CHAPTER 9

## 9.1 Introduction

Climate has a fundamental influence on the quantity, quality, and timing of water resources available to support the needs of humans and natural systems. Research indicates that the CABY region could be dramatically affected by climate change, including the amount and timing of precipitation and snowpack level. Climate, and specifically drought condition, is increasingly at the forefront of water resource management decisions. The effects of climate change influence water balances across the region, precipitation, evaporation, soils and vegetation and numerous ecological processes.

CABY is working in conjunction with ongoing regional efforts and strategies addressing climate and drought issues, including the Water Evaluation and Planning System (WEAP) modeling effort – a tool with the potential to aid in drought preparedness associated with climate change – and the El Dorado County Western Slope Drought Analysis effort – a planning and assessment process completed in spring 2007 with the goal of preparing South Fork American River water users for extreme drought. This chapter summarizes these ongoing efforts, which have long term implications for the future of the CABY region and IRWMP and enhance the utility of the CABY IRWMP.

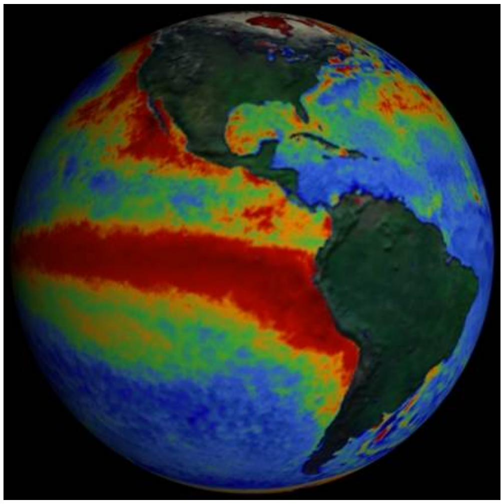
## 9.2 WEAP Modeling

The WEAP model was developed through collaboration between the Stockton Environment Institute (SEI – US Center) and the National Center for Atmospheric Research (NCAR). The implementation of the model into scenarios useful to CABY is funded through a grant obtained by the SEI from the US EPA.

The implementation of WEAP by CABY was predated by a contract between EID and the WEAP developers and between PCWA and the WEAP developers. WEAP presents a useful tool for water managers to use in the prediction of weather effects on water availability because of its dependency on rainfall as the driver of runoff and, following that, streamflow. EID and PCWA are exploring the use of WEAP as a water management modeling system.

For CABY, WEAP will model three scenarios. Beginning in November, representatives from the SEI and NCAR set out to complete the model with base information from all of the CABY watersheds; this is referred to as WEAP-*CABY*. WEAP-*CABY* was then employed to identify a series of three "runs" for implementation as identified by Planning Committee members in early November. The projects chosen as challenges for WEAP-*CABY* to solve are:

1. the mercury remediation project: under a climate change scenario, will there be greater Hg methylation? how much? where?;
2. the effects of an environmental water bank on the CABY region streams and rivers, especially under a climate-change scenario; and
3. the overall effects of different climate change scenarios on CABY-region surface water.



These runs were identified because of their appropriateness for implementation into the WEAP-*CABY* model, the potentially very useable outcome, and the Committee's level of interest in these challenges. In mid-2007, the outcome of these three runs will be discussed at a CABY Planning Committee meeting.

**Implementing CABY Goals and Objectives**

The following Goals and Objectives are appropriate targets for eventual analysis using in the CABY-WEAP model.

**Goals:**

1. Promote a sustainable water supply;
2. Derive multiple benefits from the management of water resources, diversions and infrastructure.

**Objectives:**

11. Manage water infrastructure to optimize in-stream temperatures;
17. Evaluate and modify water infrastructure to improve efficiency.
23. Manage rivers, tributaries and infrastructure to provide flow regimes that benefit ecosystem function.

For a more technical description of the WEAP objectives and functions, please see Appendix F.

## 9.3 El Dorado County Western Slope Drought Policy Analysis

The El Dorado County Western Slope Drought Policy Analysis project is a preliminary drought analysis of the El Dorado County Western Slope to benefit EDCWA, EID, GDPUD, GFCSD, and the City of Placerville. Residents of El Dorado County primarily depend on surface water from the watersheds of the Sierra Nevada mountain range for their water supply. The high Sierra Nevada mountain snowpack serves as natural storage for much of the region's winter precipitation. These watersheds are vulnerable to large variations in annual water supply. The worst drought of historical hydrologic record in the watershed occurred 1976 to 1977, pictured in Figure 9.1.

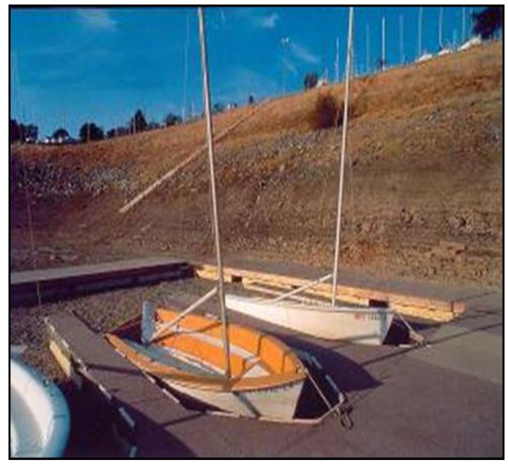


**Figure 9.1. Photo of Jenkinson Lake/Sly Park Reservoir 1977, courtesy of EID.**

Project Needs, Goals and Objectives

Although these past droughts had significant impacts, historical paleoclimatic and hydrologic records, as well as present-day climate change science, indicate the occurrence of droughts of significantly greater severity and duration. It is inevitable that droughts of varying duration and severity will return. This drought analysis has several objectives:

1. translate the science of drought into real world impacts using "virtual" drought simulations. These "virtual" droughts test the vulnerabilities of each water purveyor's system through the Shared Vision Model (SVM);
2. develop and document the SVM to include analysis of historical runoff hydrology (including critically dry conditions), reservoir storage capabilities with current operating rules, demands projected from the present through year 2030, and additional new water supply or demand mitigation measures that can offset anticipated shortfalls;
3. identify existing drought tracking indices;

4. provide a summary of stakeholder input; and document and describe supply conditions during the design drought as modeled by the SVM.

This analysis will be used to develop individual drought preparedness plans for participating purveyors, and could also be used as a model for drought preparedness through the CABY region.

## Drought History and Future Climate Change

Both paleoclimatic records and more recent streamflow data provide examples of the variability of climate conditions. Paleoclimatic records alert those engaged in drought preparedness planning to the fact that droughts can be of a greater duration and intensity than those observed more recently. Up to eight decades of streamflow records exist for the watersheds that supply water to the purveyors in El Dorado County. The lowest recorded precipitation on record in 1977 led to critically dry streamflow conditions and the lowest reservoir levels on record. Extreme low flow conditions occurred in 1924, 1932, 1934, 1960, 1976-77 and 1987-92.

Drought preparedness planning in El Dorado County includes detailed information on the potential for future climate change for the west slope of the Sierra Nevada. Four potential climate change scenarios are included in the County SVM. Future climate change, whether caused by naturally recurring cyclic patterns or human activity, may impact the intensity and duration of future droughts. Future droughts may exhibit different characteristics than those observed during recent “period-of record” droughts. Predictions have been made by the climate analysis community that climate cycles are on a warming trend that will cause average temperatures to rise by approximately 2°C during the next 100 years. If these predications prove accurate, the result would be less snowpack, earlier runoff (more runoff during winter months), and much lower stream flows during the summer months. Drought preparedness planning conducted without consideration of the potential effects of climate change on the supplies of individual water agencies would be incomplete, potentially resulting in unanticipated impacts.

## Shared Vision and Drought Analysis Approach

The collaborating agencies involved in the drought analysis envisioned an approach that would evaluate social, institutional, and political impacts of water shortages together with stakeholders. The shared vision approach was selected as it addresses the difficulties of integrating economic, environmental and social factors into defensible drought management decisions. Throughout the shared vision process, the Microsoft© Excel based SVM was built with stakeholders as a framework for creating a dynamic, consensus-based view of each purveyor’s water system. The success of this project was due in large part to enthusiastic participation of the stakeholders as Drought Advisory Committee members.

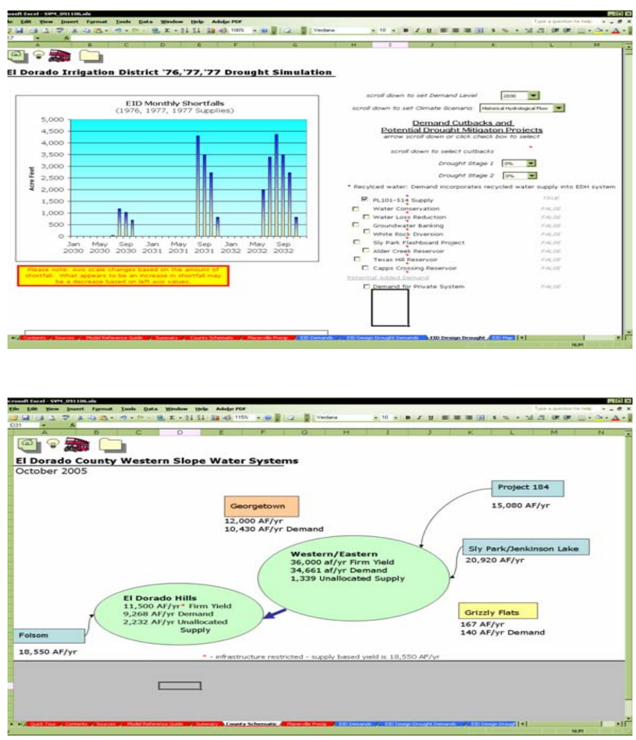



Figure 9.2. Shared Vision Model Worksheet

## Model Overview

The SVM incorporates needs defined by stakeholders, experts, and water agency staff. The SVM provides a structure for virtual drought simulations under various future demand conditions and climate change scenarios.

The SVM offers the user the opportunity to review information, assumptions, and data references with embedded comments throughout the model. It is comprised of 41 worksheets with color coded tabs that distinguish between purveyor systems and model components. The SVM home sheet is shown in Figure 8.5. Each purveyor's system infrastructure, supply constraints, and operating rules are modeled. SVM output capabilities, including supply, shortfall, and reliability estimates, allow for a parallel comparison of system reliability.

The approach to shared vision modeling consists of creating simulations of the County's worst case drought scenario using historic dry year conditions. "Worst case" scenarios were constructed from historical hydrology runoff data and a review of best available monthly runoff hydrology data sets projected under four future climate change scenarios for the American River watershed (provided by the University of California, Davis). System reliability is analyzed by including proposed demand mitigation and supply projects and comparing the projected supply shortages during the design drought and climate scenario.

## Drought Indicators and Institutional Framework

Drought indicators are variables that describe the magnitude, duration, severity, and spatial extent of drought. As drought preparedness plan development advances through Phase 2, several drought indicators and associated data sources will be further considered. Often, multiple drought indicators may be adopted for use. Potential indicators include precipitation, snow pack, and reservoir storage.

Regular monitoring and assessment of the indicators against predetermined drought indices, referred to as "trigger levels," provide decision-makers with necessary information needed to identify and help manage drought impacts. Phase 2 will recommend indicators and trigger levels for drought monitoring.

Implementing the drought plan will require an organizational framework for efficient collaboration of drought monitoring and response efforts among all the agencies. This organizational framework is recommended to include the following capacities:

- decision-making authority;
- monitoring and evaluation capabilities;
- drought risk assessment capabilities; and
- "news-shed" concept for communication network (Note: News-shed refers to the residents living in the region that local broadcast and print reach, which can be larger than an individual water purveyor's service area).

## Phase 1 Findings and Conclusions

Western slope supply versus demand assessments reveal the western slope will have supply shortfalls under projected demand and current supplies in a severe dry year sequence.

A full historical record analysis exhibited compromised reliability of each purveyor's system under projected water demands. It is assumed that western slope private water system users will increase purveyor demand under multiple critically dry year conditions, therefore increasing shortfall and decreasing system reliability.

Drought mitigation alternatives serve to increase purveyor system reliability in dry year conditions. The SVM demonstrates that reasonable demand cutbacks and conservation efforts alone will reduce but not eradicate supply shortfalls. Examples of specific findings include:

- EID can completely mitigate projected 2030 shortfalls under 1976, 1977 and 1978 dry year conditions and historical hydrological flow patterns with: (1) mandatory 20 percent cutbacks in critically dry years and groundwater banking; (2) consistent water conservation program implementation and the White Rock Diversion Project; or (3) PL101-514 Supply, water conservation program implementation, and the White Rock Diversion Project.

• GFCSD is vulnerable to severe drought under current demands, even with off-stream storage at Spring Flats and urban and agricultural demand cutbacks of 60 percent.

• GDPUD can expect approximately 570 acre-feet per month of shortfall for duration of approximately four months with their current drought plan of 50 and 15 percent cutbacks on raw and treated water, respectively, and PL101-514 water supplies.

### Recommendations for Phase 2

Phase 1 provides tools necessary to complete individual drought preparedness plans. The objective for Phase 2 is to complete drought response plans for each of the three purveyors and one overarching plan for EDCWA. The main work tasks suggested for Phase 2 are described in this section.

• Review feedback from Phase 1 Drought Analysis results. The stakeholder workshops held during Phase 1 generated meaningful dialogue and led to the current “shared vision” for Western Slope El Dorado County’s drought planning process.

• SVM Refinement. Update the SVM to include an EID design drought of 1976, 1977, and 1977 (repeated) hydrology. Additional updates and modifications requested during Phase 1 will be discussed with updates selected based on available resources.

• SVM Utilization. Utilize the updated SVM to analyze potential drought responses and drought avoidance measures to assist in creating the drought response plans.

• Public Involvement. Stakeholder discussions during Phase 2 will include review and input of drought response policies and actions, and overall review and input to the drought response plan documents.

• Draft and Final Drought Preparedness Plans. Prepare drought response plans that provide recommendations for organizational structures, indices and triggers, responses, and drought impact avoidance projects.

• Community Outreach. Provide technical support to each purveyor for public presentation efforts on an as-needed basis.

## 9.4 Data Management and Web Portal

A wide array of data and information has been collected during the CABY planning process. This includes maps, reports, and time series data, and other information that has been used to identify problems and opportunities and to characterize conditions in the CABY Region. There is an opportunity to leverage the initial investment in information collection and support implementation of the CABY IRWMP.

### Issues and Need

One problem with the historical data that has been collected is that the much of the information is in hardcopy formats that do not readily allow for comparison, analysis and distribution. Also, much of the digital information that is available (e.g.; soils, topography, stream flow and rainfall time series data) from local, state and federal sources is widely distributed in multiple data bases and is not in compatible formats that can be easily integrated and analyzed.

A major component of the CABY IRWMP is related to collecting future data to document watershed health and the benefits CABY projects. As explained further in Chapter 11, CABY will use specific performance measures to track progress at three levels: basin or watershed; CABY Plan implementation, and Project scale.

Both the historical and new data will need to be managed so that it can be distributed and used to supports decisions and to document the benefits of the CABY projects and programs.

CABY has identified a need for a data management system (DMS) that would allow for shared access to the wide array of maps and data that have been, or which will be collected. Within the CABY Region, this data and a well designed DMS, will provide long- term value because they will:

- improve the understanding of the conditions;
- support public education and generate public awareness and support for proposed projects and programs;
- reduce risk and uncertainty in decision making by land use and water agencies;
- facilitate sharing of data between local, state and federal agencies;
- increase the cost effectiveness and utility of the data collection and management efforts.

Other Long-term goals of regional data management are:

- Increase the staff efficiency and effectiveness;
- Reduce cost of long-term information management;
- Provide a one-stop shop for basin-wide water related data; and
- Provide the highest level of support to the Water Forum, the KRCD Board, and the member agencies.

A proposed objective is for CABY to develop a mechanism that would provide a clearinghouse for maps and data and would stakeholders and individuals within the CABY Region to easily access and manage data and produce information. This will require a flexible and expandable DMS which would provide for shared access to information for member agencies, NGOs and the public.

### Potential Solutions

The Internet and changes in technology allow groups like CABY to consider a new model for sharing and distributing data. The concept of web enabled data ‘portals’ do not require a centralized data base, but instead allow for shared access via the internet to existing local, state and federal data sets through a common map based web interface that is easy to use.

The DWR has developed an Integrated Water Resources Information System (IWRIS) that provides a portal to water resources and other related data sets. The IWRIS technology could provide CABY a web enables GIS interface and the necessary tools to support regional planning. The DWR approach would help CABY to gain rapid access to existing public domain data, while working to develop the regional data sharing and management agreements that would allow local stakeholders to publish their data to the IRWIS portal such that other CABY stakeholders can gain access. In this way, local water and land use agencies and watershed groups can access and leverage the existing state and federal investments in data collection while maintaining control of their own information and investments in data collection and management. Each CABY agency would decide which data it would publish to the web site. The CABY web page could be further developed and support distribution and a shared CABY DMS designed to serve as a common point of access to data stored in many different locations. This includes groundwater levels, water quality, well logs, hydrogeologic information, stream flows, precipitation, and other data sets from existing systems.

CABY should seek to work with its stakeholders and DWR to define alternative approaches and opportunities to reduce costs and apply the IWRIS tools. The development of the CABY DMS and IRWMP Portal would be completed in two phases over a period of 2 years.

### Step 1 - Develop and Implement Regional Data Management System.

Step 1 will focus on acquisition and installation of all components necessary for CABY to have a GIS-based web interface for access to the data via the internet. The changes, updates, or replacement of the current CABY web page will be evaluated and a plan developed. A Data Sharing Agreement will be initiated to standardize data, and produce a CABY Metadata Usage Guide. Step 1 activities will focus on the surface water and water data collected by participating agencies. The goals of Step 1 actions are to establish a shared project vision, develop data sharing agreements with member agencies, design a structure for capture and storage of standardized data, upload and verify selected surface water and groundwater data, and make them accessible to stakeholders via a GIS-based web interface. Step 1 will support the data sharing and access needs of the CABY members. It is estimated that Step 1 could cost in the range of $100K-$200K and take about 9 to 12 months.

### Step 2 - Expand Regional Data Management System and Connect to Statewide System.

Step2 of the project will focus on expanding the CABY DMS to include additional data, such as hydrogeologic data, model input/output data, well log data, project cost data, project monitoring data etc. This phase will include connection and coordination with the statewide data management systems, such as Surface Water Ambient Monitoring Program (SWAMP), Groundwater Ambient Monitoring and Assessment (GAMA), Integrated Water Resources Information System (IWRIS), Water Data Library (WDL), etc. It will also include linkages to other off-site databases maintained by member agencies.

In addition to serving as a repository for regional compilation of water resources data and information, the CABY Plan will support statewide data activities by requiring that data collected to support project performance assessment is collected in a manner consistent with continuing statewide data collection programs. Consistency with Statewide monitoring programs is critical to ensuring that regional projects contribute to efficient, uniform, and comprehensive study design and data collection. Data collected as part of CABY Plan project implementation will be required to be comparable with applicable statewide SWAMP and GAMA programs. Upon completion of the CABY performance assessment, the project-specific data collected, along with its associated quality assurance/quality control information, would be provided to the state in a format that could be easily integrated into statewide data collection and tracking programs. As appropriate, CABY will also encourage project proponents to contribute data to the following statewide data programs:

- DWR Integrated Water Resources Information System (IWRIS), a website that connects to local databases through a GIS-based web interface;
- DWR Water Data Library (WDL), which contains groundwater level and water quality data;
- California Environmental Resources Evaluation System (CERES), an information system developed by the California Resources Agency to facilitate access to natural resource data;
- California Environmental Data Exchange Network (CEDEN), a website developed by the State for coordinated data sharing.