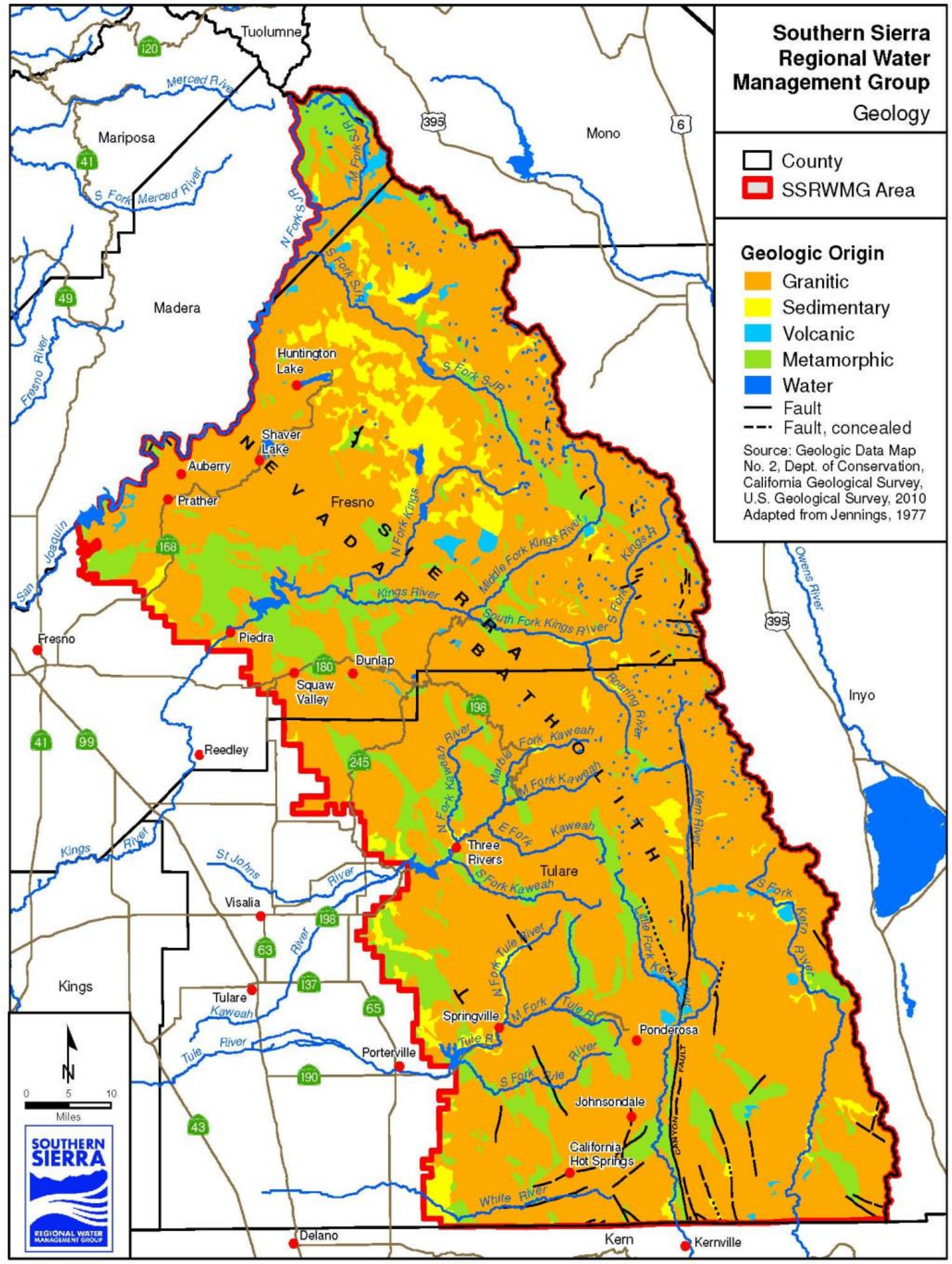
Water Purveyors

- Numerous water purveyors in region
- Most water purveyors very small – not represented in Regional Water Management Group
- Water purveyors generally in two groups:
  - Disadvantaged community
  - Affluent vacation community

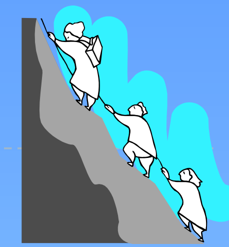


Regional Geology

- Primarily hard rock aquifers
- Shallow soil layers
- Granite most common rock type
- Small areas of alluvium along rivers



Water Management Challenges



- Large geographic area
- Small population
- Disadvantaged communities
- No large agency to lead Regional Water Management Group
- Shortage of water agencies with rate payers (Federal agencies, NGOs)

- Vast surface water supplies used outside of area
- Limited groundwater supplies
- Limited data on water resources

- Increasing development in foothills
- Numerous small water purveyors

- Impacts of fire on water supply/quality
- Septic systems / nitrate pollution

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Federal Land Management

- National Forests
  - Manage watersheds to improve water supply and quality (erosion control, forest thinning, road mang., etc.)
  - Develop forest products and resources
  - Constantly manipulating watersheds
  - Maintains / improves existing water infrastructure
- National Parks
  - Prefer to leave watersheds untouched
  - Removes infrastructure
  - Manage water through preservation (hands off approach)
  - Do little to 'manage' water
  - Do restore some damaged habitats (i.e. meadows)

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP

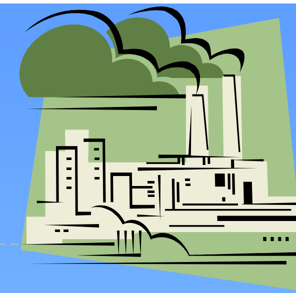
Groundwater and Surface Water

- Groundwater
  - No defined groundwater tables or basins
  - Primarily fractured granite
  - Low storativity / variable transmissivity
  - Difficult to quantify supplies
  - Replenishment unpredictable

- Surface Water
  - Vast quantities (millions of acre-feet) flow out annually
  - Fully appropriated in downstream areas
  - Used very little locally
  - Number one export from region

Regional Goals and Objectives

- Primary Goals:
  1. Improve Water Supply Management
  2. Protect and Improve Water Quality
  3. Perform Integrated Flood Management
  4. Improve Watershed / Environmental Resources Management
  5. Expand Stakeholder Education
  6. Protect Unique / Important Environmental Resources



Climate Change Model

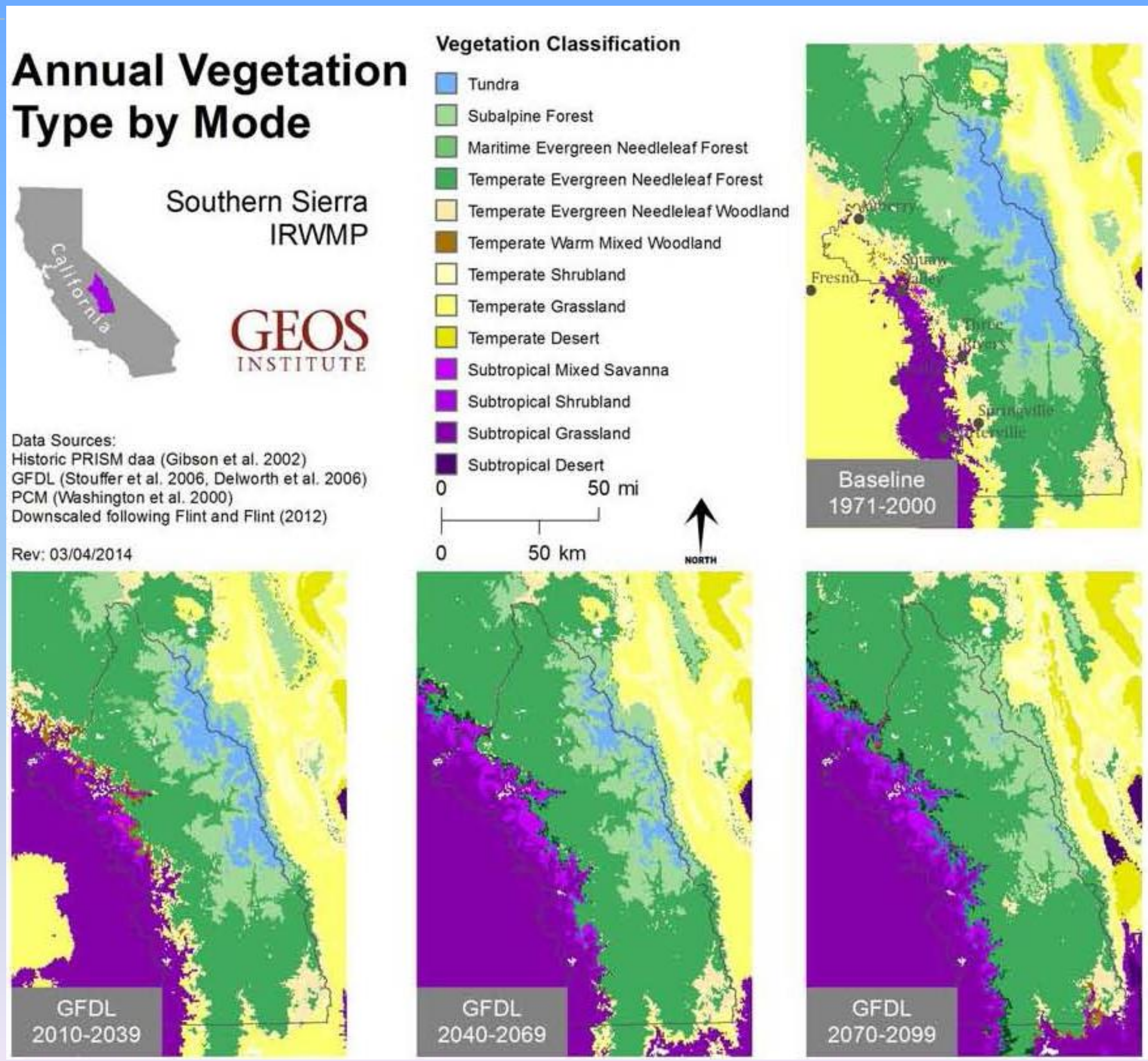
- Climate Change Model of Southern Sierra
  - Prepared by GEOS INSTITUTE
  - Evaluated climate, hydrology, vegetation and wildfire
  - Completed in May 2014
- A2 Climate Trajectory (business as usual)
- Certainty in Predictions
  - High – Temperature, snowpack
  - Medium – Severe storms, precipitation, wildfire
  - Low – Vegetation

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Climate Change Model (cont'd)

- Temperature Predictions:
  - 2010-2039 – (+1.2°)
  - 2040-2069 – (+2.1° to 2.2°)
  - 2070-2099 – (+3.4° to 4.1°)
- Precipitation Predictions
  - Vary from higher to lower
  - Overall drier conditions due to higher temp. and evapo-transpiration
- Hydrology
  - Changes already seen in flow, water temperature, storm intensity and seasonal timing
  - Runoff predictions
    - 2010-2039 – (-8% to +1.9%)
    - 2040-2069 (-1.7% to +0.4%)
    - 2070-2099 (-39% to +12%)

Climate Change Model (cont'd)



Climate Change Model (cont'd)

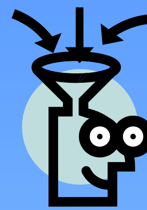
- Future hydrology will not resemble the past
- Plan for change, even if precise trajectory uncertain
- No Regret Strategies promoted
  - "Strategies that benefit water management with or without climate change"

Integrated Regional Water Management Plan

- First truly regional, integrated effort
- Funded by California Dept. of Water Resources
- Required for eligibility for several grant programs
- Public process and collaboration
- Topics covered:
  - Goals and Objectives
  - Water Management Strategies
  - Stakeholder Outreach / Coordination
  - Climate Change
  - Project Review and Selection
  - many others

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

Lessons Learned



1. Value of professional meeting facilitator
2. Importance of lead agency / regional water management agency
3. Importance of agencies with ratepayers
4. Difficulty identifying / ranking goals and objectives
5. Need for inter-regional projects across entire watershed OR regional water management groups that cover entire watershed

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT GROUP

Questions or Comments

SOUTHERN SIERRA REGIONAL WATER MANAGEMENT

September, 2014

Plan Briefing

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

The IRWM Process

- ✓Voluntary
- ✓Non-regulatory
- ✓Non-binding
- ✓Collaborative
- ✓Consensus-seeking
- ✓Generates multiple-benefit projects

- ➢Integrate land use and water planning
- ➢Designed to be a stakeholder-driven plan
- ➢Implement the plan with projects

SOUTHERN SIERRA
REGIONAL WATER MANAGEMENT GROUP

The IRWM Process

Pre-planning
Grant Application

Complete

Planning
IRWM Plan

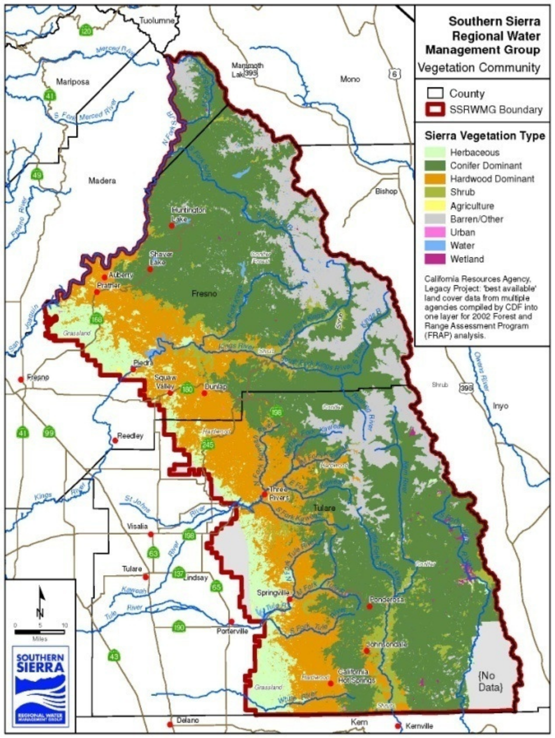
Beginning work now on IRWMP; Complete by Nov 2014

Implementation
Apply for project funding

Submitted DWR implementation grant application March, 2013
Call for projects, 2014

Region Description

- Largest Chapter in IRWMP
- Provides general regional description of IRWMP area (only a few details of individual entities provided)
- Provides background information to help inform decisions and planning
- Topics addressed include:
  - Watersheds
  - Water Supply/Demands
  - Water Quality
  - Biological/Environmental Issues
  - Social/Cultural Makeup
  - Membership
  - Boundaries



Regional Goals and Objectives

- Regional Goals and Objectives developed through collaborative process
- 6 Main Goals:
  1. Improve Water Supply Management
  2. Protect and Improve Water Quality
  3. Perform Integrated Flood Management
  4. Improve Watershed and Environmental Resource Management
  5. Expand Stakeholder Education
  6. Protect Unique/Important Environmental Resources
- Each Goal has 4 to 6 Measurable Objectives
- Six goals considered co-equal
- Objectives ranked (low, medium, high) through public survey

Objectives

- **1 - Improve Water Supply Management**
- Enhance natural water storage
- Increase understanding of water balance
- Increase capacity of water storage facilities
- Improve water use efficiency
- Mitigate and adapt to climate change impacts on water resources
- Promote sustainable water supplies for new human developments

2 - Protect and Improve Water Quality

- Protect natural water bodies
- Promote water quality best management practices
- Reduce erosion and sedimentation
- Promote storm water management planning and implementation
- Assess water quality of small water systems
- Study septic system impacts

3 - Perform Integrated Flood Management

- Address climate change impacts from flooding
- Integrate flood management with other activities
- Protect/restore floodplain connectivity
- Increase water storage capacity

4 - Improve Watershed and Environmental Resource Management

- Promote water quality best management practices
- Manage vegetation to reduce fire risk
- Reduce erosion and sedimentation
- Promote natural water storage
- Protect and restore floodplain connectivity

5 - Expand Stakeholder Education

- Perform community education on water issues
- Increase outreach to Native American Tribes
- Create and distribute water management best practices
- Increase outreach to disadvantaged communities
- Create RWMG website

6 - Protect Unique/Important Environmental Resources

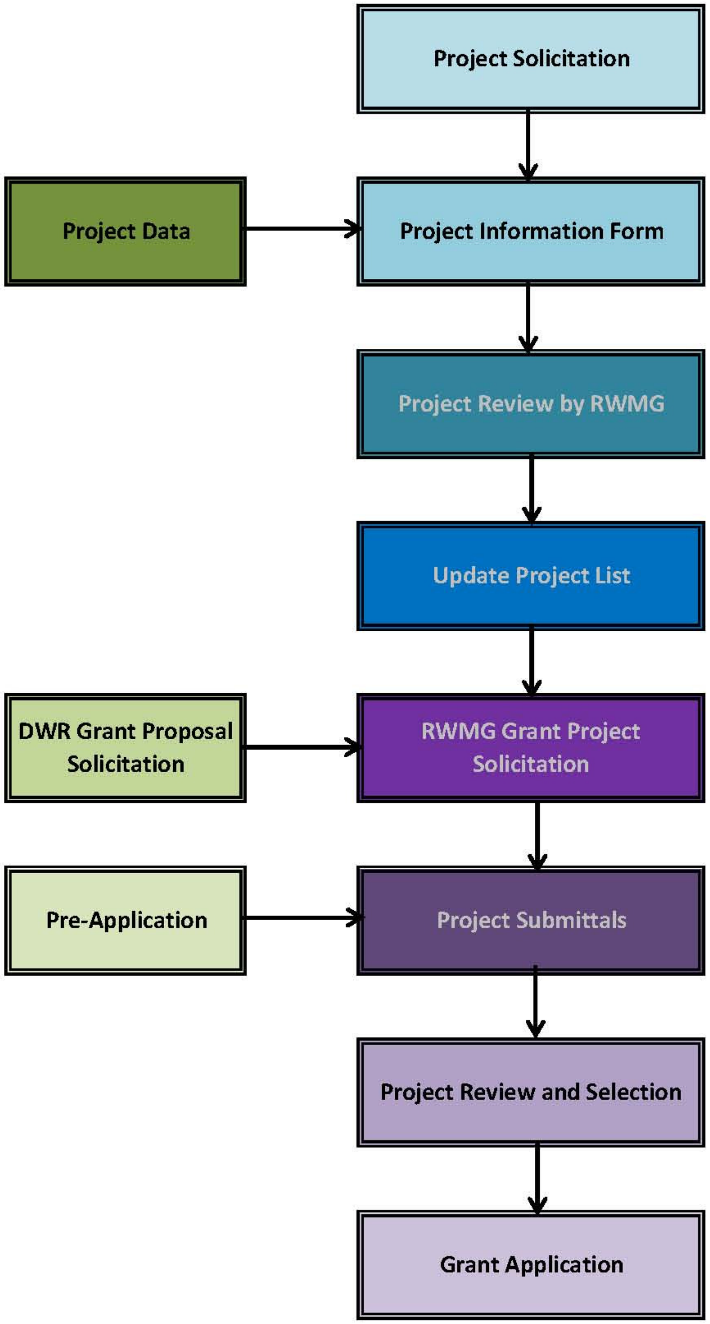
- Protect areas with high value to water storage and groundwater recharge
- Protect areas with high value to water quality protection and remediation
- Protect areas with high value to other water resources issues
- Enhance water management in already protected areas

Resource Management Strategies

- **Resource Management Strategy:** A project, program or policy that helps local agencies and governments manage their water and related resources (or simply 'water and land management strategies')
- 37 strategies evaluated → 32 applicable to area
- Examples:
  - Urban water conservation
  - Watershed management
  - Rainfed agriculture
  - Matching water quality to use
  - Drought planning
  - etc.

Project Review Process

- Project must be on official list to be considered for funding
- Project must be consistent with at least one goal/objective
- Detailed process for selecting projects for grant applications
- Preliminary work recommended
- Pre-application required



COMMENTARY: 2014 DROUGHT

Water management requires regional collaboration

In this year, when drought impacts grip the majority of California, identifying solutions to our water challenges is more imperative than ever.

The water challenges we face affect us on many levels, from the water that comes out of our tap, to the water that irrigates the food we eat, and that which filters back into the ground to restore underground aquifers. Managing this important resource is complicated and is marked by a contentious history.

In a shift toward collaborative, cross-jurisdictional and multiple-benefit water management, Integrated Regional Water Management refines the process for managing water challenges and opportunities. IRWM works off the premise that outcomes are more sustainable when a diversity of viewpoints agree on solutions; when multiple benefits are maximized; and when planning efforts transcend federal, state, county, and local jurisdictions. At a time when economic and human capacities are stretched thin, collaboration expands a region's collective resources to effect meaningful change.

The Southern Sierra Regional Water Management Group formed in 2008 to do just that. The RWMG is a voluntary collaboration of nonprofit organizations, agencies, local water/flood/conservation districts and landowners recognized by the California Department of Water Resources as the IRWM group for the Southern Sierra Region. For the past six years, the group has convened public meetings

Chris Moi

BobbyKamansky

to plan and implement creative water-management solutions that enhance the natural resources and human communities in the expansive region.

The Southern Sierra Region, one of the more severely drought-impacted areas of California, is critically important to all southern San Joaquin Valley residents, and beyond. The region includes many of California's most precious natural resources: Sequoia and Kings National Parks; Sequoia, Sierra and Inyo National Forests; Devils Post Pile National Monument; and the upper watersheds of the San Joaquin, Kings, Kaweah, Tule, Deer, White and Kern rivers, in addition to several smaller watersheds. The boundaries of the Southern Sierra Region include the foothill and Sierra Nevada portions of Madera, Fresno and Tulare Counties as well as Native American tribal lands.

Water is the largest export of the region. The Sierra Nevada's snowy peaks form the headwaters of several major rivers, which pass through storage facilities to supply clean water to Valley cities, farms, ecosystems and underground aquifers. Those headwaters irrigate millions of acres of the nation's top-producing farmland and support more than two million seasonal visitors from around the world, which also supports the local economy.

Careful, collaborative management of this special region is critical.

To that end, the RWMG recently released its Southern Sierra Integrated Regional Water Management Plan, a voluntary, non-regulatory planning document that identifies consensus-based water resource projects and programs for the 6,200 square-mile region. The plan is available on the RWMG website for review and public comment. Public comments will be accepted through Oct. 26.

The SSIRWM Plan is an important planning document; moreover, it is a tool to attract state and federal funding to this large, rugged, and sparsely-populated region, which has struggled to compete for project funding. Once the plan is approved, the RWMG will focus on bringing in resources to implement the plan and its multiple-benefit projects aimed at improving conditions for the watershed, both upstream and downstream.

Examples of multiple-benefit projects and programs include those that improve water quality, provide better flood management, restore and enhance ecosystems, and create more reliable water supplies. Such multiple-benefit projects are our best shot at managing California's erratic precipitation patterns in the face of increasing water demands and a changing climate.

Even when the state is not gripped in drought, we are

TERESA DOUGLASS

Snow on the Sierra Nevada.

between potentially devastating dry spells and should plan accordingly. Or we are flooded by storm water that overwhelms our natural and human infrastructure.

In this time of drought, we should remind ourselves that we are all stakeholders in the integrated management of our most precious and limited resource, water. Successful, sustainable water management requires collaborative, regional, and resourceful multiple-benefit project planning and implementation, which also depends largely on an informed, voting citizenry.

INFORMATION

Learn more about the Southern Sierra RWMG and its IRWMP at *www.southernsierrarwmg.org.*

Public comments will be accepted through Oct. 26.

Chris Moi is Land Transaction Director for the Sequoia Riverlands Trust, and Bobby Kamansky is Principal Biologist with Kamansky's Ecological Consulting.

Appendix Q

Public Notices

THE BUSINESS JOURNAL
FRESNO | KINGS | MADERA | TULARE
P.O. Box 126
Fresno, CA 93707
Telephone (559) 490-3400

(Space Below for use of County Clerk only)

IN THE COUNTY OF FRESNO, STATE OF CALIFORNIA

NOTICE OF INTENTION TO ADOPT AN SOUTHERN SIERRA INTEGRATED REGIONAL WATER MANAGEMENT PLAN

RWMG intends to adopt at the Special October 25 RWMG Meeting

MISC. NOTICE

DECLARATION OF PUBLICATION
(2015.5 C.C.P.)

STATE OF CALIFORNIA

COUNTY OF FRESNO

I am a citizen of the United States and a resident of the County aforesaid; I am over the age of eighteen years, and not a party to or interested in the above entitled matter. I am the principal clerk of **THE BUSINESS JOURNAL** published in the city of Fresno, County of Fresno, State of California, Monday, Wednesday, Friday, and which newspaper has been adjudged a newspaper of general circulation by the Superior Court of the County of Fresno, State of California, under the date of March 4, 1911, in Action No.14315; that the notice of which the annexed is a printed copy, has been published in each regular and entire issue of said newspaper and not in any supplement thereof on the following dates, to wit:

SEPTEMBER 17, 24, 2018

I declare under penalty of perjury that the foregoing is true and correct and that this declaration was executed at Fresno, California,

ON SEPTEMBER 24, 2018

Cam Mat

NOTICE OF INTENTION TO ADOPT AN SOUTHERN SIERRA INTEGRATED REGIONAL WATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that the Southern Sierra Regional Water Management Group (RWMG) intends to adopt an update to the 2014 Southern Sierra Integrated Regional Water Management Plan (IRWMP) at the Special October 25 RWMG Meeting. This updated IRWMP has been prepared in accordance with the updated State of California Department of Water Resources Integrated Regional Water Management Plan Guidelines. The IRWMP includes groundwater, surface water, and storm water management objectives and a listing of strategies to accomplish the objectives of the IRWMP. The RWMG currently includes 18 Members and over 100 stakeholders.

The RWMG published its Notice of Intent to prepare an update to the IRWMP in July 2018 in which landowners and stakeholders were invited to participate in the preparation. The RWMG met since 2008 and implemented several projects. Presentations have been made at the RWMG and Coordinating Committee meetings to update Members, and Stakeholders on the status of the IRWMP update and encourage participation.

The RWMG now solicits comments on the updated IRWMP. The updated IRWMP is available at the RWMG's website at http://www.southernsierrarwmg.org/irwm-plan.html. Comments must be submitted in writing to the Southern Sierra Regional Water Management Group, 428 S. Garden, Visalia, California, 93277, Attn. Bobby Kamansky, no later than October 17, 2018.

This Notice has been prepared in accordance with Government Code 6066 requirements. Following completion of preparation of the IRWMP, the RWMG, as well as its member entities and interested parties, will adopt the IRWMP.

/s/ Bobby Kamansky
RWMG Coordinator
September 17, 2018
09/17/2018, 09/24/2018

rocess your change request, ...
turn it to: 1300 18TH ST, BAKERSFIELD ...

THE BUSINESS JOURNAL
FRESNO | KINGS | MADERA | TULARE
www.thebusinessjournal.com

-----------Proof Sheet----------

Note: Hyphenation and column inch may fluctuate according to actual page column.

Attn: Mr. Kamansky
Rough estimate quote 6 ½ inch column @ $40 per column inch $260 each run
Two runs $520.00

Thank you and have a great day.

Callie
559-490-3503

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RWMG Coordinator
September 17, 2018
09/17/2018, 09/24/2018

Appendix R

Letters of Agreement with Neighboring RWMGs

2037 W. Cleveland Ave.
Madera, CA 93637-3593
(559) 661-6333
FAX (559) 675-7639
TDD (559) 675-8970

RESOURCE MANAGEMENT

AGENCY

Rayburn Beach, Director

DATE: October 14, 2008

TO: Board of Supervisors

FROM: Greg Farley, County Engineer

SUBJECT: Coordination with South Sierra IRWMP Planning Committee on 'Joint Madera-South Sierra IRWMP Overlap Area

Recommendation: That your Board conceptually agree to support a 'Joint Madera – South Sierra IRWMP Overlap area' and appoint a representative to work with the South Sierra IRWMP Planning Committee.

In 2005 Madera County received a grant from the Department of Water Resources (DWR) to create an Integrated Regional Water Management Plan (IRWMP) for the County. This planning process has been completed, and the IRWMP was adopted by the Board of Supervisors last April. The 'region' covered by the plan is defined as the Madera County jurisdictional boundaries.
DWR will be funding a new round of IRWMP planning grants in the near future. The Southern Sierra foothill region has begun to prepare for this application process, under the auspices of the newly formed South Sierra IRWMP Planning Committee. The 'region' they are contemplating currently includes most of the foothill areas in Kern, Tulare and Fresno Counties. Because DWR is moving to a more 'watershed-based' approach, the Planning Committee would also like to include the San Joaquin River watershed in the regional boundaries, including the portions that are in Madera County. This would mean that the Madera County portion of the San Joaquin River watershed would be included in two IRWMPS – the Madera County IRWMP and the South Sierra IRWMP.

The Department of Water Resources has indicated that such IRWMP overlap is not a problem. In fact, for the cross-over area inclusion in both plans could be an advantage. For example, specific water management projects may be targeted as priorities in one plan but not the other. This will increase the options for funding for the cross-over area. There is also the possibility of having management projects that are agreed upon by the two IRWMP's, giving those issues greater credibility and funding chances.

The South Sierra IRWMP Planning Committee is requesting that Madera County conceptually agree to the IRWMP overlap in the Madera County portion of the San Joaquin River watershed. They have proposed that the overlapping area be termed the "Joint Madera – South Sierra IRWMP Collaboration Area". They also propose that the governance bodies of the two plans should enter into a conceptual agreement or MOU on how to handle projects and issues that arise in the joint area. This agreement would not bind or restrict either group but would set forth some suggestions on how to communicate and collaborate on plans and projects and how to handle any potential disputes or issues that might arise. They have requested that the Board of Supervisors appoint a representative to work with the South Sierra IRWMP in drafting the conceptual agreement or MOU on the joint area.

This request was considered and approved by the Water Advisory Commission in its meeting of September 18, 2008. It is recommended that the Board appoint one of the Commissioners as its representative to work with the South Sierra IRWMP.

Fiscal Impact: There will be no fiscal impact from this item.

Southern Sierra
Integrated Regional Water Management

427 Garden Street
Visalia, CA, 93277

DATE: November 14, 2008

TO: Board of Supervisors

FROM: The South Sierra IRWMP Planning Committee

SUBJECT: Coordination with South Sierra IRWMP Planning Committee on 'Joint Madera-South Sierra IRWMP Overlap Area

Request: That the Madera County Board of Supervisors conceptually agree to support a 'Joint Madera – South Sierra IRWMP Overlap area' and appoint a representative to work with the South Sierra IRWMP Planning Committee.

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Fiscal Impact: There will be no fiscal impact from this item.

Draft Conceptual Agreement/MOU regarding Joint Area Covered by the Madera County IRWMP and the South Sierra IRWMP
Draft 9/12/08

Recitals: Whereas

- Madera County has adopted an Integrated Regional Water Management Plan (IRWMP) in which the 'region' is defined as the County's jurisdictional boundaries.
- A partnership in the South Sierra region is developing a South Sierra IRWMP (SSIRWMP) in which the regional boundaries are based on watersheds. The Upper San Joaquin River Watershed is included in the Plan's 'region'.
- The Upper San Joaquin River Watershed is partially in Madera County. This area will therefore be jointly covered by two IRWMPs, (the Joint Area).
- The South Sierra IRWMP Planning group and Madera County (hereafter 'Entities') wish to avoid disputes over management of this joint area and establish communication and collaboration procedures between the two Entities with the goal of maximizing effective water and watershed management.

Therefore, the Madera County Board of Supervisors and the South Sierra IRWMP Planning Committee enter into this Memorandum of Understanding (MOU) consisting of the following policies and procedures for planning and management of the Joint Area.

1. Communication – Within 90 days of executing this Agreement each Entity will select a planning/policy body to be actively involved in communication and collaboration with the other Entity regarding the Joint Area. Each planning/policy body will appoint a contact person to receive communications and requests from the other Entity and to take the necessary steps to assure that they are addressed.

2. Planning – Each Entity will make every reasonable effort to include the other Entity in the development and completion of plans which address or impact the Joint Area. Prior to the adoption of any such plan, each Entity will provide written notice to the other of the proposed plan's impact on the Joint Area and will provide sufficient time (a minimum of 90 days) for the other Entity to analyze and comment on the proposed plan. All such comments will be included in the final version of the proposed plan.

3. Requests for Funding and other Resources – When seeking resources (grant applications, technical assistance requests, etc.) for activities that address or impact the Joint Area, each Entity will make every reasonable effort to include the other Entity in the development of such applications and requests. Prior to the submission of any such request, each Entity will provide written notice to the other of the proposed request's impact on the Joint Area and will provide sufficient time (a minimum of 30 days) for the other Entity to analyze and comment on the proposed request. All such comments will be included in the final version of the proposed request.

4. Management Activities - Prior to initiating any management activities in the Joint Area, each Entity will inform the other of the proposed activity and provide sufficient time (a minimum of 45 days) for the other Entity to communicate concerns or suggestions. This process will not substitute for any CEQA, NEPA notification/comment process or any other notification otherwise required.

5. Disputes – If a dispute or serious disagreement arises between the Entities regarding water or watershed management of the Joint Area, the Entities will make every reasonable effort to engage in alternative dispute resolution, including mediation and/or arbitration, prior to taking legal action.

6. Sharing Data – Each Entity agrees to make all non-confidential studies, reports and data regarding the Joint Area available to the other Entity upon request.

7. Non-Interference - Nothing in this MOU will be construed to require modification of each Entity's established decision-making or governance process.

Signed and Agreed:

Madera County__________	South Sierra IRWMP Planning Group___
By Authorized Representatives:	
__________________________	____________________________________
Date:____________________	___________________________

United States Department of the Interior

NATIONAL PARK SERVICE
Devils Postpile National Monument
P. O. Box 3999
Mammoth Lakes, California 93546
760-934-2289

L317

March 9, 2009

Norman Shopay
Department of Water Resources
PO Box 942836
Sacramento, CA 94236

Subject : Devils Postpile National Monument within Madera, Southern Sierra, and Mono/Inyo IRWMP

Dear Mr. Shopay,

Thank you for the opportunity for inclusion of Devils Postpile (DEPO) into the Integrated Regional Management Groups process that is underway within California. The purpose of this letter is to inform Dept of Water Resources of an agreement between Madera, Southern Sierra, and Mono/Inyo IRWMPs to identity this as an area of shared interest and overlapping boundaries, and to request approval of this agreement to help facilitate the regional acceptance process.

Devils Postpile National Monument is located near the headwaters of the Upper Middle Fork of the San Joaquin in Madera County, and can only be accessed by road from the Town of Mammoth Lakes in Mono County CA. Devils Postpile is at the core of the glaciated river valley with abundant wetlands and wildlife, and as a National Park Service unit is a destination visited by many people that brings satisfaction to them and revenue to the local gateway communities in Mono County. The Monument which is along the Upper Middle Fork of the San Joaquin in Madera County is interconnected to Mono County by the shared groundwater aquifer on Mammoth Mountain, migratory corridors for wildlife and shared biodiversity, and the ecotourism benefits to the gateway communities. By maintaining a healthy watershed, biodiversity and migratory corridors will be preserved, while there is a clean and sustainable water supply for downstream users. Additionally, visitors and gateway communities will benefit from the recreational and ecotourism benefits, and an intact watershed will reduce risk of catastrophic fires and eroded slopes that could cause flooding and siltation and have a negative impact on gateway communities sustainable tourism economy and downstream users. Another important aspect of insuring the watershed's integrity, is maintaining the resilience of the watershed and the ability to adapt to climate change scenarios that may significantly impact water resources.

IRWMPs share the goals of understanding the watershed resources, and making sound decisions. Through the discussions among the representatives of the Madera, Southern Sierra, and Inyo/Mono IRWMP, and DEPO, there is consensus that it is important to include DEPO in these IRWMPS and include each other in discussions that affect this shared area of interest. Thank you again for your consideration, and if any further information can be provided, please contact me.

Sincerely,
/s/ Deanna M. Dulen
Superintendent

INYO-MONO INTEGRATED REGIONAL WATER MANAGEMENT PLANNING PROJECT

TO:	Mr. Svetich State of California Department of Water Resources Division of Planning and Local Assistance
FROM:	Dr. Mark Drew, Project Manager, Inyo-Mono IRWMP Launch Project
SUBJECT:	Integrated Regional Water Management-Letter of Agreement on Regional Boundaries
DATE:	4/1/2009
CC:	Tracie Billington, Department of Water Resources Jim Lin, Department of Water Resources

Dear Mr. Svetich:

This Letter of Agreement establishes that the undersigned Regional Water Management Groups (RWMGs) accept a common shared boundary for purposes of defining their respective IRWM Regions, as set forth in the Department of Water Resources' (DWR) 2009 *Final IRWM Region Acceptance Process Guidelines*. The shared boundary between the South Sierra RWMG and the Inyo-Mono RWMG is defined in the paragraph below.

Shared Boundary Description:

The majority of the shared boundary between the South Sierra RWMG and the Inyo-Mono RWMG will follow the crest of the Sierra Nevada range, which also follows the Inyo and Mono County jurisdictional lines to the east and Tulare and Fresno County jurisdictional lines to the west. In Kern County, the South Sierra and Inyo-Mono RWMGs are separated by the Sierra Nevada crest, a watershed boundary.

On behalf of the South Sierra Regional Water Management Group:

Bobby Kamansky

Bobby Kamansky, South Sierra IRWMP Project Manager
Lead Agency: Sequoia Riverlands Trust
Contact: Mr. Bobby Kamansky
Phone number: (559) 298-3311

On behalf of the Inyo-Mono Regional Water Management Group:

Mark Drew, Inyo-Mono IRWMP Launch Project Manager
Lead Agency: California Trout
Contact: Dr. Mark Drew
Phone number: (760) 924-1008

Tule IRWMP Letter

TO: MR. SVETICH

State of California
Department of Water Resources
Division of Planning and Local Assistance
Attn. Ralph Svetich
Post Office Box 942836
Sacramento, CA 94236-0001

FROM: MR. BOBBY KAMANSKY, PROJECT MANAGER

SUBJECT: INTEGRATED REGIONAL WATER MANAGEMENT-LETTER OF AGREEMENT ON REGIONAL BOUNDARIES

DATE: 6/18/2009

cc: Tracie Billington, Department of Water Resources
Jim Lin, Department of Water Resources

Dear Mr. Svetich:

This Letter of Agreement establishes that the undersigned Regional Water Management Groups (RWMGs) accept a common shared boundary for purposes of defining their respective IRWM Regions, as set forth in the Department of Water Resources' (DWR) 2009 *Final IRWM Region Acceptance Process Guidelines*. The shared boundary between the South Sierra RWMG and the Tule RWMG is defined in the paragraph below.

Shared Boundary Description:

In the Tule River Area, the SSIRWMP boundary includes the Tule River Indian Reservation and down to approximately the 600-foot contour in all forks of the Tule and squared to section lines. The Tule IRWMP planning area will follow irrigated lands while the SSIRWMP will follow rangeland in the mountains.

The parties will work to maintain communication and collaboration on a variety of watershed-based issues.

On behalf of the South Sierra Regional Water Management Group:

____

Lead Agency: Sequoia Riverlands Trust
Contact: Mr. Bobby Kamansky
Phone number: (559) 287-3311

On behalf of the Tule Regional Water Management Group: