

**Climate Change Activities
of the
Department of Water Resources
during 2008**



Edited by Nikki Blomquist and John Andrew
June 2009

Introduction

In this century, climate change will have a dramatic effect upon the core elements of our business at DWR—water supply, flood management, and the ecosystems upon which they depend. From research studies to computer models, business processes to grantmaking, the Department of Water Resources is tackling climate change at every opportunity. For instance, there are four studies already underway to explore carbon sequestration and subsidence reversal in the Sacramento-San Joaquin Delta. DWR staff are also developing new models or revising existing ones to improve our ability to operate the State Water Project, anticipate how and when streams and rivers will flood, and project sea level rise. With the help of local water agencies and other stakeholders, DWR is incorporating climate change into its grant guidelines, to assist local and regional water managers to mitigate and adapt to climate change.

At home, DWR is also modifying its business practices to make them “greener”, to account for its GHG emissions, and to use clean energy. With all of our activities, we have implicitly established a pool of experts that is continually called upon to provide expertise to other State agencies, and local water agencies and users. And our public outreach efforts effectively convey to diverse audiences the complexity and seriousness of the climate change challenge, as well as the need for reasoned action.

All of these projects and activities are summarized in the following pages. In all, it is an impressive program across every division, particularly so because there remains no dedicated resources for climate change at DWR. These projects are instead the result of dedicated staff either incorporating climate change into existing work processes and products, or voluntarily taking on additional workload—and often both. Despite this resource handicap, the program arguably leads all of State government in the realms of planning, research, mitigation, adaptation, and public outreach related to climate change. To all the staff involved in this endeavor, thank you for all your efforts during 2008.

John T. Andrew, P.E.
Executive Manager for Climate Change
Activities

Cover art from the cover of the Fall 2008 edition of *DWR News/People* that focused on climate change activities at DWR.

Table of Contents

Introduction	2
Field studies.....	4
Twitchell and Sherman Island Subsidence Reversal Projects	4
<u>DWR/USGS Wetland Research Facility – Twitchell Island</u>	4
<u>Permanent Wetland for Waterfowl - Sherman Island</u>	4
<u>Farm Scale Rice Demonstration and Research Facility</u>	5
<u>Farm Scale Wetland Demonstration Project</u>	5
Planning, modeling, and data collection	7
Analysis of Climate Change for the California Water Plan Update.....	7
Data Collection and Climate Services	7
Incorporating Sea Level Rise into Water Resources Planning Tools.....	8
Analysis of Regional Observed and Simulated Historical Period Data	8
Analysis of the Impact of Climate Change on Streamflows in California	9
Sensitivity Analysis of the Upper Feather Basin to Temperature Changes Using PRMS.....	10
Climate Change Impacts to State Water Project and Central Valley Project Operations.....	10
Isolating the Relative Effects of Warming from Climate Change Impacts on California’s Water Resources	11
Using Future Climate Projections to Support Water Resources Decision Making in California	11
Climate Change Technical Advisory Group.....	12
Operations.....	13
Coordinated Reservoir Operations.....	13
Evaluation of Benefits of Reoperation of Water Supply Systems.....	13
Energy and Greenhouse Gas Emissions.....	15
Water-Energy Subgroup of the Governor's Climate Action Team.....	15
Power Portfolio Policy for the State Water Project.....	15
2007 Emissions Report to the California Climate Action Registry	16
Business practices and technical expertise.....	17
Cement	17
Environmental Documentation and Decision-Making.....	17
Methodology for calculating and addressing GHG emissions from proposed projects.....	17
Sustainable Business Operations Initiatives.....	18
Climate Change Matrix Team.....	20
Grantmaking and technical assistance.....	21
Integrated Regional Water Management Grant Program	21
Provide Expert Assistance for Water Use Efficiency	21
National and International Scientific Committees.....	21
Public Outreach	22
State Climatologist's Office.....	24
Presentations and Posters.....	26
Articles.....	28
Matrix Team Members.....	29

Field studies

Twitchell and Sherman Island Subsidence Reversal Projects

Status: In progress

Contact: Jay Chamberlin, Bryan Brock

DWR is currently developing several projects to demonstrate the potential for subsidence reversal and carbon sequestration. Sequestering atmospheric carbon via plant photosynthesis and net retention of carbon within the soil by decomposing plant matter will not only reverse subsidence in the western Delta, but may also help reduce the impacts caused by greenhouse gas emissions. Currently, there are four projects that are in various phases of implementation including:

- DWR/US Geological Survey (USGS) Wetland Research Facility – Twitchell Island
- Permanent Wetland for Waterfowl - Sherman Island
- Farm Scale Rice Demonstration and Research Facility - Location to be determined
- Farm Scale Wetland Demonstration Project – Location to be determined

Furthermore as a carbon market develops in California, the potential for the sale of carbon credits may provide an alternate means of producing income on existing agricultural lands. Through these demonstration projects, DWR will study the costs and benefits of these land use management practices to help define the potential value in a carbon market.

DWR/USGS Wetland Research Facility – Twitchell Island

DWR and the USGS constructed approximately 15 acres of wetlands in 1997 to evaluate land surface elevation changes and carbon accretion due to the accumulation and decay of plant materials. Two ponds were constructed and flooded to depths of 25 and 50 centimeters. Tule and cattail growth was measured as they populated the ponds. Water siphoned from the San Joaquin River keeps the water elevation constant year-round. When plants die at the end of each growing season, they decompose on site and measurements are taken to determine the amount of accumulating organic matter and land surface elevation change.

Ongoing research at this facility has shown that surface elevation changes due to accretion range from 3.2 to 5.6 cm/yr (1.3 - 2.2 in/yr), while surrounding areas used for agricultural purposes lost elevation due to subsidence. The new material bulk density is fairly low (i.e., less than 0.1 g/cm³), but it has a high degree of structural integrity. The test cores required considerable effort to section with a hacksaw, and there was no evidence of compaction during collection of the cores.

This study has shown that decaying organic matter can not only eliminate subsidence, but also reverse subsidence through utilization of appropriate land management practices. Additional studies will be implemented in the near future to investigate carbon sequestration rates on a per acre basis, as well as the potential air and water quality impacts that may occur as a result of the decaying organic matter.

Permanent Wetland for Waterfowl - Sherman Island

The creation of a permanent wetland for waterfowl on Sherman Island—which may also reduce subsidence and sequester carbon—is currently in the design phase and may

begin construction during the Fall of 2009 (depending upon CEQA documentation completion and environmental regulatory permitting) and should be completed by summer of 2010. The land identified on Sherman Island is a 307-acre parcel currently owned by DWR that is leased to individuals that operate the land as a duck club. The proposed project will enhance and create wetlands on the mid-westerly portion of the island.

Currently the land is a mixture of uplands, seasonal wetlands, and ponds, but it does not remain wet year-round. The proposed project will make necessary improvements to ensure the land can be maintained as a permanent wetland. Key project components include:

- Increasing perimeter levee height to ensure year-round saturation,
- Incorporating interior levees to enable management of water quality and vegetation,
- Building drainage swales and depression areas to allow for waterfowl ponds, and
- Creating loafing islands for secure waterfowl habitat.

As a result of these wetland improvements and based upon carbon sequestration data determined from the DWR/USGS wetland study on Twitchell Island, it is anticipated that this project will also achieve carbon sequestration and subsidence reversal.

Farm Scale Rice Demonstration and Research Facility

Similar to growing tules, growing rice may be a very effective and sustainable way to reduce subsidence and facilitate carbon sequestration, while maintaining a farm economy. There are several water quality and farming issues that must be evaluated and resolved during this large-scale demonstration. The data analyzed during this five-year project will allow DWR and others to develop recommendations on how this method can be applied to reduce subsidence and sequester carbon. This data will also provide a road map for best management practices that can be used for rice farms throughout the Delta.

DWR will conduct this research on an approximately 300-acre farm-scale demonstration rice field in the Delta. Key research components of this project include:

- Demonstrating the feasibility of growing rice in the Delta;
- Quantifying subsidence and carbon sequestration rates;
- Determining water quality contaminant loading and exports; and
- Creating best management practices to minimize environmental impacts, while maximizing subsidence reduction and carbon sequestration.

Nearly 175 acres of rice fields and testing facilities were constructed in 2008, and rice was expected to be planted in April 2009. The remaining 125 acres of rice fields will be constructed during the summer of 2009 and planted in 2010.

Farm Scale Wetland Demonstration Project

Currently, all constructed wetlands on Sherman and Twitchell Islands have followed a conventional engineering design and contractor build process similar to most large-scale infrastructure projects. However, utilizing a farm construction process may be more cost effective. DWR is currently planning to construct a 500-600 acre wetland based upon this "farm construction" technique.

A site has been selected on the easterly portion of Twitchell Island and a wetland design has been developed to provide the right conditions for wetland vegetation growth to sequester carbon and to be consistent with how a typical Delta farmer would construct

such a wetland. In addition, water and air quality monitoring activities will be undertaken and coordinated with the DWR/USGS wetlands research project.

One of the overall goals of the demonstration project is to develop a wetland “farming” option for Delta farmers. It is anticipated that as a carbon market emerges in California, Delta farmers may be able to profit from farming wetlands and sequestering carbon in the western Delta. As part of this project, DWR will work with State regulatory agencies, including the Air Resources Board, to ensure that Delta carbon sequestration efforts are considered when developing a statewide program.

DWR staff will begin to develop CEQA documentation and environmental permits for this project so that the project will be ready to move to construction once funds become available. Cost estimates for constructing approximately 500 acres of wetlands and research cells are \$4.5-\$6 million, based upon preliminary designs.

Planning, modeling, and data collection

Analysis of Climate Change for the California Water Plan Update

Status: In Progress
Contact: Rich Juricich

With input from the Water Plan's technical advisory group, the Statewide Water Analysis Network (SWAN), DWR chose to apply the Water Evaluation and Planning System (WEAP) for Update 2009 as a tool to help quantify future scenarios and alternative water management responses.¹ During and after the completion of Update 2005, DWR evaluated several possible approaches to quantify future scenarios for Update 2009, including the Analytica tool used for Update 2005. In 2005, DWR participated in a study with the Stockholm Environment Institute (SEI) funded by the U.S. Environmental Protection Agency to apply the WEAP tool to understand the potential effects of climate change on the Sacramento Valley. DWR chose the WEAP tool for Update 2009 because WEAP:

- has a friendly graphical user interface that supports collaboration,
- requires a shorter learning curve than alternatives,
- was successfully applied by RAND Corp to evaluate climate scenarios for the Inland Empire Utilities Agency, and
- received generally positive feedback from SWAN and other Water Plan stakeholders.

For Update 2009, most of the scenario analysis will be performed at the hydrologic region scale. DWR is using WEAP to develop a low-resolution regional demand and supply balance representation for each of the 10 hydrologic regions in California. For this analysis, indoor urban demand will be represented in a manner similar to that used for the CWP 2005 Update. The representation of outdoor urban and agricultural water demand is improved using evapotranspiration (ET) requirements and irrigation patterns, and variable monthly sequences of precipitation and temperature based on 12 available scenarios representing future climate change. Monthly available supply by Hydrologic Region is based largely on inventories of available supplies and projections from the region's major water suppliers. Due to the coarse nature of this analysis, only a rough comparison of the independent projections of demand to supply will be performed.

Data Collection and Climate Services

Status: Development
Contact: Arthur Hinojosa, Frank Gehrke, Michael Anderson

Data collection and climate services enable DWR to gather, analyze, and distribute important weather and climate information for operational and planning efforts. This project aims to coordinate data collection activities, manage the incoming data, provide the necessary analyses, distribute information, and interact with other groups who also collect data relevant to DWR's goals and activities. Opportunities for improving the hydroclimate monitoring network and incorporating new technologies will be pursued.

¹ See www.weap21.org for additional information about the WEAP tool.

Methods are being developed to improve and implement quality control and quality assurance assessments of the incoming data streams. DWR will develop partnerships with other agencies and groups to help achieve the goals of the project. The data gathered through this project will be made available through the California Data Exchange Center.

Incorporating Sea Level Rise into Water Resources Planning Tools

Status: Completed/On going

Contact: Francis Chung, Jamie Anderson, Sanjaya Seneviratne, Maury Roos

According to the recent Fourth Assessment report of the Intergovernmental Panel on Climate Change (IPCC), sea levels rose gradually over the 20th century, with the rate of rise increasing in the latter half of the century. This increased rate of sea level rise is projected to continue in the 21st century due to thermal expansion of the ocean and melting of glaciers and polar ice caps. This project develops, applies, and adapts analysis methods and tools to incorporate the potential effects of sea level rise into water resources planning. Work completed to date includes:

- Historical sea level data were examined for the California coast, the Delta, and selected additional North American locations.
- Two methods were used to estimate amounts of possible future sea level rise.
 - By extrapolating the current rate of sea level rise acceleration into the future, sea levels could be expected to increase by about 0.5 ft by mid-century and by 1.0 ft by the end of the century.
 - If it is assumed that increasing air temperatures will increase the rate of sea level rise, sea levels could be expected to increase by 0.6-1.2 ft by mid-century and by 1.4-4.0 ft by the end of the century.
- Computer applications were developed to estimate salinity intrusion into the Delta for one foot and two foot sea level rise scenarios. These applications can be used in computer models of the operations of the State Water Project and Central Valley Project to evaluate potential impacts of sea level rise on system operations.
- Methods were explored for using sea level rise projection information to create relative probabilities that could be used to support decision-making.

Analysis of Regional Observed and Simulated Historical Period Data

Status: Completed/Ongoing

Contact: Messele Ejeta, Tariq Kadir, Jianzhong Wang

Emerging studies suggest that at a regional level future warming will be strongly modulated by natural climate variations on time scales of decades. This analysis focuses on the: 1) reduction of uncertainties in climate change modeling processes through the analysis of observed data, and 2) evaluation of how well observed data has been reproduced through these processes by analyzing simulated historical period data. The first part made detection and attribution studies through the analysis of the trend of regional observed data in California using a long record of temperature, snow, precipitation, natural streamflow, and sea level change data. The trends in each type of data and their correlations across these types of data sets were analyzed. The data was also analyzed in relation to the Pacific Decadal Oscillation (PDO), a long-lived El Niño-like pattern of Pacific climate variability. A strong correlation was found between two “cool” to “warm” PDO regime shifts on record and the two lowest natural streamflows on

record since the early 20th century for California's eight major rivers. For seven out of these eight rivers, the two lowest natural flows occurred in 1924 and 1977. For the remaining river, the natural flows in 1924 and 1977 were among the lowest three flows on record. The two "cool" to "warm" PDO regime shifts are noted to have occurred between 1924 and 1925 and 1976 and 1977.

The second analysis was done to evaluate how well the historical period streamflow data obtained from the climate change modeling processes represents the observed streamflow data. This analysis is the basis for using the projected streamflow data for the study of the impact of climate change on the State Water Project (SWP) and the Central Valley Project (CVP) as well as on the Sacramento-San Joaquin Delta's water quality. A draft Technical Memorandum report of these analyses, which is tentatively entitled "Analysis, Methodologies, and Evaluations," has been prepared.

Future plans under this task include:

- Detection and attribution studies through the analysis of regional historical data,
- Feedback of new insights from such studies to reduce uncertainties in climate change impact studies, and
- Evaluation of simulated historical period streamflow data as a bridge to the study of the impact of climate change on streamflows at a projected level of development.

Analysis of the Impact of Climate Change on Streamflows in California

Status: In progress
Contact: Messele Ejeta

For the 2008 biannual report update to Governor Schwarzenegger, researchers generated daily and monthly streamflows for the Climate Action Team (CAT) at 18 locations across California's Sierra Nevada mountain range. The data, which spans the 1950 – 2099 period, was generated for two greenhouse gas emission scenarios each modeled using six different General Circulation Models (GCMs). Results from these models were downscaled to local level using two methods: 1) the Bias Correction and Spatial Disaggregation (BCSD) method, and 2) the Constructed Analog (CA) method. The BCSD method was applied to the results of all the six GCMs for each emission scenario whereas the CA method was applied to the results of three GCMs for each emission scenario. Thus, daily and monthly sets of 12 projected streamflows corresponding to the BCSD method and the Bay-Delta Office has obtained six projected streamflows corresponding to the CA method. The daily and monthly sets of streamflow data have been analyzed with respect to flood occurrence and water supply planning, respectively. A summary report of this analysis is included in the Technical Memorandum report "Analysis, Methodologies, and Evaluations" mentioned above.

Future plans in this project include:

- Continue the analysis of the impact of climate change on streamflows as more data becomes available and the climate change processes continue to evolve.
- Providing public access to the methodology and data analysis tools used to determine the impact of climate change on streamflows.

Sensitivity Analysis of the Upper Feather Basin to Temperature Changes Using PRMS

Status: Completed
Contact: Tariq Kadir

Because snow melting and sublimation is heavily dependant on temperatures, it is important to the operation of Lake Oroville to know how projected future climate conditions can affect both the timing and quantity of flows arriving there. A rainfall-runoff model of the upper Feather Basin was used to examine potential changes in runoff processes impacting flow into Oroville due to changes in ambient air temperature. The approach used was to conduct a sensitivity analysis to determine how increases in air temperature of 1°C, 2°C, 3°C, and 4°C (1.8°F, 3.6°F, 5.4°F, and 7.2°F) in the upper Feather River basin would affect natural flows into Lake Oroville. The [Precipitation-Runoff Modeling System \(PRMS\)](#), a physically based precipitation-runoff model developed by the USGS for DWR in 2004 was used to determine the impacts of increasing daily minimum and maximum temperatures over a 30-year period (water years 1972–2001) on different hydrological components, including streamflow and base flow. The model simulates all the major snowmelt and precipitation-related physical processes, including snowpack accumulation or melting, sublimation, evapotranspiration, surface runoff, subsurface flow, and groundwater flow. Air temperature was the only parameter that changed for each simulation. Spatial and temporal distributions of precipitation and all other model parameters were the same for each simulation. This paper focuses on comparing alternative air temperature scenarios with the historical base scenario. Key findings were that the timing of the center of the mass, the April through July runoff as a percent of the annual runoff, and the April snowpack water equivalent are shown to change appreciably with rising temperature.

Climate Change Impacts to State Water Project and Central Valley Project Operations

Status: Completed/On going
Contact: Hongbing Yin, Sushil Arora, Francis Chung

The State Water Project (SWP) and the Central Valley Project (CVP) are the two major projects for California's water supply system. Investigating climate change impacts to SWP and CVP operations provides a foundation for developing system adaptation plans. DWR has conducted initial studies of climate change impacts to SWP and CVP operations using the CalSim-II model under existing physical, operational and institutional conditions. Impacts were evaluated for projected changes to streamflows, agricultural water demands, and rising sea levels. Twelve climate change projections recommended by the Governor's Climate Action Team were used for the study. Mid-century and end of the century impacts were assessed for

- Annual Delta exports
- Reservoir carryover storage
- Sacramento valley groundwater pumping
- Power supply
- Delta X2 salinity standard compliance
- Vulnerability of the system to operational interruption

The initial assessment indicated that SWP and CVP would be impacted significantly by projected climate changes. In order to provide a climate change baseline assessment of SWP and CVP impacts and to help regional scale climate change planning studies, the

current assessment needs to be further refined in the following aspects: (1) Re-evaluate methods of downscaling GCM model outputs and generating projected streamflows; (2) Improve the estimation of projected agricultural water demands; and (3) Develop the hydrologic inputs under climate change conditions for soon-to-be-released CalSim 3.0 model, which will provide linkages to regional scale climate change studies.

Isolating the Relative Effects of Warming from Climate Change Impacts on California's Water Resources

Status: Completed/On going
Contact: Jianzhong Wang, Hongbing Yin

As described above, impacts of climate change on SWP and CVP operations were evaluated for 12 scenarios using the CalSim-II model. The results from the study were further analyzed to try to isolate the relative effects of inflow seasonal pattern change (caused mainly by the warming trend), annual inflow change (induced predominantly by annual precipitation trend) and sea level rise on water resource management for the SWP and CVP. A three step perturbation ratio method is proposed to facilitate separation of the impacts of inflow seasonal pattern change and annual inflow change on the water planning. This study provides clues to water resources management strategies on adaptation to climate change. Results from this sensitivity study are being analyzed and will be submitted to a peer-review journal.

Future work includes:

- Estimate climate change impact on water consumptive use and its subsequent impact on water supply in the SWP and CVP
- Improve methods for incorporating climate change into the water planning models such as CalSim-II and CalSim 3.0.

Using Future Climate Projections to Support Water Resources Decision Making in California

Status: In progress
Contact: Francis Chung, Jamie Anderson

Some of the climate change work described above was documented in a report titled "Using Future Climate Projections to Support Water Resources Decision Making in California" submitted to the California Energy Commission. After peer review, the report is expected to be released as part of the 2009 Climate Action Team report.² The topics covered in the report include:

- Sea level rise
 - projections
 - relative probabilities
 - computer software for assessing impacts of sea level rise to Delta salinity
- Evaluation of how well global climate models represented California's climate from 1950-1999
- Methods for using climate change projections to estimate future streamflows

² The 2009 CAT report was released on April 1, 2009.

- Impacts of increasing air temperatures on snowpack, runoff, and surface and subsurface flow in the upper Feather River Basin
- Impacts of climate change on operations of the State Water Project and Central Valley Project

Climate Change Technical Advisory Group

Status: Ongoing

Contact: Tom Filler/John Andrew

In 2008, DWR convened a highly qualified team of climate experts to provide technical advice to DWR on incorporating climate change into decision-making about California's water resources. This team, known as the Climate Change Technical Advisory Group (CCTAG), is focusing on the challenges presented in developing state-of-the-art climate change science, better analytical tools for modeling and planning for climate change impacts, and developing adaptation strategies for climate change adaptation for California's water sector.

Operations

Coordinated Reservoir Operations

Status: Development
Contact: Boone Lek

DWR will develop and implement a Forecast-Coordinated Operations (F-CO) program for the major reservoirs in the Central Valley to improve downstream flood protection without impacting the water supply of the upstream reservoirs. The F-CO program will allow operators to make controlled releases ahead of flood events allowing for more water supply storage during the flood control season (October through April). Increasing operational flexibility and flood control space is critical if the expected climate change impacts of higher snowlines, decreased snowpack, and earlier snowmelt are realized. This may include updates to applicable water control manuals (or at least flood control curves) issued by the U.S. Army Corps of Engineers.

The F-CO program is considered one of the most cost-effective measures to improve flood control and is currently being implemented on the Yuba-Feather system. The F-CO will help minimize the risk of exceeding river channel capacity and increase the warning times to communities along the major California rivers and downstream of flood control reservoirs through enhanced communication between local, state and federal agencies; improved data gathering and exchange; and utilization of the most recent advancements in weather and river forecasting.

Evaluation of Benefits of Reoperation of Water Supply Systems

Status: Development
Contact: Sean Sou, Michael Mierzwa

California's water system is made up of state, federal, and local agencies, each having infrastructure in place to provide water supply and flood control benefits. The current operation of these independent systems is based on physical and legal constraints. Changes in the climate, legal framework, and social values associated with water use may require alternations to existing operations and management procedures, new facilities, and new laws. System reoperation refers to changes made to existing operations and management procedures.

DWR has begun an evaluation of potential benefits of reoperation of both its own water management programs and other water systems. This evaluation will better define the scope of system reoperation and serve as a guide for other local and federal agencies to evaluate the potential benefits associated with reoperation of their own programs.

Though some new strategies, such as forecast-based operations, promise to improve the efficiency of trading of reservoir storage (water supply) for flood control, a quantitative evaluation of system reoperation benefits requires the establishment of a common baseline hydrology and better understanding of California's water system components. DWR's evaluation will establish California's present hydrologic and climate conditions and will also develop a consistent climate change hydrology. This baseline and future projection can then be used by both DWR and others in order facilitate comparative evaluations of system reoperation benefits of independent systems.

Determining a baseline and better understanding climate change's impact on hydrology will require new data in locations like the snow-rain transition zone and new

tools to allow better integration of independent water management programs. This project will also include some element of outreach to explain both the opportunities and challenges to reoperation, as well as to communicate the group's progress.

Energy and Greenhouse Gas Emissions

Water-Energy Subgroup of the Governor's Climate Action Team ("WETCAT")

Status: Ongoing
Contact: Mark Cowin/John Andrew

DWR co-chairs the Water-Energy Subgroup, better known as WETCAT, of the Governor's Climate Action Team. In addition to DWR, the principal agencies in the subgroup are State Water Resources Control Board, California Energy Commission, and the California Public Utilities Commission. In 2008, the WETCAT developed and proposed five measures to the California Air Resources Board for inclusion in the AB 32 Scoping Plan.

- Water conservation
- Water recycling
- Energy intensity of water systems
- Urban runoff and stormwater reuse
- Renewable energy production

Power Portfolio Policy for the State Water Project

Status: Development
Contact: Veronica Hicks

To reduce the State Water Project's reliance on fossil-fired power generation, with its associated adverse impacts, DWR will develop and implement a power portfolio policy for procuring power. This policy will contain strategies to increase the use of renewable energy as part of the SWP's power portfolio and reduce greenhouse gas emissions in California. These strategies are consistent with State policy and the goals established by the Governor's Executive Order S-03-05 (which established greenhouse gas emission reduction goals for California).

While developing the SWP energy policy, numerous operational and regulatory constraints shape the following objectives DWR is committed to meeting:

- Reliable water deliveries.
- Affordable water deliveries.
- Protection of the natural environment.
- Responsibilities under regulatory authorities.
- State and federal environmental policy goals.

As an example of the challenges DWR faces in balancing the needs and requirements of the SWP energy portfolio, in December 2007, U.S. District Court Judge Oliver Wanger imposed court order restrictions on water deliveries from the Delta to protect the threatened delta smelt. The order has significantly decreased water deliveries to homes, farms, cities and industry by both the SWP and the federal Central Valley Project, and has fundamentally affected SWP operations. The full impact of the reduction of the SWP's available energy resources, pumploads, and therefore greenhouse gas emissions, will in turn affect the SWP's power portfolio. To date, DWR's strategies for reducing emissions associated with the SWP portfolio include:

- To develop and maintain a credible and accurate record of the SWP's energy profiles and baselines, DWR filed its 2007 carbon dioxide emissions (CO₂) to the California Climate Action Registry (CCAR) in June 2008, and will continue reporting its emissions annually. In addition to the indirect emissions associated with the SWP power purchase portfolio, DWR reports direct and indirect emissions for the Department's leased facilities, vehicular fleet, and mobile and stationary facilities equipment.
- The SWP's current energy efficiency improvements programs include the refurbishment and replacement of DWR's hydroelectric generators and pumps at key SWP plant facilities. These programs result in almost one thousand gigawatt hours in cumulative energy savings by 2011. If additional proposed energy efficiency improvements are implemented through 2020, cumulative emissions avoided will reach one million metric tons of CO₂.
- Since July 1983, DWR has received up to 235 Megawatts of energy from Reid Gardner (RG) Powerplant, a coal-fired facility near Las Vegas, Nevada. This long-term agreement for energy from RG Unit No. 4 expires in July 2013, at which point, the SWP's CO₂ emissions levels will drop to over 30 percent from its 1990 levels. To replace this energy with cleaner, more efficient resources, DWR is investigating technologies such as cogeneration and combined cycle power, wind energy, small hydroelectric generation, as well as additional energy efficiency projects, and contracts for renewable energy resources.
- During high energy demand periods over the summer months of 2007 and 2008, the SWP was the largest provider for California's Demand Response Program. In 2007, at least three thousand tons of CO₂ emissions were avoided, as demand response reduces the need for the least efficient thermal generators to be brought on line during peak hours. In 2008, an estimated 900 tons of CO₂ emissions were avoided as a result of the Program, and dropped 7,600 Megawatt Hours of electricity during 2007.

2007 Emissions Report to the California Climate Action Registry

Status: Implementation

Contact info: Holly Cronin/Veronica Hicks/John Engstrom

DWR will quantify and report 98 percent of its total estimated direct and indirect CO₂ emissions from the State Water Project (SWP) power transactions, electricity, and natural gas used at DWR-occupied buildings, and fuels consumed by DWR-owned vehicles and backup generators (such as diesel, propane, and gasoline). These emissions will be reported to the California Climate Action Registry (the Registry), using the web-based Climate Action Registry Reporting Online Tool (CARROT). In addition, DWR will obtain certification of the resulting GHG Emission Report by a certifier that has been approved by both the Climate Action Registry and the State (Air Resources Board).

Business practices and technical expertise

Cement

Status: **Development**

Contact info: **Rick Ramirez/Gordon Enas**

Emissions of greenhouse gases (GHG) from cement production arise primarily from chemical processing (calcination) and fossil fuel combustion. While the cement industry has achieved significant GHG emission reductions since 1990, opportunities for further reductions still exist, particularly with expanded research into cement processing and concrete blending technologies. DWR will first identify its current contribution to cement-related GHG emissions and then develop a policy to use cement with a lower carbon content, if technically feasible, in DWR construction, maintenance, and replacement activities in accordance with statewide goals. A technical forum will be established within DWR to provide technical advice and support on cement-related topics for DWR employees and interested public agencies.

Environmental Documentation and Decision-Making

Status: **In progress**

Contact info: **Katy Spanos/John Andrew**

DWR has developed environmental analysis methodologies and reference materials for climate change to include with appropriate departmental work products. These methodologies and materials are used to help DWR comply with environmental documentation required to implement laws, regulations, and other operational mandates pertaining to climate change. In addition, DWR is implementing a consistent approach for conducting project specific environmental analyses for CEQA/NEPA compliance documents, biological assessments, permit applications, and other environmental needs.

Methodology for calculating and addressing GHG emissions from proposed projects

Status: **Completed**

Contact: **Andrew Schwarz**

New projects that are subject to NEQA/CEQA regulations are now required to address climate change in their environmental documentation. One element of the required analysis is an inventory and calculation of greenhouse gas emissions from the project. Developing an inventory requires defining the boundaries of the project and addressing possible emissions sources for which scope and impact data are lacking.

The GHG emissions calculation methodology was originally developed for use on proposed surface storage projects, but has been broadened, and is now generally applicable to most departmental construction projects. The methodology provides recommendations for drawing boundary lines around the project to define which emissions are attributable to the project. Recommendations on calculating detailed aspects of construction and operations emissions are also provided. In addition, recommendations are provided for qualitatively addressing emissions from sources that are not well understood or are unquantifiable at this time.

This methodology should allow most projects to inventory and calculate GHG emissions from the project and express them in metric tons of carbon dioxide equivalent.

This number can then be used in the determination of significance for NEPA and CEQA purposes. The methodology provides some recommendations for establishing a significance threshold, but may not reflect the current thinking in this area. Setting thresholds of significance continues to be an evolving issue. This methodology will require periodic updating on the issue of significance as additional information becomes available.

Sustainable Business Operations Initiatives

Status: Completed; Development
Contact: John Engstrom

DWR will identify, measure, and implement sustainable business operations practices, and then educate employees in these practices. The sustainable business operations practices to make DWR “greener” will include working to reduce energy and resource consumption, while lowering greenhouse gas emissions and creating healthier working environments for DWR employees. Enhanced business practices will include purchasing, commuting, traveling, as well as the means to reduce, reuse, and recycle.

DWR has already provided the *Environmentally Preferable Purchasing (EPP) Practices Handbook* to staff. The “Greening DWR” intranet web page has resources, employee suggestion box, and information on green practices, travel, commuting, facts, and links to help employees find ways to green their work practices. In fall 2007, a quarterly broadcast began of news on DWR’s greening activities, upcoming events, and accomplishments.

“Greening Business Operations” proposed initiatives include:

- Implement more sustainable business procedures, and processes. DWR is investigating integrating a document management system into its business operations. This type of system will reduce paper quantity and create an electronic system for tracking of approvals and electronic retention of documents to save time and resources.
- DWR will continue to promote the EPP Procurement program to utilize procurement methods that provide options for purchasing “green” products. Increased purchases from the EPP program will provide the Department with more sustainable and environmentally friendly office products and equipment.
- DWR will increase its efforts to reduce, reuse, and recycle in all areas of DWR’s daily business activities. DWR will look at continuing to increase its waste diversion reporting metrics under AB 75 to further reduce the amount of solid waste entering landfills. In addition, DWR is looking at creating a reuse center for slightly used or almost new office supplies that are no longer needed in one area of DWR business, but can be utilized by others in the Department.
- DWR will promote ways to reduce employee business travel for meetings by use of technology like teleconference centers or web casting. These technologies will allow employees from different regions of the state to meet more easily and reduce travel. DWR has some teleconference capabilities at its larger outlying offices but coverage is limited and more equipment is needed to make this more successful. In addition, training webinars and other online training opportunities will be investigated to reduce training commute for employees.

Accomplishments for 2008 include:

- Proposed “Sustainability Policy”- The corner stone for DWR sustainable activities is the “Sustainability Policy” proposed and submitted to DWR Executive for approval. The policy embodies the goals and directions the Department will take to be a leader within State government and the California water community. The changes implemented through this policy will not only make DWR better stewards of the environment, but also should yield cost savings to the State taxpayers through reduced operating cost and provide healthier work environments for staff and the visitors.
- Environmentally Preferable Purchasing (EPP) Practices- The Purchasing Services Office held purchasing workshops to update the department buyers about the EPP program and why it is in the best interest for the Department to utilize this opportunity. The purchases are reportable in many cases under the mandated goals outlined in the Public Contract Code (PCC) (12153-12320) for buying recycled-content products (RCPs). The goal of this effort is to increase purchases of RCP’s.
- Enterprise Content Management System (ECM) - A feasibility study concluded that there is an acute need for a document and records management system at DWR. On June 2, 2008, DWR Governance Board approved the project and funding. The first phase, procurement and implementation, of the ECM infrastructure was started. This ECM system will reduce paper retention, thus reduce office space necessary for files. Long term savings for reduction of office space, heating, cooling, and labor efficiency will be gained once this system is completed.
- Green Week- The first Green Week was held the week of April 21, 2008. The week highlighted information on the 3 R’s, Earth Day, EPP, Carbon footprint, DWR’s involvement in the California Climate Action Registry (CCAR), E-waste, and a voluntary E-waste drop off day.
- Green Print and Podcasts- Staff has promoted sustainability through quarterly “Green Print” articles posted through AquaNet. The articles discuss sustainable opportunities that staff can utilize both at work and at home. In addition, a Podcast was produced on efforts DWR is taking to green it business operations.
- Greening DWR Intranet Web Site- The web page was released in December 2007. Over the last year the site has been updated to include new information on sustainable practices. The web site also hosts the home for the Green Print articles past and present. The web page has a suggestion box that has provided input and comments from the readers. These comments have been the catalyst for recommendations for making our business operations greener. The Payroll Deduction Transit Pass Program is one of the suggestions currently under review.
- Proposed Payroll Deduction Transit Pass Program- This proposed program came from a suggestion made to the Green Team. The proposal recommends that monthly transit passes be sold through a pretax payroll deduction program. This has benefits for both employees and the Department. The employee saves money on the purchase of the transit pass, and the Department reduces the number of travel expense claims for those employees that purchase their tickets at retail vendors. The Resources Building is the only location that DWR sells transit passes and tickets.
- Green Award for Waste Reduction and Diversion- The Director approved a new Green Award for excellence in Waste Reduction and Diversion. The first award will be awarded for 2008 efforts.

- Leadership in Energy and Environmental Design (LEED) Buildings- The State Water Project Southern Field Headquarters is planned to be the first LEED Gold building developed by the Department. Currently, the project is being designed and is scheduled to be completed in 2010. The department is also working with DGS to have the lease facility in West Sacramento LEED Certified. Currently the building is under construction. The facility will be submitted for LEED Interior Construction (IC) Certification.
- Road Show- Staff developed a “Road Show” presentation, which will be presented to all divisions and offices in 2009. The road show has an overview of all sustainable activities occurring within DWR and gives reference, guidance, source material, and contacts to implement greener business practices.

Climate Change Matrix Team

Status: Ongoing

Contact: John Andrew

DWR’s Climate Change Matrix Team includes representatives from every division and major program in the Department. The team of approximately 40 staff (membership is on the last page of this report) meets at least quarterly to communicate and coordinate on climate change projects; meetings regularly feature an external speaker on climate change.

Grantmaking and technical assistance

Integrated Regional Water Management Grant Program

Status: Development
Contact info: Tracie Billington

DWR will incorporate climate change issues into the Integrated Regional Water Management Plan (IRWM) standards and into grant program criteria. DWR has held scoping meetings to get public input on the proposed climate change standards. The draft standards will be released for public comment in fall 2009 and finalized by winter 2009/2010. The standards will include links to DWR and other agencies web sites that will provide the latest information on various ways to mitigate or adapt projects to accommodate climate change in IRWM Plans.

Provide Expert Assistance for Water Use Efficiency

Status: Development
Contact info: Rick Soehren, Manucher Alemi

The Office of Water Use and Efficiency and Transfers (OWUE&T) will respond to inquiries about how to use water efficiently at all levels, from statewide usage to options specific to the State Water Project. OWUE&T have requested resources needed to carry out its water-energy relation activities. When resources are made available, expected in July 2009, staff will begin the activities. Staff experts will answer questions or provide data and information. DWR is also requiring grant applicants to analyze the energy impacts of their water conservation projects.

OWUE&T will work with other organizations within DWR and with other state agencies (ex. California Energy Commission, Air Resources Board, California Public Utilities Commission) to gather and disseminate information about methods to use water efficiently and to reduce greenhouse gas emissions. Staff will also provide analysis and produce studies to determine the most cost-effective programs, projects, or practices that can be implemented to meet the greenhouse gas emission standards mandated by Assembly Bill 32.

National and International Scientific Committees

Status: Ongoing
Contact: Jeanine Jones/Maury Roos

During 2008, Jeanine Jones served on the National Research Council's Committee on Strategic Advice for the U.S. Climate Change Science Program, and NOAA's Climate Working Group, a formal federal advisory committee to NOAA's Climate Programs Office. Maury Roos consulted on Technical Paper VI, *Climate Change and Water*, of the Intergovernmental Panel on Climate Change.

Public Outreach

Status: Ongoing

Contact: Elissa Lynn/Amy Norris/Jeanine Jones/John Andrew/Michael Anderson

DWR is actively engaged in outreach efforts with multiple partners on the water resources impacts of climate change, focusing on public awareness, interagency coordination, and adaptation strategies. For example, climate change was the focus of the Fall 2008 *DWR News/People* issue, which detailed current programs, initiatives, and future plans for DWR climate change measurement, mitigation, and adaptation efforts. Information on workshops, conferences, water supply, and State Climatologist programs are sent via the "Weather and Climate Newsletter" to 1500 subscribers. DWR also maintains a climate change website which provides the opportunity for the general public to e-mail climate change inquires to DWR staff.

State Fair and Climate Change Video

The California State Fair, 2007 DWR Exhibit was on Climate Change, and won the National Association of Government Communicators Gold Award. Visualizations of global warming computer models on a six-foot spherical projection screen were used as the focal point for the first climate change video produced by DWR. A new 20-minute movie, "A Climate of Change," is being produced through the Water Education Foundation, and will be available in spring 2009.

Presentations

DWR made approximately 60 presentations on climate change, including several keynote addresses, including at interstate and international venues. As adaptation and mitigation plans begin to yield guidelines, recommendations, and implementation policy, DWR outreach efforts in climate change will increase through partnerships and local coordination.

Workshops

DWR sponsored a series of climate change related workshops in 2008

- Climate Change Adaptation Summits were held in October 2007 in Santa Monica and November 2008 in Long Beach with the Water Education Foundation.
- March 2008 workshop with Western Governors' Association, Western States Water Council, and the U.S. Climate Change Science Program (CCSP) in Boulder, Colorado.
- September 2008 Western States Water Council/Western Governors' Association workshop on climate change adaptation policy in Irvine.
- April 2008 U.S./Mexico Border-area climate change science workshop in Tucson with the University of Arizona.
- The first ever Winter Outlook Workshop was held in November, 2008 in San Diego, bringing together western U.S. climate experts to provide the first long-range outlooks for California's upcoming rain season.

Reports

In July 2008, DWR produced a bilingual special report for the XXVI Border Governors Conference, *Water & Border Area Climate Change, an Introduction*, in conjunction with the US/Mexico climate change science workshop.

In October 2008, DWR released “Managing an Uncertain Future”, a white paper on the climate change adaptation for California’s water sector that sets forth ten adaptation strategies to help avoid or reduce climate change impacts to water resources. This report was the first State-level adaptation strategy for water resources in the US, and the first for any sector in California. It is currently being used as a model for the California Climate Adaptation Strategy directed by Executive Order S-13-08.

State Climatologist's Office

Status: Ongoing

Contact: Michael Anderson

DWR is designated as the official State Climate Office (SCO) for California, which includes the Office of the State Climatologist (OSC), Dr. Michael Anderson. Interacting with the California Climate Data Archive (CalClim) group at the Western Regional Climate Center (WRCC), the OSC provides a growing range of climate services for California.

During 2008, the updating of the state's rainfall intensity duration frequency design curves continued with the completion of an internal draft document. Release of the updated document on the web is expected in 2009. Concurrently NOAA is working to produce an update to its rainfall frequency product for California, which should be complete sometime in 2010. Both of these products will be used in an effort to produce hydrologic information for floodplain mapping and other hydrologic and hydraulic studies associated with California's [FloodSAFE](#) program.

In another flood management project, collaboration with NOAA began on the development of an extreme precipitation monitoring network that will include GPS-Met stations to monitor atmospheric water vapor, soil moisture sensors, and vertically pointing radar to detect freezing level in the atmosphere. The project, born out of NOAA's Hydrometeorological Testbed work in the American River watershed, is a five-year effort to lay out the initial components to a statewide monitoring network to improve precipitation forecasts and increase lead time for flood mitigation actions.

On October 1, 2008, California joined the CoCoRaHS nation. In the first six months of the program, over 500 volunteers have signed up. CoCoRaHS offers another opportunity for collaboration between NOAA personnel and the State Climatologist with NWS Weather Forecast Offices taking the lead as regional coordinators.

Drought response activities increased in 2008 as the second dry year in a row unfolded. The OSC participated in the DWR drought team providing data and material for decision support and outreach activities. Interactions with the U.S. Drought Monitor continued with increased coordination between the OSC and the NWS California-Nevada River Forecast Center (RFC), the Sacramento Weather Forecast Office and the WRCC. Three new products relating precipitation and reservoir conditions to the Drought Monitor levels were created and posted on the RFC website. Efforts are expected to continue in 2009 as dry conditions persist.

As dry conditions continued in California during 2008, an increase in data requests handled through the office via email and phone was observed. As for the data portals, the California Data Exchange Center (CDEC) recorded over 124 million page views in 2008 while CIMIS recorded 345,271 data reports generated. The State Climatologist website saw over 93,000 page views.

Similar to the OSC, CalClim has received more data requests this year than in previous years through its online data request and feedback form. Large data requests this year included the California Air Resources Board and the South Coast Air Quality District, as well as collaborating on acquiring data for a heat wave study by OSHA. While there are several "repeat customers", in 2008 there were many more new or one-time data

requests. The CalClim group continues to grow its data archive through the addition of networks, both existing and new installations. 2008 saw the implementation of a small network on Santa Catalina Island that is included in the updated data interface, as well as the inclusion of a US Navy weather network and other smaller networks that have been funded at WRCC.

Presentations and Posters

Manucher Alemi

Climate Change Summit, November, Long Beach

Jamie Anderson

CWEMF annual meeting, February, Asilomar

CALFED Science Conference, October, Sacramento

Michael Anderson

Alluvial Fan Task Force, March, Los Angeles

American Society of Civil Engineers Water Congress, May, Honolulu

MTNCLIM, June, Silverton, Colorado (Poster)

Water Plan Update Climate Change Technical Advisory Group, July, Sacramento

Presentation to Dutch Ambassador, July, Sacramento

Floodplain Management Association, September, San Diego

FMA Local Chapter, October, Sacramento

CALFED Science Conference, October, Sacramento (Poster)

American Geophysical Union, December, San Francisco

Francis Chung

UN World Meteorological Organization Executive Council, June, Geneva, Switzerland

American Geophysical Union, December, San Francisco

Messele Z. Ejeta et al.

ASCE/EWRI 2008 Congress, May, Honolulu, Hawaii (presentation and proceeding paper)

CALFED Science Conference, October, Sacramento (presentation and posters)

American Geophysical Union, December, San Francisco (poster)

Michael Floyd

Kevin Kao

American Geophysical Union, December, San Francisco

Elissa Lynn

California Department of Parks and Recreation, January, Marshall

Sonoma State University, Focus the Nation Teach-in on Climate Change, February,
Rohnert Park

Natomas Charter School, March, Sacramento

DWR Field Guides annual meeting, April, Oroville

Association of California Water Agencies, May, Monterey (keynote)

Sacramento Kiwanis Club, June, Sacramento

Sacramento Water Forum, June, Sacramento

State Fair, August-September, Sacramento

DWR Environmental Scientists Workshop, September, Granlibakken (keynote)

Sacramento River Watershed, September, Sacramento (keynote)

CALFED climate Video presentation, October, Sacramento (host)

Climate Change Summit, November, Long Beach

Roy Peterson

CALFED Science Conference, October, Sacramento (Poster)

Maury Roos

U. S. Committee on Irrigation and Drainage, September, Portland, OR
California Climate Change Research Conference, September, Sacramento (Poster)
US Committee on Irrigation and Drainage, September, Portland (Poster)
CALFED Science Conference, October, Sacramento
Work shop of Working Group on Climate Change and Agricultural Water Management,
International Committee Congress Conference, October, Lahore, Pakistan

Andrew Schwarz

DWR Environmental Scientist's Workshop, September, Granlibakken

Jianzhong Wang et al.

American Geophysical Union, December, San Francisco (Poster)

Hongbing Yin et al.

American Geophysical Union, December, San Francisco (Poster)

John Andrew

California Water Law Symposium, January, San Francisco (keynote)
Santa Clara Valley Water District Board of Directors, January, San Jose
California Irrigation Institute, January, Sacramento
Climate Adaptation for Water Managers, February, Biosphere II, Arizona
ASCE Infrastructure Symposium, February, Sacramento
State Water Resources Control Board, February, Sacramento
Environmental Alliance of Contra Costa, February, Martinez
Urban Water Resources Center, March, UC Irvine
California Public Health Association-North, March, UC Davis
North Bay Watershed Association, April, Petaluma
Southern California Water Dialogue, April, Los Angeles
Texas Climate Change Conference, April, Austin, Texas
North Coast Regional Water Quality Control Board, May, Santa Rosa
Delegation from New South Wales, June, San Francisco
Land Use and Climate Change, June, Los Angeles
Solutions for the Water Economy, August, San Francisco
Climate Change Symposium, Floodplain Management Association, September, San Diego
(co-host)
California Climate Change Conference, September, Sacramento (moderator)
Plenary, California Water Plan Update, September
Bay Area Water Forum, September, Oakland
Opportunities for Agriculture Workshop, September, Tulare
Western States Water Council/Western Governor's Association, September, Irvine
Delegation from Melbourne Water, October, Sacramento
Climate, Ecosystems, and Resources in Eastern California, November, Bishop

Articles

Maury Roos, "Sea Level Rise; An Increasing Risk to California Water Projects", *American Water Resources Association Impacts Journal* (in press)

John Andrew, Jessica Roberts Pearson, and John K. Woodling, "California Water Management: Subject to Change," *West-Northwest Journal of Environmental Law and Policy*, Summer 2008

Climate Change Matrix Team

Executive Sponsor: Mark Cowin

Linda Ackley
Manucher Alemi
Curtis Anderson
Michael Anderson
John Andrew, Chair
Tracy Billington
Nikki Blomquist
Steve Bradley
Francis Chung
Rob Cooke
Holly Cronin
Gordon Enas
John Engstrom
Y-Nhi Enzler
Megan Fidell
Tom Filler
Dan Flory
Mike Ford
Dan Fua
Jim Goodridge
Dale Hoffman-Floerke
Veronica Hicks
Arthur Hinojosa
Ray Hoagland
Jeanine Jones
Rich Juricich
Elissa Lynn
Dave Mraz
Mike Myatt
Amy Norris
Roy Peterson
Jessica Pearson
Glen Pearson
Steve Roberts
Maury Roos
Greg Smith
Rick Soehren
Jim Spence
Harry Spanglet
Michael Werner
Rick Ramirez