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Department of Water Resources

The State Water Project Delivery Reliability Report 2007

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Arnold Schwarzenegger, Governor
State of California

Mike Chrisman, Secretary for Resources
The Resources Agency

Lester A. Snow, Director
Department of Water Resources

Bay Delta Office
Katherine Kelly, Chief

Modeling Support Branch
Francis Chung, Principal Engineer

Individuals contributing to the development of the report
John Andrew, Principal Engineer, Executive Office
Sushil Arora, Supervising Engineer, Bay-Delta Office
Ralph Svetich, Supervising Engineer, Division of Flood Management
Erik Reyes, Senior Engineer, Bay-Delta Office
Michael Mierzwa, Senior Engineer, Division of Flood Management
Bob Suits, Senior Engineer, Bay-Delta Office
Alan Olson, Engineer, Bay-Delta Office
Christopher Quan, Engineer, Bay-Delta Office

Editorial review, graphics, and report production
Gretchen Goettl, Supervisor of Technical Publications
Nikki Blomquist
Patricia Cornelius
Mike Durant
James Joelson
Carole Rains
Marilee Talley

Foreword

The water delivery reliability of the State Water Project (SWP) is at a crossroads. Future water deliveries to millions of Californians throughout the state will be affected by many factors, including two significant changes: Delta pumping restrictions and climate change.

This report provides a glimpse of our current path if no action is taken to address these and other factors. The report also identifies many other factors that could be changed to positively affect our water future.

Estimating the delivery reliability of the SWP depends on many issues, including possible future regulatory standards in the Delta, population growth, water conservation and recycling efforts, and water transfers. The impact of climate change on hydrology, consumptive use of water, fisheries and sea level rise must also be considered. This report evaluates the impacts of potential changes in hydrology of climate change. These other factors, also need to be considered: the stability of Delta levees, and therefore, SWP water deliveries, are threatened by earthquakes, land subsidence and floods.

On the positive side, there are significant and promising processes under way that could take us to a much more reliable and sustainable Delta water conveyance system for the SWP.

In this report, a possible future for these factors is presented. However, to the extent that these factors can be and are changed by actions over the next few years, this estimate of water delivery reliability will also change.

In spring 2007, the state saw the first voluntary shutdown of the SWP pumps in the Delta to protect fish. Delta smelt and some other pelagic (open water) fishes have been in decline since the early 2000s for reasons that likely include the presence of invasive species, which have altered the basic food web in the Delta, and the impacts of toxics and water project operations. In 2007, water project operations changes in the Delta costing over 500,000 acre-feet were taken to help protect the endangered Delta smelt with the use of the Environmental Water Account. Unfortunately, these actions did not result in an increase in the abundance of Delta smelt in the fall of 2007 suggesting that more than just water project operational changes in the Delta are needed to increase Delta smelt abundance. In addition, another pelagic fish, the long-fin smelt, is now also being considered for listing under the State Endangered Species Act. Clearly, a more comprehensive approach to address the decline in pelagic fish is needed.

In December 2007, a federal court imposed interim rules that will significantly restrict the operations of both the SWP and the Central Valley Project while a new federal biological opinion for Delta smelt is written in 2008.

During 2007, new Delta planning efforts — including Delta Vision established by Gov. Arnold Schwarzenegger and the Bay-Delta Conservation Planning process — have reached important conclusions about the need to change the way water is conveyed across or around the Delta to better protect fish and provide a sustainable and reliable water supply for the state. Those efforts will continue into 2008.

This report on water delivery reliability of the SWP represents the current state of water affairs and future delivery scenarios if no action is taken. It shows a continued eroding of SWP water delivery reliability under the current method of moving water through the Delta and assumed near-term effects of climate change.

The estimates for current deliveries show that, when compared to the estimates in the *2005 State Water Project Delivery Reliability Report,* total annual SWP deliveries decrease in 93 percent of the years based on the historical data used in the analysis. Water deliveries estimated for 20 years into the future are also presented as a range of values to capture the variability in the results of the climate change studies.

When compared to the future estimates in the 2005 report, total annual deliveries for 2027 show even greater decreases in most of years if no action is taken to address the factors causing this decrease in water delivery reliability. That is why DWR is, and will continue to be, at the forefront of efforts to improve conditions in the Delta that will protect the ecosystem and water supply reliability for 25 million Californians.

Lester A. Snow
Director
California Department of Water Resources
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Introduction

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The State Water Project (SWP) is primarily a water storage and delivery system intended to help close the gap in California between when and where precipitation primarily falls and when and where most water demands occur. Water from the SWP is a critical component of water supply for the 29 state water contractors, who may also receive water from other sources. While each of the water supply contracts defines the maximum amount of water to be delivered annually, the amount of water actually delivered may be less due to such factors as variable precipitation and runoff, physical and institutional limits on storage and conveyance, and contractors' variable water demands. For communities receiving SWP water, the reliability of SWP water deliveries is a key factor for local planners and government officials estimating their own water supply reliability.

Since the *2005 SWP Delivery Reliability Report*, DWR has updated its estimate of current (2007) and future (2027) SWP delivery reliability and has expanded the conditions under which reliability is quantified. The additional conditions are changes in hydrology due to potential climate change and restrictions on SWP and CVP pumping in accordance with the interim operation rules imposed by the December 2007 federal court order.

This report first briefly describes the SWP and the Sacramento-San Joaquin Delta (Delta), the hub of water deliveries in California. Next, it discusses the general topic of water delivery reliability and how DWR calculates delivery reliability for the SWP. Then it summarizes key planning activities that may affect future SWP delivery reliability. These activities are Delta Vision, the Bay Delta Conservation Plan, the Delta Risk Management Strategy, and the CALFED Ecosystem Restoration Program Conservation Strategy. The report presents three areas of significant uncertainty to SWP delivery reliability: the recent and significant decline in pelagic organisms in the Delta (open-water fish such as delta smelt and striped bass), climate change and sea level rise, and the vulnerability of Delta levees' to failure. Next, the report discusses the general approach to simulating SWP operations by CALSIM II for this report.

The report presents results of CALSIM II studies that assume future climate change scenarios and SWP operations under high and low flow restrictions in the Delta. The assumed flow restrictions are designed to estimate the operation restrictions to be put in place by the federal court to protect delta smelt for water year 2008 and until replaced by new federal biological opinions.

Finally, the report provides guidance on how to apply the delivery estimates to water management plans. Presented in appendixes are detailed CALSIM II simulation assumptions and results and recent SWP deliveries.

This report does not include analyses of how specific water agencies should integrate SWP water supply into their water supply equation. This topic requires extensive information about local facilities, local water resources, and local water use, which is beyond the scope of this report.

Moreover, such an analysis would require decisions about water supply and use that traditionally have been made locally. DWR believes that local officials should continue to fill this role.

Background

Purpose

This report on SWP delivery reliability is intended to help local agencies, cities, and counties that use SWP water while planning integrated water resources management to develop adequate and affordable water supplies for their communities. These activities are usually conducted in the course of preparing a water management plan such as the Urban Water Management Plans required by Water Code Section 10610. The information in this report can be used by local agencies in preparing or amending their water management plans and identifying the new facilities or programs that may be necessary to meet future water demands. Local agencies and governments will also find in this report useful information for conducting analyses mandated by laws requiring water retailers to demonstrate whether their water supplies are sufficient for certain proposed subdivisions and development projects subject to the California Environmental Quality Act.

This report can be used with published guidelines that explain how to integrate SWP supply information with supply information from other sources to develop an overall reliability assessment of each contractor's total water portfolio. DWR has published two documents addressing this topic. *Guidebook for Implementation of Senate Bill 610 and Senate Bill 221 of 2001* (October 2003) includes suggestions on how local water suppliers can integrate supplies from various sources, such as the SWP, into their analyses. Another document is *Guidebook to Assist Water Suppliers in the Preparation of a 2005 Urban Water Management Plan* (January 2005). Both documents can be found on DWR's Office of Water Use Efficiency home page at **http://www.owue.water.ca.gov**.

Reporting Requirements

As a result of a court-approved settlement agreement executed by the Planning and Conservation League, DWR, state water contractors and other entities in the wake of the 3rd Circuit Court of Appeal's ruling in the "Monterey Amendments" case in 2000, DWR has a legal duty to prepare State Water Project delivery reliability reports every two years. In that agreement, DWR committed to the following:

> Commencing in 2003, and every two years thereafter, the Department of Water Resources (DWR) shall prepare and deliver to all State Water Project (SWP) contractors, all city and county planning departments, and all regional and metropolitan planning departments within the project service area a report which accurately sets forth, under a range of hydrologic conditions, the then existing overall delivery capability of the project facilities and the allocation of that capacity to each contractor. The range of hydrologic conditions shall include the historic extended dry cycle and long-term average. The biennial report shall also disclose, for each of the ten years immediately preceding the report, the total amount of project water delivered and the amount of project water delivered to each contractor. The information presented in each report shall be presented in a manner readily understandable by the public. (Settlement Agreement Attachment B).

Previous Reports

The *2007 SWP Delivery Reliability Report* is the third report of this type. The previous reports in 2003 and 2005 defined and calculated delivery reliability the same manner as in this report with output from DWR's CALSIM II model. This report differs from those earlier reports because it includes estimates of reductions to SWP delivery reliability due to the pelagic organism decline (POD) and future climate changes. This report also discusses the risk of conveyance disruption due to Delta levee failure.

Context

The State Water Project

The SWP is a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants that extends for more than 600 miles. Its main purpose is to divert and store surplus water during wet periods and distribute it to areas in Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California. It is also used for recreation and to control floods, generate power, protect fish and wildlife, and manage water quality in the Sacramento-San Joaquin Delta.

The keystone of the SWP is Lake Oroville, which conserves water from the Feather River watershed. It is the SWP's largest storage facility with a capacity of about 3.5 million acre-feet. Releases from Lake Oroville flow down the Feather River into the Sacramento River, which drains the northern portion of California's Central Valley. The Sacramento River flows into the Sacramento-San Joaquin Delta, comprised of 738,000 acres of land interlaced with channels that receive runoff from about 40 percent of the state's land area. The SWP and the federal Central Valley Project (CVP) rely on Delta channels as a conduit to move water from the Sacramento River inflow to the points of diversion in the south Delta. Thus, the Delta is actually part of the SWP conveyance system, making the Delta a key component in SWP deliveries. The significance of the Delta to SWP deliveries is described in more detail below.

From the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay Aqueduct. Near Byron in the southern Delta, the SWP diverts water into Clifton Court Forebay for delivery south of the Delta. Banks pumping plant lifts water from Clifton Court Forebay into the California Aqueduct, which channels the water to Bethany Reservoir. The water delivered to Bethany Reservoir from Banks Pumping Plant is either delivered into the South Bay Aqueduct for use in the San Francisco Bay Area or continues down the California Aqueduct to O'Neil Forebay, Gianelli Pumping-Generating Plant, and San Luis Reservoir.

San Luis Reservoir is jointly operated by DWR and the Bureau of Reclamation and has a storage capacity of more than 2 million acre-feet (maf). DWR's share of gross storage in the reservoir is about 1.062 maf. Generally, water is pumped into San Luis Reservoir during late fall through early spring, and is temporarily stored for release back to the California Aqueduct to meet summertime peaking demands for SWP and CVP contractors.

SWP water not stored in San Luis Reservoir and water eventually released from San Luis continues to flow south through the San Luis Canal, a portion of the California Aqueduct jointly owned by DWR and the Bureau of Reclamation. As water flows through the San Joaquin Valley, deliveries of CVP water are made through numerous turnouts to farmlands in the service areas of the CVP. Near Kettleman City, the Coastal Branch Aqueduct splits from the California Aqueduct for water delivery to agricultural areas to the west and municipal and industrial water users in San Luis Obispo and Santa Barbara counties.

The remaining water conveyed by the California Aqueduct travels farther in the San Joaquin Valley to agriculture users such as Kern County Water Agency before reaching Edmonston Pumping Plant, which raises the water high enough to travel across the Tehachapi Mountains into Antelope Valley. In Antelope Valley, the Aqueduct divides into the East and West Branches. The East Branch carries water into Silverwood Lake and Lake Perris. Water in the West Branch flows to Quail Lake, Pyramid Lake, and Castaic Lake.

Twenty-nine state water contractors have signed long-term water supply contracts with DWR for 4.173 million acre-feet (maf) per year. Signed in the 1960s, all contracts are in effect to at least 2035 and are essentially uniform. Each contract contains a schedule of the maximum amount of water the contractor can receive annually. This schedule is contained in SWP Table A. The annual amount was designed to increase each year, with most contractors reaching their maximum amount in 1990. In most cases, SWP water is an important component of local water supplies. Five contractors use SWP water primarily for agricultural purposes and the remaining 24 contractors use SWP water primarily for municipal purposes. All available water is allocated annually in proportion to each contractor's annual SWP Table A amount. Appendix C contains additional information about SWP Table A.

The Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta is a network of natural and artificial channels and reclaimed islands at the confluence of the Sacramento and San Joaquin rivers. The Delta forms the eastern portion of the San Francisco estuary, receiving runoff from more than 40 percent of the state's land area. It is a low-lying region where over the years sediment from the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers mingled with organic matter deposited by marsh plants. Covering 738,000 acres interlaced with hundreds of miles of waterways, much of the land is below sea level and relies on more than 1,100 miles of rather fragile levees for protection against flooding.

Because the SWP and the CVP use Delta channels to convey water to the southern Delta for diversion, the Delta is the focal point for water distribution throughout the state. In fact, the Delta is one of the few estuaries in the world that is used as a major source of drinking water supply: about one-quarter of California's drinking water comes from the Delta; two-thirds of Californians get some portion of their drinking water from the Delta. The Delta also provides a unique estuarine habitat for many resident and migratory fish and birds, some of which are listed as threatened or endangered. Most of the native fish either migrate through the Delta or move into it for spawning. Resident native fish are mainly present in areas strongly influenced by the Sacramento River inflows.

The CVP pumps at Jones Pumping Plant have a capacity of 4,600 cubic feet per second (cfs) and divert water directly from Old River. The CVP has contracts to divert 3.3 maf annually from the Delta for primarily agricultural use south of the Delta. The SWP pumps at Banks Pumping Plant have a combined pumping capacity of 10,300 cfs; however, diversions into the buffering Clifton Court Forebay are restricted to 13,870 acre-feet (af) daily and 13,250 af per day over a three-day average. A rate of 13,250 af per day equates to an average pumping of 6,680 cfs.

CVP and SWP reservoir releases and Delta exports are coordinated according to the Coordinated Operating Agreement (COA), which sets guidelines for the sharing of supply and responsibility for meeting water quality standards in the Delta. Most of the water exported by the SWP depends on water rights derived from Lake Oroville storage; however, the SWP can also divert water considered in excess in the Delta. These excess conditions in the Delta usually result when there is sufficient inflow to meet all beneficial needs and the SWP is not required to make supporting releases from Lake Oroville. Diversions during excess Delta conditions are still governed by various determinations and rules.

In addition to the state and federal projects' diversions, irrigation water for use in the Delta is taken from channels and sloughs through approximately 1,800 diversions which can total more than 5,000 cfs in July and August.

Delta water quality is primarily governed by the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta (1995 Bay-Delta Plan). This plan established beneficial uses, associated water quality objectives, and an implementation program. The State Water Resources Control Board (SWRCB) in Water Rights Decision 1641 assigned primary responsibility for meeting many of the Delta water quality objectives to the SWP and CVP. Key factors in determining water quality in the western Delta are the quality of important Delta inflows and the intrusion of ocean-derived salts associated with daily tides. The extent of this intrusion is primarily determined by the magnitude of Delta inflows, export pumping rates, and operation of the Delta Cross Channel. Delta inflows are normally at least partially regulated by upstream reservoir operations.

The water flowing in Delta channels is constrained by an extensive levee system that protects Delta islands from flooding. This protection is critical because land subsidence in the Delta, primarily due to the consuming oxidation of aerated peat soils, has placed most of the land in the Delta below sea level. In fact, the elevation of Delta islands can be more than 20 feet below sea level. The resulting difference between the elevations of Delta lands and the water surface in adjacent channels makes Delta levees vulnerable to failure. Land subsidence in the Delta is expected to continue, which will increase the vulnerability of levees to failure and subsequent island flooding.

Water Delivery Reliability

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As mentioned in the Introduction, estimates of SWP delivery reliability are intended to help local SWP water users assess their water supply reliability, a key measure of a system's ability to match water supplies with demand. Just how water delivery reliability is assessed is critical to whether it is a meaningful guide for such an analysis. This chapter presents DWR's method for calculating SWP delivery reliability, the factors affecting SWP delivery reliability, and the limitations to estimating future water delivery reliability.

Calculating SWP Delivery Reliability

For this report, "water delivery reliability" is defined as the annual amount of water that can be expected to be delivered with a certain numeric frequency. SWP delivery reliability is calculated using computer simulations based on 82 years of historical data. The annual amounts of SWP water deliveries are ranked from smallest to largest and a probability is calculated for each amount. These results are often displayed as a graph, commonly referred to as an exceedence plot. They can also be presented in a table.

Factors Affecting Water Delivery Reliability

The amount of the SWP water supply delivered to the state water contractors in a given year depends on the demand for the supply, amount of rainfall, snowpack, runoff, and water in storage, pumping capacity from the Delta, and legal constraints on SWP operation. Expressed in more general terms, water delivery reliability depends on three general factors: the availability of water at the source, the ability to convey water from the source to the desired point of delivery, and the magnitude of demand for the water.

Availability of Source Water

The availability of water at the source depends on the amount of rain and snow and water use in the source areas. For the SWP, the size of the April 1 snowpack in the Feather River watershed and the storage in Lake Oroville are key components of the annual estimation of the SWP's delivery capabilities from April through September.

Factors of Uncertainty The inherent yearly variable location, timing, amount, and form of precipitation in California introduce some uncertainty to the availability of future SWP source water and hence future SWP deliveries. The approach of analysis of SWP deliveries by simulating an 82-year sequence based on historical weather patterns restricts the subsequent simulation to no more extreme droughts or severe storms than have historically occurred. However, the 82-year sequence of weather patterns does produce a wide range of hydrologic events with which to evaluate the ability of the SWP to deliver water.

The second source of uncertainty in source water is due to climate change. Current literature suggests that global warming is likely to significantly affect the hydrologic cycle, changing California's precipitation pattern and amount from that shown by the record. In fact, there is evidence that some changes have already occurred, such as an earlier beginning of snowmelt in the Sierra, an increase in winter runoff as a fraction of the total runoff, and an increase in winter flooding frequency. More variability in rainfall, wetter at times and drier at other times, would place more stress on the reliability of existing flood management and water supply systems, such as the SWP.

Treating Availability of Source Water Issues in CalSim II Studies The State Water Project operation analyses contained in this report are based upon operation simulations under an extended record of historical precipitation and adjusted historical runoff. The 82-year record of 1922-2003 runoff patterns in the studies simulating 2007 and 2027 levels of development have been adjusted as needed to reflect the current and future levels of development in the source areas by analyzing land use patterns and projecting future land and water use. These series of data are then used to forecast the amount of water available to the SWP under Current and Future (2027) conditions.

Potential changes in climate patterns are becoming better defined and studies have been done on potential impacts to SWP deliveries due to associated changing hydrology. In a 2006 DWR report, *Progress on Incorporating Climate Change into Management of California's Water Resources*, broad-brush estimates are made of the potential impact upon the SWP around the year 2050 if no additional conveyance facilities or upstream reservoirs are built. These climate change studies adjusted the 73-year historical record (1922-1994) of rainfall and runoff according to four scenarios: weak temperature warming and weak precipitation increase in California under model PCM; modest warming and modest drying under model PCM; modest warming and modest drying under model GFDL v. 2.0; and weak temperature warming and weak precipitation increase in California under model GFDL v. 2.0. These studies have been updated for this report by expanding the simulation period to 82 years (1922-2003).

DWR has estimated potential deliveries at the 2027 level. However, these estimates are based on the assumption that no changes will be made in either the way water is conveyance across the Delta or in the interim operating rules defined by the recent court order to protect delta smelt. These assumptions are not a prediction of the future but an assessment of the future if these factors do not change. In addition, these estimates must be viewed with caution given the uncertainty of the effects of climate change in the future and the simplifying assumptions required for the analyses.

Ability to Convey Source Water to the Desired Point of Delivery

The ability to convey source water to the desired point of delivery refers to the availability of facilities to capture and convey water and any institutional limitations placed upon the facilities. Uncertainty in SWP deliveries may be in part due to uncertainty in the ability to convey water. For the SWP, this uncertainty centers on the Delta.

Factors of Uncertainty In general, SWP operations are closely regulated by Delta water quality standards established by the State Water Resources Control Board (SWRCB) and set forth in Water Rights Decision 1641. Even in the times SWP operations are left to the discretion of DWR, actions often require consultation with federal and state fish and wildlife agencies under its Endangered Species Act provisions. The evolving response to the continuing unexplained decline in many pelagic fish species since the early 2000's, and the legal challenges to SWP operation and ongoing planning activities related to the Delta's future are sources of uncertainty for SWP delivery reliability related to water conveyance.

On May 25, 2007, a federal judge found that the 2005 USFWS Biological Opinion for delta smelt was not consistent with the requirements of the Federal Endangered Species Act and must be rewritten. On Aug. 31, 2007, the same judge established interim operating rules to protect delta smelt until USFWS rewrites the biological opinion. The interim operating rules set in-Delta flow targets in Old and Middle rivers from late December through June that will restrict CVP and SWP pumping in 2008 and until the delta smelt biological opinion is rewritten. In Chapter 4, this report discusses the process used to rewrite this biological opinion.

Another potential uncertainty for SWP water conveyance through the Delta is the risk of interruptions in SWP diversions from the Delta due to levee failure. SWP source water enters the Delta through the Sacramento River and is conveyed to Banks Pumping Plant via Delta channels lined with fragile levees. If a levee fails, depending on the location and the size of the adjacent island, the flow of water from nearby channels onto the affected island can draw saline water from Suisun and San Pablo bays into the central Delta. In such an incident, SWP pumping at Banks Pumping Plant may have to be curtailed or ceased for a period to prevent drawing saline water into the south Delta. Additional releases from Lake Oroville may also be necessary to flush the Delta of the saline water. As discussed in Chapter 4, the likelihood of levee failures in the future is expected to increase.

Finally, future sea level rise associated with climate change could increase the salinity in the Delta as higher ocean tides push saline water farther inland. If Delta water quality standards remain the same, SWP pumping could become more restricted, at least under some hydrologic conditions.

Treating SWP Conveyance Issues in CalSim II Simulations The 2007 base study in this report assumes current facilities and institutional limitations, which include Water Rights Decision 1641, export curtailments for the Vernalis Adaptive Management Plan (VAMP) as described in a 2004 new Operating Criteria and Plan (OCAP) developed by DWR and U.S. Bureau of Reclamation for the SWP and Central Valley Project, and court-ordered in-Delta flow targets in Old and Middle rivers to protect delta smelt. This report examines two levels of Old River and Middle River flow targets. Chapter 6 has a more detailed description of these assumptions. For comparison, the 2027 studies in this report assume the same institutional limitations as the 2007 simulations regarding Delta water quality requirements, fish protection, and Delta flows will be in place 20 years in the future; no facility improvements, expansions, or additions will be made to the SWP; and conveying water through the Sacramento-San Joaquin Delta will not be significantly interrupted by levee failures. These assumptions are not a prediction of the future but an assessment of the future if these conditions are not changed. As discussed in Chapter 3, there are several processes under way to further the discussion on the need for changes in water conveyance around the Delta to address many of the issues. The 2027 studies also incorporate assumptions about climate change, but do not account for sea level rise or the expected accompanying increase in Delta salinity because the tools to evaluate this impact of climate change have not yet been completed.

Also not included in this report are CALSIM II studies that reflect risk of levee failure. The impact on SWP deliveries due to a single or multiple levee failure is highly dependent on where the levees fail and the Delta conditions at the time. As the Draft DRMS Phase 1 Summary Report indicates, the effect on SWP deliveries can range from relatively minor to catastrophic for a large earthquake with extensive levee failures, depending on whether the earthquake occurs under dry or wet Delta conditions. However, the same report points out that if multiple Delta islands are left flooded with openings to adjacent channels after a large-scale levee failure, the volume of water that would move into and out of the Delta over a tidal cycle could actually increase, resulting in higher salinities in the west Delta. If Delta water quality standards remain unchanged, releases from Lake Oroville would then most likely need to increase above current levels to enable the same level of SWP pumping. The DRMS report also indicates that multiple levee failures and Delta island flooding due to flood flows may not significantly affect SWP deliveries due to the fresh water Delta-wide conditions that would exist at the time of flood flows. Chapter 4 addresses Delta levee vulnerability to failure in detail.

Demand for System Water

Water demand in the delivery service area is affected by such factors as the magnitude and types of water demands, the extent of water conservation measures, local weather patterns, and water costs. Supply from a water system may be sufficiently reliable at a low level of demand but become less reliable as the demand increases. In other cases, the reliability of a water supply system to meet a higher demand may be maintained at its past level because new facilities have been added or the operation of the system has been changed. In general, the higher and the more time-concentrated the water demands, the more need for storage and conveyance capacity to achieve the same delivery reliability. For example, if the demand occurs only three months in the summer, a water system with a sufficient annual supply but insufficient water storage may not be able to reliably meet the demand. If, however, the same total amount of demand is distributed over the year, the same system could more easily meet the demand because the need for water storage is reduced.

Demand levels for the SWP water users in this report are derived from historical data and information from the SWP contractors. Demand on the SWP is nearing the maximum contract amount (in other words, "Maximum SWP Table A amount"). Each SWP contract contains a SWP Table A, which states the maximum annual delivery amount over the period of the contract. These annual amounts usually increase over time. Most contractors' SWP Table A amounts reached a maximum in 1990. The total of all contractors' maximum SWP Table A amounts is 4.173 million acre-feet (maf) per year. SWP Table A is used to define each contractor's portion of the available water supply that DWR will allocate and deliver to that contractor. The SWP Table A amounts in any particular contract are not guarantees of annual delivery amounts but are used to allocate individual contractors' portion of the total delivery amount available. Estimates of each contractor's amount of water delivered are determined by the factors described in this report. (See Appendix C for additional explanation and listing of the maximum SWP Table A amounts).

Of the 29 SWP contractors, Yuba City, Butte County, and the Plumas County Flood Control and Water Conservation District are north of the Delta. Their total maximum SWP Table A amounts is 0.040 maf. The total maximum SWP Table A amounts for the remaining 26 contractors, who all receive their supply from the Delta, is 4.133 maf. This report focuses on SWP deliveries from the Delta because the amount of water pumped from the Delta by SWP facilities is the most significant component of the total amount of SWP deliveries. The results presented in this report in terms of estimated delivered water supplies as a percent of SWP Table A deliveries apply to contractors north of the Delta in the same manner as those contractors receiving supply from the Delta.

Factors of Uncertainty Estimating future demand for SWP water requires assumptions be made about population growth, water conservation, recycling efforts, other sources of supply available to the SWP contractors, and climate change. The estimates also depend on the cost to the SWP contractor for each of the components of their integrated water management plan. These factors are considered by the SWP contractors in the estimates of their current and future demands.

Treating Water Demand Issues in CalSim II Simulations SWP Table A and Article 21 demands in the 2007 studies were assumed the same as those in the 2005 study from the *2005 SWP Delivery Reliability Report*. SWP Table A and Article 21 demands in the 2027 studies were assumed the same as those in the 2025 study from the *2005 SWP Delivery Reliability Report*. The demand values are assumed to vary from year to year depending on the weather. Specific values used in the CalSim II studies are contained in Appendix A.

Limitations to Estimating Future Water Delivery Reliability

Studies Must Rely on Assumptions

Actual, historical water deliveries cannot always be used with a significant degree of certainty to predict future water deliveries. As discussed earlier, there are continual, significant changes over time in the determinants of water delivery for a specific water supply system. These changes include water storage and delivery facilities, water use in the source areas, water demand in the receiving areas, and the regulatory constraints on the operation of facilities for the delivery of water. Given the highly significant changes that have occurred for the SWP over the past 40 years, past deliveries are not a good predictor of SWP current deliveries, much less of future deliveries.

For example, the demand 30 years ago for water from the SWP was lower than it is now or expected to be in the future. Past lower demand for SWP water resulted in less water transported through the SWP during normal and wet times than could have been—or would have been if the demand for water had been higher. Less water was delivered then because less water was needed; the amount of source water and conveyance capabilities weren't limiting factors for deliveries. Conversely, the recent court-ordered restriction on SWP exports from the Delta is estimated to reduce annual deliveries from what has been delivered in the recent past. Analyses estimating future SWP deliveries must include assumptions about future (2027) conditions. Some assumptions are very important to the analyses and are key to understanding the resulting estimates of annual water deliveries. A discussion of the important assumptions for the studies in this report follows.

Studies Assume Repeating Historical Weather Patterns

One of the most significant assumptions for water planning in general is how wet, dry and variable the weather will be. Until recently, assuming the future weather pattern would be similar to the past was sufficient for many planning purposes. Given the evolving information on the potential effects of global climate change in the future, this approach is no longer adequate. Incorporating climate change into future projections is difficult because of the many ways the patterns of rain, snow and temperature could shift. A way to measure some of the uncertainty is to analyze many potential climate change scenarios in order to capture the range of water supply impacts.

This report contains estimates of future SWP deliveries under four future climate change scenarios. The scenarios are variations based upon the historical record of precipitation information for the Central Valley for the period 1922 through 2003. The amount and timing of rainfall and runoff is adjusted but the sequence of dry years or wet years is the same for all scenarios. Evaluating how water management systems will respond under severely dry periods is limited to assuming the worst droughts in the period of historical record. The worst multiyear drought on record is 1928 through 1934, although the brief drought from 1976 through 1977 was more acutely dry.

Other Important Assumptions

To identify the assumptions with the most effect on the estimates of SWP deliveries, DWR conducted a sensitivity analysis for assumptions in CalSim II model studies. In a sensitivity analysis, an assumption such as the amount of water used in the watershed above Lake Oroville is varied over several studies and the results for SWP deliveries are compared. This is done to assess how each assumption affects study results. The *2005 SWP Delivery Reliability Report* presents and discusses the results of DWR's study. The parameters having the largest net impact on SWP Delta deliveries are SWP Table

A demands and Banks Pumping Plant limits. The most elastic parameters (i.e., parameters causing the most percent change in SWP deliveries per percent change in value) are SWP Table A demands and Lake Oroville inflow. The estimates for the future inflow to Lake Oroville depend on what is assumed for climate change. Legal limitations are one of the factors defining the rules for operating Banks Pumping Plant. Therefore, the assumptions for climate change and the court-ordered restrictions directly affecting Banks Pumping Plant operations will significantly affect SWP delivery estimates.

Status of Planning Activities That May Affect SWP Delivery Reliability

3

As discussed earlier, the Sacramento-San Joaquin Delta is an essential part of the conveyance system for the SWP. SWP pumping at Banks Pumping Plant is largely regulated to protect the many uses of the Delta. However, there is a growing recognition that today's uses in the Delta are not sustainable over the long term under current management practices and regulatory requirements. Four major concurrent Delta planning efforts are under way with objectives related to providing a sustainable Delta. These plans may propose changes to SWP operations which in turn could affect SWP delivery reliability. These efforts are Delta Vision, Delta Risk Management Strategy, the CALFED Ecosystem Restoration Program Conservation Strategy, and the Bay Delta Conservation Plan. Each could affect SWP and CVP operations in the Delta.

Delta Vision

On Sept. 28, 2006, in conjunction with the signing of SB 1574, Gov. Schwarzenegger signed an executive order to initiate Delta Vision and establish an independent Blue Ribbon Task Force to develop a durable vision for sustainable management of the Sacramento-San Joaquin Bay Delta. The Delta Vision process is looking more broadly at the sustainability of the Delta. The Blue Ribbon Task Force has prepared its vision for sustainable management of the Delta at **http://www.deltavision.ca.gov**. A strategic plan to implement the vision will be the focus of the Task Force during 2008.

Key points from the Task Force's vision are:

- The water system and the ecosystem of the Delta are co-equal values.
- The Delta is a unique place that has value in its own right.
- Future management must work with nature to achieve desired goals for the Delta.
- Design for resiliency by encouraging regional self sufficiency and developing alternative ways to move water among areas of the state.
- Separate water for human uses from water for the ecosystem.
- New storage and improved conveyance must be constructed to capture water at times least damaging to the environment.
- Over time, reliance on levees should be reduced. However, levees remain critical to the future of the Delta and new policies should match levels of protection provided to uses allowed.
- Assess dual conveyance systems as the preferred direction, to understand the optimal combination of through-Delta and isolated facility improvements against listed performance standards.

The Task Force also identified near-term actions that must be taken. These focus on preparing for disasters in or around the Delta, protecting the Delta ecosystem and water supply system from urban encroachment, and quickly beginning work on short-term improvements to both the ecosystem and water supply system.

Delta Risk Management Strategy

The 2000 CALFED Record of Decision presented its Preferred Program Alternative describing actions, studies, and conditional decisions to help fix the Delta. Included in the Stage 1 implementation of the preferred alternative was the completion of a Delta Risk Management Strategy (DRMS) that would look at sustainability of the Delta and assess major risks to the Delta resources from floods, seepage, subsidence, and earthquakes. DRMS would also evaluate the consequences and develop recommendations to manage the risk.

In 2005, the Legislature passed and the governor signed AB 1200, which requires DWR to evaluate the potential impacts on water supply derived from the Delta based on 50-, 100-, and 200-year projections for possible impacts on the Delta due to subsidence, earthquakes, floods, climate change, and combinations of these. DWR and The Department of Fish and Game (DFG) must determine the principal options for the Delta. DWR must then evaluate each option for addressing those impacts for its ability to, among other things, prevent the disruption of water supplies derived from the Delta, improve the water quality of drinking water supplies from the Delta, and maintain Delta water quality for Delta users. DFG is to evaluate and comparatively rate each option for its ability to restore salmon and other fisheries that use the Delta. The study is to be completed by January 1, 2008. The DRMS Project was developed, in part, to address the provision in AB 1200 and is a major source of scientific and technical information on the Delta and Suisun Marsh levees for other major studies and initiatives including the Delta Vision initiative, the Bay Delta Conservation Plan, and the CALFED End of Stage 1 Assessment.

Prior to the initiation of the DRMS study, no other levee risk assessment had been as comprehensive and complex. Due to the relatively short time for the assessment, DRMS made the best estimates possible based on existing data and models. While data gaps exist, there were no opportunities to gather new data in the course of the DRMS effort. Results should be considered on a regional basis rather than for any individual island or levee reach. The results should be used for a gaining broad understanding of the condition in the entire Delta, and should not be used as a basis for design for any specific location.

The DRMS preliminary findings have been reviewed by a CALFED scientific panel. The review has lead to a reevaluation of some of the initial DRMS analyses. The results of the reevaluation will be incorporated into the final report and will be completed in April 2008. Delta Vision, the CALFED Ecosystem Restoration Program and the Bay-Delta Conservation Planning effort depend on the best available information from DRMS to support their own processes. The findings discussed in Chapter 4 should be viewed as a progress report that is subject to refinement. While specific numbers may change, the essence of the findings is expected to remain the same.

CALFED Ecosystem Restoration Program Conservation Strategy

The Ecosystem Restoration Program (ERP) implementing agencies are developing a Conservation Strategy to guide ecosystem restoration implementation based on evaluation of past actions, new information, and changing understanding of the ecosystem. The Conservation Strategy is non-regulatory and based on willing seller participation. To date, the effort has focused on the Delta due to the emphasis placed on the pelagic organism decline (POD) and other planning efforts. In future versions, comparable conservation strategies will be developed for the entire ERP focus area including the Sacramento and San Joaquin rivers' watersheds.

The Conservation Strategy is a biological view of where restoration of important habitat types could occur to restore ecosystem form and processes to the maximum extent. Areas have been identified in the Conservation Strategy with potential for various kinds of habitat restoration in the Delta-Suisun Marsh based upon existing elevations, habitat, and natural process requirements of pelagic organisms and other native fishes. Elevation and soil type are the drivers for this preliminary depiction, which does not consider the constraints of water conveyance options, infrastructure, or land use patterns and ownership. The Conservation Strategy is also incorporating information from other Delta-related planning efforts (e.g., Delta Risk Management Strategy, Suisun Marsh Implementation Plan, the ERP End of Stage 1 Assessment, and recovery plans for Federally-listed species) and technical and public input.

The draft of the strategy focuses on five broad habitat categories for restoration or management in the Delta. These categories include managed wetland and wildlife-friendly agriculture (primarily subsided islands), inter-tidal, floodplain, upland transition, and grassland/vernal pool transition corridor.

Information on ecosystem processes, such as hydrodynamics, temperature, salinity, residence times, and productivity is being developed. Details of restoration actions that address flow and river operations — the primary drivers of aquatic systems and habitats — will be incorporated once the Delta Regional Ecosystem Restoration Implementation Plan conceptual models (January 2008) and the anadromous fish recovery plans (Spring 2008) are completed and coordinated with the BDCP process.

Bay-Delta Conservation Plan

The Bay-Delta Conservation Plan (BDCP) has a different and more specific purpose than do DRMS and Delta Vision. BDCP is being developed consistent with the federal Habitat Conservation Plan (HCP) and State Natural Community Conservation Planning (NCCP). The purpose of BDCP is to develop a conservation plan that resolves the conflict between fishery protection under state and federal Endangered Species acts and water operations of the State Water Project (SWP), Central Valley Project (CVP), and Mirant Power facilities in the legal Delta. The goal of BDCP is to develop a plan that satisfies both the conservation and water supply goals of the Planning Agreement signed in October 2006. The BDCP Steering Committee is composed of 19 groups that represent the state and federal water agencies and export contractors, non-governmental organizations representing environmental and farming interests, and Mirant Power, with state and federal fishery agencies serving as ex-officio members. BDCP is ultimately focused on satisfying permitting requirements for the water supply system in the Delta. Among other things, the plan will:

- Provide for conservation and management of at-risk fish species affected by the covered activities.
- Preserve, restore, and conserve aquatic, riparian, and associated terrestrial habitats.
- Provide clear expectations and regulatory assurances for Delta water operations and facilities (CVP, SWP, and Mirant Corp.).

The steering committee for BDCP has been actively working since April 2007 to set the scope and focus of this planning. The committee initially developed 10 options. These options were narrowed to four options for conveyance and opportunities that provide for habitat restoration and enhancement.

- **Option 1: Existing Through-Delta Conveyance.** This option includes use of existing through-Delta conveyance with physical habitat restoration in the north and west Delta and Suisun Marsh (about 28 percent of BDCP planning area).
- **Option 2: Improved Through-Delta Conveyance.** This option includes improving through-Delta conveyance with operable barriers on some channels, separating water supply conveyance flows from the San Joaquin River, and providing habitat restoration in the north, west, central, and south Delta and Suisun Marsh (about 35 percent of the BDCP planning area).
- **Option 3: Dual Conveyance.** This option is similar to Option 2 with the addition of an isolated conveyance facility from the Sacramento River to the south Delta export facilities.
- **Option 4: Peripheral Aqueduct.** This option includes construction of a peripheral aqueduct from the Sacramento River to the south Delta export facilities, which would allow habitat restoration throughout the Delta and Suisun Marsh (about 75 percent of the BDCP planning area).

Table 3.1 shows a summary of how a BDCP Steering Committee consultant ranked the options during the evaluations.

The BDCP plans to finish a draft of the conservation plan by the end of 2008 and the associated draft Environmental Impact Report/ Environmental Impact Statement available for public review at the end of calendar year 2009.

Table 3.1 Overall comparison of BDCP options by criteria category (rank)[1]

Evaluation Criteria Category	Conservation Strategy Option			
	Option 1 *Existing Through Delta*	Option 2 *Improved Through Delta*	Option 3 *Dual Conveyance*	Option 4 *Peripheral Aqueduct*
Biological	★	★★	★★★	★★★★
Planning	★	★	★★★★	★★★★
Flexibility/Sustainability/Durability	★	★★	★★★	★★★★
Impacts on Other Resources	★★★★	★★★	★	★★

[1]/ Performance ranks are ★ (lowest-performing) to ★★★★ (best-performing). Some options receive equal rank.

Areas of Significant Uncertainty for SWP Delivery Reliability

4

Delta Vision's recognition that today's uses in the Delta are not sustainable in the long term is in large part based on three major growing concerns: the pelagic organism decline, possible impacts from climate change and sea level rise, and the vulnerability of Delta levees for failure. Each of these uncertainties for SWP delivery reliability is discussed below.

Pelagic Organism Decline

In late 2004 and early 2005, scientists became concerned about the numbers of many pelagic (open water) organisms including delta smelt that had been declining sharply since the early 2000s. Other pelagic fish with very low numbers in the Delta are striped bass, longfin smelt, and threadfin shad. By 2005, the decline was widely recognized as serious and became known as the Pelagic Organism Decline (POD). Hypothesized factors contributing individually or in concert to lower pelagic productivity are:

- toxic effects,
- exotic species effects, and
- water project effects.

Studies over the past three years are indicating that all these factors might be contributing to the decline in pelagic fishes, and their relative importance might vary depending on the year, season, and location in the Delta. Continued decline in the abundance of juvenile delta smelt led to a voluntary modification in 2007 in SWP and CVP operations to reduce the reversed flows in Middle and Old rivers — a modification made possible by the Environmental Water Account (discussed below). Subsequently on May 31, 2007, DWR ceased Delta pumping and the U.S. Bureau of Reclamation reduced pumping to the minimum operating level of 850 cubic feet per second (cfs). SWP pumping resumed on June 10 at a minimal level of 90 cfs and slowly ramped up to 5,000 cfs by July 1.

In 2007, the Pelagic Fish Action Plan (Resources Agency 2007), developed jointly by DWR and DFG, made several recommendations related to actions that could be taken to improve protection of pelagic fish, including delta smelt. These actions included ways to increase primary productivity in the Delta, reduce the effects of toxics, and possible changes in water project operations. The actions related to SWP and CVP operations guided the voluntary actions taken by DWR and USBR in 2007 as part of the Environmental Water Account.

Environmental Water Account and POD

The POD is occurring despite the operation since 2001 of the Environmental Water Account (EWA). This CALFED water management tool was created to provide added protection to at-risk fish species at no uncompensated costs to SWP and CVP water deliveries. The purpose of the EWA is to enable modifying water project operations in the Delta to provide protection for fish while also compensating for any water supply lost to SWP and CVP water users. Under EWA, fish protection is achieved by periodic curtailment of SWP and CVP water diversion from the Delta to water users south of the

Delta and later replacing any lost water supply. EWA achieves this through buying water from willing sellers or diverting surplus water when safe for fish, then banking, storing, transferring, and releasing the water as needed to protect fish and compensate water users. In its simplest terms, the EWA is aimed at adding flexibility to the state's water delivery system by providing water at critical times to meet environmental needs without reducing SWP and CVP water deliveries. Funding for the EWA is expected to continue through 2008. Without the compensation for the supply effects due to restricted pumping, SWP water supply reliability will be reduced. The studies in this report assume no EWA will be in place under the current and future scenarios.

Biological Assessment of the SWP and CVP Operating Criteria and Plan

In 2004, Reclamation and DWR developed a new Operating Criteria and Plan (OCAP) for the SWP and Central Valley Project (CVP). This plan documented many aspects of the SWP and CVP through: detailing project descriptions, explaining regulatory and legal requirements, listing changes in project operations since the last OCAP in 1992, and analyzing the present and proposed operations using computer simulations. OCAP provided the project descriptions required for a comprehensive biological assessment of SWP and CVP. The biological assessment analyzed existing and potential effects of SWP and CVP operations on listed species and led to Endangered Species Act (ESA) consultation with the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA) to update biological opinions (BO) for delta smelt, winter-run salmon, and other species listed under the ESA. In 2004, USFWS issued a non-jeopardy BO with regards to impacts on delta smelt caused by revised operations of the CVP and SWP. This opinion was updated in 2005. USFWS concluded that any adverse effects from the CVP and SWP operations would be avoided or minimized by conservation and adaptive management measures included in the OCAP.

The USFWS's 2005 BO for delta smelt was challenged in U.S. District Court. This court ruled in May of 2007 that the OCAP BO for delta smelt was inconsistent with the Federal Endangered Species Act and needed to be rewritten. On Dec. 14, 2007, the court established interim operating rules to protect delta smelt while USFWS rewrites the BO. These interim operating rules are similar to the 2007 Pelagic Action Plan in that they include in-Delta flow limits in Old and Middle rivers that have the effect of restricting CVP and SWP pumping.

Assessment of Possible POD Impacts on SWP Delivery Reliability

As previously discussed in Chapter 2, a crucial impact of POD upon SWP delivery reliability is to cause additional restrictions on SWP operations. These constraints introduce uncertainty in the ability to convey SWP source water to the desired point of delivery. This uncertainty can be somewhat addressed in analyses by assuming two levels of restrictions. The 2007 and 2027 studies in this report assume constraints to Old and Middle rivers flow in accordance to the August 2007 court ruling on interim actions to protect delta smelt. These simulations are described in more detail in Chapter 6.

Climate Change and Sea Level Rise

Climate change is identified in the 2005 update of the *California Water Plan (Bulletin 160-05)* as a key consideration in planning for the state's future water management. This is because climate change may seriously affect the state's water resources, particularly the SWP's ability to deliver water. In fact, the 2005 report by the University of California, Berkeley, for the California Energy Commission, *Climate Change and Water Supply Reliability*, asserts that climate change in California "is likely to affect water users primarily through its impact on supply reliability and uncertainty" (p. 4).

For the SWP, climate change has the potential to simultaneously affect the availability of source water, the ability to convey water, and users' demands for water. These potential changes are described below.

Three climate warming scenarios prepared by the California Climate Change Center predict slightly warmer winters with less winter snowpack. Some changes in hydrology due to climate change may already be noticeable, such as an earlier beginning of snowmelt in the Sierra, an increase in winter runoff as a fraction of the total runoff, and an increase in winter flooding frequency. Also, spring and summer runoff in the Sacramento River and San Joaquin River watersheds may be declining due to reduced snowpack.

In the future, average winter flood flows to the Delta are likely to become larger due to more intense storms with more precipitation occurring as rain instead of snow. This shift from snow to rain, particularly in the northern Sierra Nevada, is expected to shift the timing of the peak runoff toward the winter. This in turn may require adjustments to reservoir flood control operations — water managers may be forced to make changes in reservoir operations and flood-control rule curves — resulting in less spring and summer Delta inflows and an increase in Delta salinity.

Climate change experts believe that the timing and quantity of available water supplies in the coming decades may be less predictable due to changing climatic conditions (DWR's 2006 report, *Progress on Incorporating Climate Change into Management of California's Water Resources*). This may exacerbate the existing mismatch in California between where and when precipitation occurs and where and when people use water.

The sea level has been rising at an average rate of 0.08 inches per year and is now about 0.6 feet higher at the Golden Gate than it was in 1920. The Intergovernmental Panel on Climate Change estimates that sea level will rise by about 0.6 to 1.9 feet over the next 100 years (Intergovernmental Panel on Climate Change 2007). Even if Delta levees are fully upgraded, sea level rise could negatively affect water supply reliability through increased salinity intrusion in the Delta. A further tightening of drinking water quality standards or increases in salinity or other constituents could significantly increase the cost of treating Delta water for municipal use. Increased salinity in the Delta reduces the opportunity for exporters to blend the less saline Delta water with other sources higher in salinity. If current in-Delta water quality standards are maintained, re-operation of upstream reservoirs would be needed to provide more water for controlling the seasonal salinity intrusion in the Delta. This would likely result in generally lower reservoir levels, perhaps reducing the ability to meet water supply and water quality needs during dry periods.

Assessment of Possible Climate Change Impacts on SWP Delivery Reliability

As previously discussed in Chapter 2, climate change can potentially affect SWP delivery reliability by altering the timing and amount of source water. In 2006, DWR released a report on climate change and its potential impact on California's water resources. Entitled *Progress on Incorporating Climate Change into Management of California's Water Resources*, the report summarizes recent research into changes in precipitation, air temperatures, snow levels, and rainfall and snowmelt runoff. The report also evaluates possible future impact on California water supply through CalSim II simulations with hydrologic sequences, which reflect different scenarios of climate change. In order to account for the uncertainty in future climate change, four scenarios are examined:

1. weak temperature warming and weak precipitation increase in California under model PCM;
2. modest warming and modest drying under model PCM;
3. modest warming and modest drying under model GFDL v. 2.0; and
4. weak temperature warming and weak precipitation increase in California under model GFDL v. 2.0.

Some of the main results of the 2006 climate change report related to estimated impacts on the SWP and Delta around the year 2050 are:

- Estimated changes in annual average SWP south-of-Delta SWP Table A deliveries range from a slight increase of about 1 percent for a wetter scenario to about a 10 percent reduction for one of the drier climate change scenarios.
- Estimated increased winter runoff and lower SWP Table A allocations result in slightly higher annual average Article 21[1] deliveries in the three drier climate change scenarios. However, the boosts in Article 21 do not offset losses to SWP Table A. The wetter scenario with higher SWP Table A allocations result in fewer Article 21 delivery opportunities and slightly lower annual average Article 21 deliveries.
- Estimated SWP carryover storage is reduced in the drier climate change scenarios and is somewhat increased in the wetter climate change scenario.

Sea level rise effects on water project operations to repulse a greater salt water intrusion under these conditions were not examined due to lack of existing tools for that type of analysis.

For this report, the Calsim II simulations were updated to incorporate an extension of the hydrologic simulation sequence to 2003 and operation of the SWP to meet the interim operating rules of the August 31, 2007, court order related to delta smelt. The same four scenarios of future climate change were simulated. It should be noted that these scenarios assume greenhouse emissions for 2050, not at the 2027 level assumed for Future Conditions. This report estimates climate change impact to SWP deliveries by interpolating between future studies that assume no climate change and studies that assume 2050 emissions. This approach is detailed in Appendix B. These studies are the best available estimates for future SWP water deliveries. Chapter 6 describes these simulations along with all other simulations presented in this report.

Vulnerability of Delta Levees for Failure

Delta levees provide constant protection from flooding because most lands in the Delta are below sea level. Most of the Delta's levees, however, do not meet modern engineering standards and are highly susceptible to failure. Levees are subject to failure at times of high flood flows, but also at any time of the year due to seepage or the piping of water through the levee, slippage or sloughing of levee material, or sudden failure due to an earthquake. According to the URS Corp./Jack R. Benjamin & Associates report, *Draft Summary Report, Phase 1: Risk Analysis, Delta Risk Management Strategy (DRMS)*, June 2007, the risk of levee failure in the Delta is significant, as shown by the fact that virtually all levees in the Delta have failed at least once over the past 100 years, with about half failing at least twice. Since 1900, there have been 166 levee failures.

A breach of one or more levees and island flooding will affect Delta water quality and water operations. Depending on the hydrology and the size and locations of the breaches and flooded islands, a significant amount of saline water may be drawn into the interior Delta from Suisun and San Pablo bays. At the time of island flooding, exports may be drastically reduced or ceased to evaluate the salinity distribution in the Delta and to avoid drawing higher saline water toward the pumps. The introduced salinity then could become dispersed and degrade Delta water quality for a prolonged period because of complex relationships between Delta inflows, tidal mixing, and the time taken to repair the breaches.

A large earthquake in the Delta causing signifi-

[1] Article 21 water is interruptible water allocated under certain conditions: SWP's share of San Luis Reservoir is full or projected to fill in the near term; other SWP reservoirs are full or at their storage targets, or conveyance capacity to fill these reservoirs is maximized; releases from upstream reservoirs plus unregulated inflow exceed the water supply needed to meet Sacramento Valley in-basin uses; SWP Table A deliveries are being fully met; and Banks Pumping Plant has spare capacity.

cant levee failures and island flooding could lead to multiyear disruptions in water supply, significant water quality degradation, as well as permanent flooding of several islands. Such permanent multi-island flooding would probably lead to increased salt water intrusion into the Delta during seasonal low inflows. Maintaining Delta water quality when several islands are flooded and breaches are open would require additional Delta inflow because the volume of water coming into the Delta on the flood tide would increase, requiring more fresh water from the rivers to prevent the saline water from extending into the Delta. When SWP and CVP pumping is restarted, Delta inflow would need to increase again beyond the pumping amount in order to prevent water quality degradation in the Delta. This chain of events would significantly affect water supply reliability by limiting pumping and requiring additional reservoir releases to generate the needed higher Delta inflows. A worst case scenario for water supply impacts would be a moderate or large earthquake causing extensive levee failure in the late summer or fall of a dry year.

The levee break on Middle River and subsequent flooding of Upper Jones Tract in 2004 is a small-scale example of this phenomenon. Following the break, Delta pumping was curtailed for several days to prevent seawater intrusion. Water shipments down the California Aqueduct were continued through unscheduled releases from San Luis Reservoir. Also, Shasta and Oroville reservoir releases were increased to provide for salinity control in the Delta.

A growing concern about the long-term viability of the Delta's levee system led to the initiation of the Delta Risk Management Strategy (DRMS).

Delta Risk Management Strategy

The 2000 CALFED Record of Decision presented its Preferred Program Alternative to help fix the Delta that described actions, studies, and decisions contingent upon subsequent environmental and engineering analyses. Included in the Stage 1 implementation of the preferred alternative was the completion of a Delta Risk Management Strategy (DRMS) that would look at sustainability of the Delta and assess major risks to the Delta resources from floods, seepage, subsidence, and earthquakes. DRMS would also evaluate the consequences and develop recommendations to manage the risk.

Assembly Bill 1200, passed in 2005, directs DWR to evaluate the potential effects of subsidence, earthquakes, floods, and climate change to Delta-based water supply. After determining principal options for the Delta, DWR must then evaluate each option according to its ability to prevent the disruption of water supplies from the Delta, improve the water quality of drinking water supplies from the Delta, and maintain Delta water quality for Delta users. By providing important information on levees in the Delta and Suisun Marsh, the DRMS Project is intended to support other major studies and initiatives including the Delta Vision initiative, the Bay Delta Conservation Plan, and the CALFED End of Stage 1 Assessment.

DWR defined Phase 1 of DRMS as the risk analysis of levee failures and associated potential economic, environmental, and public health and safety impacts and Phase 2 as the development and evaluation of strategies to reduce risks from levee failures. Risk analysis includes the likely occurrence of earthquakes of varying magnitudes in the region, future rates of subsidence given continued farming practices, the likely magnitude and frequency of storms, and the potential effects associated with global climate change (sea level rise, climate change, temperature change). Estimated risks to the Delta were made for 50-, 100-, and 200-year projections since risk can be expected to increase with time.

One reason for conducting a risk analysis is to quantitatively consider the uncertainties that relate to the performance of levees. Sources of uncertainty that affect any analysis can be fundamentally different. Events in nature such as precipitation are inherently random and this uncertainty cannot be reduced by simply collecting more information; rather, this uncertainty can be predicted in terms of probability.

The Draft DRMS Phase 1 Report looked at several hazards to levees: seismic events that cause levee failures, flood flows that can overtop levees or cause levee failure by increased pressure and seepage, undetected problems during non-flood flow periods, and erosion due to high wind waves. The level of risk of failure of Delta levees was determined by considering: the frequency of different magnitudes of hazards that can challenge the integrity of Delta levees, how vulnerable different levee reaches are to hazards, how hazards and levee vulnerabilities combine to produce levee failure, and the economic and ecosystem impacts due to levee failure. The analysis assumes that existing regulatory and management practices will continue.

Potential Interruption/Disruption of SWP Deliveries Due to Earthquakes A strong earthquake affecting the Delta could cause simultaneous levee failures on several islands, and there is a real possibility of several simultaneous island flooding. DRMS considered scenarios that consisted of different combinations of flooded islands, ranging from one island to 30 islands flooded. **Table 4.1** summarizes impacts of various scenarios of island flooding associated with a single seismic event as presented in the URS/Jack R. Benjamin & Associates report, *Draft Summary Report, Phase 1: Risk Analysis, Delta Risk Management Strategy (DRMS)*, June 2007.

Preliminary analysis indicates that some water may not be treatable by municipal agencies for many months beyond those listed in **Table 4.1** due to high organic carbon concentrations. This would extend the period that Delta water supply would be unavailable for urban users.

Key findings of the Draft Phase 1 DRMS report on possible impacts on SWP deliveries due to earthquakes are:

- When the probability of all seismic levee breaches under existing conditions is considered, about 115 levee failures can be expected during 100 years.
- There is about a 28 percent chance of 30 or more islands simultaneously failing during a major earthquake in the next 25 years.
- A moderate to large earthquake capable of causing multiple levee failures could happen in the next 25 years. Under such an earthquake, extensive levee failure would most likely occur in the west and central Delta. Levee repairs could take up to 6.5 years and exports from the Delta could be disrupted for up to two years with a loss of up to 9.3 maf of water.
- By 2050, the frequency of island flooding from seismic events is expected to increase by 12 percent over 2005 conditions, if a seismic event has not occurred.

The Draft DRMS Phase 1 report is being reviewed as recommended by the CALFED Independent Science Board evaluation of the draft report. Based on the review conducted to date the specific numbers in the Draft Phase 1 report may change but the overall conclusions of the report are not likely to change.

Table 4.1 Expected impact on Delta exports due to salinity intrusion from various seismic events

Seismic Case	Flooded islands	Months to repair levees	Months without pumping	Water not exported (maf)
1	1	up to 20	up to 2	up to 0.7
2	3	19	1 to 3	0.1 to 1.0
3	3	23	1 to 4	0.1 to 1.2
4	10	45	2 to 10	0.7 to 2.5
5	20	62	11 to 21	6.3 to 6.5
6	30	81	16 to 23	6.5 to 9.3

Potential Interruption/Disruption of SWP Deliveries Due to Floods During an average year, about 85 percent and 10 percent of the total Delta inflow comes from the Sacramento and San Joaquin rivers respectively. The remaining Delta inflow primarily comes from three eastside tributaries. Inflow from the Sacramento and San Joaquin rivers depends on reservoir releases, precipitation, and snowmelt. Over the long-term, many different combinations of high flood flows in the Sacramento and San Joaquin rivers are possible because of the large geographical extent of the two rivers' watersheds and the variability in storm paths. DRMS considered magnitude and frequency of flooding in different parts of the Delta from different sources to evaluate the probability of these high flows. This approach allows the inclusion in the risk analysis of floods that, while possible, are larger than have been historically recorded. The DRMS report views an analysis which relies only on historical data as likely to underestimate risk.

Potential disruption of Delta exports due to floods and levee failures would depend on the number of flooded islands, the timing and size of the flood flows, and the water quality in the Delta and Suisun Bay at the time of the flood. However, during such high flows, there would normally be little or no impact on water quality on the exports due to levee failures and DRMS assumes no significant effect on Delta exports.

Key findings of the Draft Phase 1 DRMS report on possible impacts on SWP deliveries due to flood flows are:

- By 2050, Delta flood hazard is expected to increase 200 percent due to sea level rise and more frequent high flows.
- By 2050, the frequency of island flooding from floods is expected to increase over 2005 conditions.
- By 2050, flood fragility of levees is expected to increase 10 percent due to subsidence, and overall Delta island flood frequency is expected to increase 230 percent.
- By 2050, the frequency of floods is expected to increase by 50 percent and levees are expected to become 20 percent more vulnerable to flooding due to increased seepage and stability problems associated with more subsidence and sea level rise.
- By 2050, the combined effects of increased levee vulnerability and flood flows indicates an 80 percent expected increase in island flooding from flood flows.

The Draft DRMS Phase 1 report is being reviewed as recommended by the CALFED Independent Science Board evaluation of the draft report. Based on the review conducted to date the specific numbers in the Draft Phase 1 report may change but the overall conclusions of the report are not likely to change.

Potential Interruption/Disruption of SWP Deliveries Due to "Sunny Day" Event A "sunny day" levee failure is a failure that occurs during non-flood times and is not caused by an earthquake. Possible causes of levee failure include wave action, animal activity, and seepage. DRMS reports that, on average, there will be about 5.4 sunny-day breaches with 50 years of exposure in the Delta. These types of levee failures are not expected to involve the potential of simultaneous multilevee events as could happen with high flood flows and a large earthquake.

Combined Potential Interruption/Disruption of SWP Deliveries DRMS evaluated combined risk of levee failure due to earthquakes, floods, and "sunny day events" as well as how risks may change in the future. Key findings by DRMS are:

- Taking into account the probability of all levee breaches from all hazards under 2005 conditions, the number of levee failures in the Delta can be expected to about double over the next 100 years.
- Levee hazards are expected to grow in the future due to such factors as sea level rise and more frequent flood flows that will put more pressure on the levees.

- The overall likelihood of a major Delta event causing extensive levee failure is increasing as is the magnitude of the consequences from a given event.
- There is a possible range of sea level rise of from 0.7 to 4.6 feet over the next 100 years, depending on the assumed future greenhouse gas emissions and the forecast model used. Current estimates by the Intergovernmental Panel on Climate Change indicate that sea level will rise from 0.6 to 1.9 feet over the next 100 years. The CALFED Independent Science Board (ISB) has recommended that planning that incorporates sea level rise, should use the full range of variability of 20-55 inches.

The Draft DRMS Phase 1 report is being reviewed as recommended by the CALFED Independent Science Board evaluation of the draft report. Based on the review conducted to date the specific numbers in the Draft Phase 1 report may change but the overall conclusions of the report are not likely to change.

Emergency Operations Plan

As part of its efforts to reduce impacts to the SWP should a levee failure occur, DWR has initiated the development of an Emergency Operations Plan (EOP). This plan will provide procedures for emergency preparedness and incident management typically necessary for a jurisdiction or organization with emergency response roles and responsibilities. While DWR has current general procedures for emergency response, the EOP will ultimately enhance the state's ability to prepare for, respond to, and recover from a Delta levee failure disaster and will provide DWR with a plan focused specifically on a catastrophic levee failure disaster. The EOP will be a blueprint for coordinating the protection of life and property with its local, state, and federal partners in taking the steps necessary to protect the state's water system.

DWR has completed the first of two phases of engineering design work intended to enhance the state's ability to respond to large-scale levee failures or floods in the Delta. In the first phase, DWR conducted a discovery process to analyze previously developed plans and procedures and to identify current DWR capabilities for response to emergencies and disasters in the Delta. This phase included: developing plans to determine the quantity and gradation of rock needed to repair several levee breaches and block certain river channels to minimize salinity intrusion into the interior of the Delta, securing strategic joint stockpile-transfer facilities, completing design requirements and contracting for the construction of a new belt conveyor system, and establishing new procurement contracts for rock to be placed at the stockpile-transfer facilities. Through this process, DWR has categorized response actions that can be taken to reduce the impact of a Delta levee failure disaster. The first phase, now complete, has resulted in a DWR report, *Delta Emergency Operations Plan Concept Paper April 2007*. This report can be accessed at **http://www.dfm.water.ca.gov/er/**.

In the second phase, DWR will engage its partners in local, state, and federal government, and in the private sector, to develop a detailed EOP for responding to levee failure events, stabilizing the system, and facilitating recovery. The EOP will be consistent with and in compliance with California's Standardized Emergency Management System (SEMS)[2] and with the National Incident Management System (NIMS)[2]. By developing the EOP, DWR will improve preparedness capabilities for response and recovery.

[2]/ SEMS is an emergency management system required by California Government Code Section 8607(a) for managing incidents involving multiple jurisdictions and agencies. NIMS is a nationwide, federal emergency management approach, for managing incidents with all levels of government, private-sector, and nongovernmental organizations working together. For more SEMS/NIMS information, please visit: **www.oes.ca.gov.**

General Approach for Assessing SWP Delivery Reliability

5

CalSim II, a computer model jointly developed by DWR and U.S. Bureau of Reclamation, simulates much of the water resources infrastructure in the Central Valley and Delta region of California. CalSim II models all areas that contribute flow to the Delta. The geographical coverage includes the Sacramento River Valley, the San Joaquin River Valley, the Sacramento-San Joaquin Delta, the Upper Trinity River, and the CVP and SWP service areas. CalSim II simulates operation of the CVP-SWP system using a monthly time step. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over this period.

General Solution Techniques and Incorporating Operational Constraints

CalSim II routes water through a CVP-SWP system network representation. The network includes more than 300 nodes and over 900 arcs, representing 24 surface reservoirs and the interconnected flow system. The physical description of the system is expressed through a user interface with tables outlining the system characteristics. CalSim II uses logic for determining deliveries to north-of-Delta and south-of-Delta CVP and SWP contractors. The delivery logic uses runoff forecast information, which incorporates uncertainty and standardized rule curves (i.e., Water Supply Index versus Demand Index Curve). The rule curves relate forecasted water supplies to deliverable demand, and then use deliverable demand to assign subsequent delivery levels to estimate the water available for delivery and carryover storage. Updates of delivery levels occur monthly from January 1 through May 1 for the SWP and March 1 through May 1 for the CVP as runoff forecasts become more certain. The south-of-Delta SWP delivery is determined based on water supply parameters and operational constraints. The CVP system-wide delivery and south-of-Delta delivery are also determined using water supply parameters and operational constraints with specific consideration for export constraints.

Hydrology

The historical flow record is adjusted for the influence of land-use change and upstream flow regulation in order to represent the possible range of water supply conditions. The hydrology used by CalSim II was developed jointly by DWR and U.S. Bureau of Reclamation. Water diversion requirements (demands), stream accretions and depletions, rim basin inflows, irrigation efficiency, return flows, non-recoverable losses, and groundwater operation are components that make up the hydrology used by CalSim II. Sacramento Valley and tributary basin hydrologies are developed using a process designed to adjust the historical sequence of monthly stream flows to represent a sequence of flows at a future level of development. Adjustments to historical water supplies are determined by imposing future level land use on historical meteorological and hydrologic conditions. San Joaquin River basin hydrology is developed using fixed annual demands and regression analysis to develop flow accretions and depletions. The resulting hydrology represents the water supply available from Central Valley streams to the CVP and SWP at a future level of development. Groundwater has only limited representation in CalSim II. This resource is modeled as a series of interconnected lumped-parameter basins. Groundwater pumping, recharge from irrigation, stream-aquifer interaction and interbasin flow are calculated dynamically by the model.

Demands

SWP demands are preprocessed independent of CalSim II and vary according to the specified scenario (e.g., 2007, 2027) and according to hydrologic conditions. Agricultural land-use-based demands are calculated from an assumed cropping pattern and a soil moisture budget. Urban demands are typically set to contract amount, but with reductions in wet years based on recent historical data. Both land-use-based demands and estimated contract amounts serve as upper bounds on deliveries. Environmental demands such as minimum reservoir storage requirements, minimum in-stream flows and deliveries to national wildlife refuges, and wildlife management areas are as stipulated in current regulatory requirements and discretionary interagency agreements.

Meeting Delta Water Quality Standards

CalSim II uses DWR's Artificial Neural Network (ANN) model to simulate the flow-salinity relationships for the Delta. The ANN model correlates DSM2 model-generated salinity at key locations in the Delta with Delta inflows, Delta exports, and Delta Cross Channel operations. The ANN flow-salinity model estimates electrical conductivity at the following four locations for modeling Delta water quality standards: Old River at Rock Slough, San Joaquin River at Jersey Point, Sacramento River at Emmaton, and Sacramento River at Collinsville. In its estimates, the ANN model considers antecedent conditions up to 148 days, and considers a "carriage-water" type of effect associated with Delta exports.

CalSim II Priorities in Water Deliveries

CalSim II allocates water according to the four priorities shown in Table 5.1. Highest priority is given to prior-right water users, minimum in-stream flow requirements and water quality requirements. While CVP and SWP contractor deliveries take precedence over next year's storage, a balance between the two is struck in the allocation decision to ensure that enough water is left in storage at the end of the year in case of impending drought.

SWP Table A and Article 21 Deliveries

The CalSim II simulations in this report estimate SWP delivery amounts for SWP Table A and Article 21. As mentioned in Chapter 2, SWP Table A is the contractual method for allocating available supply, and the total of all maximum SWP Table A amounts for deliveries from the Delta is 4.133 million acre-feet (maf) per year. Article 21 refers to a provision in the contract for delivering water that is available in addition to SWP Table A amounts. (See Appendices A and B for more discussion.) Article 21

Table 5.1 CalSim II water use prioritization

1	Prior-right water users, minimum in-stream flow requirements, water quality requirements
2	SWP Table A contractors, CVP contractors
3	Reservoir storage for the next year (carryover)
4	SWP Article 21 deliveries

of SWP contracts allows contractors to receive additional water deliveries only under specific conditions. These conditions are:

1. The water is available only when it does not interfere with SWP Table A allocations and SWP operations;
2. The water is available only when excess water is available in the Delta;
3. The water is available only when conveyance capacity is not being used for SWP purposes or scheduled SWP deliveries; and
4. The water cannot be stored in the SWP system. In other words, the contractors must be able to use the Article 21 water directly or be able to store it in their own system.

Water supply under Article 21 becomes available only during wet months of the year, generally December through March. Because an SWP contractor must have an immediate use for Article 21 supply or a place to store it outside of the SWP, not all SWP contractors can take advantage of this additional supply.

The importance of Article 21 water to local water supply is tied to how each contractor uses its SWP supply. For those SWP contractors who are able to store their wet weather supplies, Article 21 supply can be stored by being put directly into a reservoir or by offsetting other water that would have been withdrawn from storage, such as local groundwater. In the absence of storage, Article 21 water is not likely to contribute significantly to local water supply reliability. Incorporating supplies received under Article 21 into the assessment of water supply reliability is a local decision based on specific local circumstances, facts, and level of water supply reliability required. This report presents information on Article 21 water separately so local agencies can determine whether it is appropriate to incorporate this supply into their analyses.

CalSim II Performance

Some of the comments to the *Draft 2003 SWP Delivery Reliability Report* expressed concern about the accuracy of CalSim II and the credibility of conclusions about SWP delivery reliability that are based on CalSim II simulations. In order to respond to these concerns, DWR conducted several CalSim II studies. In one study, results from a CalSim II simulation using historical input from 1975 to 1998 were compared to historical operations. This study is documented in the report, *CalSim-II Simulation of Historical SWP/CVP Operations, Technical Memorandum Report, November 2003* and was provided in Appendix E of the *2005 SWP Delivery Reliability Report*. In a second study, a sensitivity analysis was performed to quantify the effects of various inputs on CalSim II results. Two performance measures were used, a Sensitivity Index and Elasticity Index, to quantify the sensitivity of 12 model output responses to 12 different model input parameters. This sensitivity study was also provided in Appendix E of the *2005 SWP Delivery Reliability Report*.

In a follow-up study, DWR staff conducted a more detailed analysis of the sensitivity results, focusing on the delivery reliability of SWP system. The results of this analysis are documented in an internal memorandum report, dated April 30, 2007. The purpose of this analysis was to assist SWP contractors and other interested parties in evaluating the impact of model input parameters on SWP deliveries (SWP Delta deliveries, SWP north-of-Delta deliveries, and SWP deliveries under Article 21) with respect to a selected subset of input parameters. This memorandum report is available via the internet at **http://baydeltaoffice.water.ca.gov/** by clicking on the announcement of the *Draft 2007 SWP Delivery Reliability Report* under "Items of Interest."

Recent Improvements to CalSim II Simulations

The SWP operation simulations in this report use the CalSim II model developed for the 2004 Long-Term Central Valley Project Operations Criteria and Plan (OCAP) that was then modified specifically for these studies. In addition to the modifications needed for the 2007 U.S. District Court Judge Oliver Wanger's decision, the 2004 OCAP version was modified to include the improvements listed below. A complete list of model assumptions is included in Appendix A. The new enhancements to CalSim II are:

- **Improved representation of the San Joaquin River Basin** The previous San Joaquin River Basin representation was replaced by the San Joaquin River Water Quality Module version 1.00 (SJRWQM) developed by U.S. Bureau of Reclamation Mid-Pacific Region. The SJRWQM is an update to previous versions that has gone through extensive agency review and a formal peer review.

- **Improved modeling of flow-salinity relationships in the Delta** The previous Artificial Neural Network (ANN) used to estimate flow-salinity relationships has been replaced with a newer more accurate version. The new ANN and its accompanying implementation to the CalSim II model produces salinities that match more closely the Delta Simulation Model 2 (DSM2) salinities.

- **An extended hydrologic sequence** The Hydrologic sequence of 74 simulated years has been extended to 82 years, from water years 1922 through 1994 to water years 1922 through 2003.

Assessment of Present and Future SWP Delivery Reliability

6

CalSim II simulations were conducted to evaluate current (2007) SWP delivery reliability and incorporate actions to protect delta smelt defined by the 2007 federal court ruling. Simulations to evaluate future (2027) SWP delivery reliability incorporate the current interim court-ordered operating rules related to delta smelt and a range of possible climate change impacts to hydrology in the Central Valley. The interim operating rules for delta smelt are simulated at both a more-restricted level and a less-restricted level for Delta exports to provide a range of estimated water deliveries. Therefore, for 2007, two studies are conducted. For 2027, 10 simulations are used to reflect the four assumed scenarios for climate change and the two levels of operation rules. By using these interim court-ordered operating rules in the studies, DWR is not making an assumption about the results of the ongoing discussions to revise the delta smelt Biological Opinion. The studies are simply an indication of the near-term impacts of these interim operating rules. An update of this report for 2009 will be done using operating rules defined by the revised delta smelt Biological Opinion.

Results of these updated CalSim II simulations are presented alongside results from the *2005 SWP Delivery Reliability Report* to help identify and explain impacts to delivery reliability due to actions to protect delta smelt and future climate change. At the end of the chapter, the information is presented in a way to easily compare the estimated SWP deliveries under Current (2007) Conditions to those under Future (2027) Conditions.

This chapter contains tables summarizing the updated estimated delivery amounts of the studies for the entire study period (1922-2003), dry years, and wet years and presents information on the estimated probability of SWP Table A delivery amounts currently and 20 years in the future. While two CalSim II simulations were made to estimate current delivery reliability (bookends for delta smelt protection) and 10 simulations were made to estimate future delivery reliability (combinations of flow constraints and climate change scenarios), simulation results in this chapter for Future (2027) Conditions are presented in terms of ranges in values for ease of analysis. The annual values for SWP deliveries estimated by all the CalSim II simulations are listed in tables in Appendix B. These tables also show the annual SWP Table A demands assumed for each study.

The results indicate potentially significant differences between the updated studies and studies done for the 2005 report under both current and future conditions for estimated deliveries during multiple-year dry periods. In general, updated estimates of both current and future SWP Table A deliveries are less than the deliveries presented in the 2005 report, particularly during multiple dry years. For a given probability of exceedence, current and future SWP Table A deliveries are also less than were presented in the 2005 report. For future conditions, the probability of an annual SWP Table A delivery exceeding 1.7 maf is substantially less than was presented in the 2005 report. The updated studies show generally higher SWP Table A deliveries under Future (2027)

Conditions compared to Current (2007) Conditions, but decreases in deliveries in the future are possible during multiple dry year periods, depending on which climate change scenario is assumed. In comparison, the 2005 report showed more frequent and greater increases in future deliveries.

Assessment of SWP Delivery Reliability under Current (2007) Conditions

Current Conditions refer to those conditions believed in effect in 2007. These conditions, described below, include Old River and Middle River flow targets from the current court-ordered interim operating rules. Results from CalSim II simulations for the *2005 SWP Delivery Reliability Report* under the 2005 study are presented throughout this section for comparison. Appendix A presents a detailed list of the study assumptions for this report.

Availability of Source Water

The 2005 level of development (level of water use in the source areas) is assumed representative of 2007. The hydrologic sequence of simulated years is based on historical precipitation and runoff patterns and is from water years 1922 through 2003. The hydrologic sequence for the 2005 report is shorter, from water years 1922 through 1994. For comparison purposes, these differences are not significant.

Demand for Delta Water

The SWP Table A demands for deliveries from the Delta assumed for 2007 are shown in **Table 6.1**. The assumed demands for the studies were developed in discussions with SWP water contractors and stakeholders involved in the development of the analyses associated with DWR's 2007 document, *Draft Environmental Impact Report: Monterey Amendment to the State Water Project Contracts (Including Kern Water Bank Transfer) and Associated Actions as Part of a Settlement Agreement (Monterey Plus)*. A range in SWP Table A demands is shown because the demand is assumed to vary each year with the weather.

Table 6.1 presents key demand values. Differences between the values in updated studies and the 2005 study in the 2005 report are due to the longer simulation period for the current report. SWP Article 21 demands for water are the same as assumed in the *2005 SWP Delivery Reliability Report* and are shown in **Table 6.2**.

Ability to Convey Source Water to the Desired Point of Delivery

The CalSim II simulations assume that current Delta water quality regulations (contained in the

Table 6.1 SWP Table A demands from the Delta under Current Conditions

Study of Current Conditions	Average Demand		Maximum Demand		Minimum Demand	
	taf /year	maximum SWP Table A[1]	taf /year	maximum SWP Table A[1]	taf /year	maximum SWP Table A[1]
2005 SWP Delivery Reliability Report, Study 2005	3290	80%	3862	93%	2321	56%
Updated Studies (2007)	3308	80%	3864	94%	2323	56%

1/ 4,133 taf /year.

Table 6.2 Article 21 demands from the Delta under Current Conditions

Study of Current Conditions	Average Article 21 demand (taf)		Total (taf/year)
	December - March	April - November	
2005 SWP Delivery Reliability Report, Study 2005	704	607	1311
Updated Studies (2007)	699	598	1297

State Water Resources Control Board's Decision 1641) are in place for the 2007 studies. The simulations also incorporate flow restrictions of the recent court-ordered interim operating rules related to delta smelt. Two CalSim II simulations were run to evaluate a lower level and a higher level of flow restrictions to give a range of potential SWP water delivery estimates. The specific rules for these flows are contained in **Table 6.3**. The lower- and higher-level restrictions are the same for Dec. 25 through Feb. 20 and April 15 through May 15. They are significantly different during Feb. 21 through April 14 and May 16 through June 30. Additional information on the characterization of the potential court decision in the model is found in Appendix A. The amount of exports allowed while achieving the Old River and Middle River flow targets are assumed shared equally between the CVP and the SWP. Combined CVP and SWP exports also are assumed constrained according to the June 30, 2004, Long-Term Central Valley Project Operations Criteria and Plan during April 15 to May 15. This operation is part of the Vernalis Adaptive Management Plan. The specific rules for this restriction are included in Appendix A.

The simulation of Current Conditions in the 2005 report also assumed D-1641 Delta standards and combined SWP and CVP pumping restrictions according to the 2004 Long-Term Central Valley Project Operations Criteria and Plan. However, the 2005 report assumed no Old River and Middle River flow targets.

Presentation of CalSim II Results

For the purpose of describing SWP deliveries under Current (2007) Conditions in this chapter, the annual deliveries from the two CalSim II simulations, which assumed a higher and a lower level of Old River and Middle River flow targets, are averaged. The annual SWP Table A and Article 21 deliveries for the two 2007 simulations are presented in Appendix B.

SWP Table A Deliveries under Different Hydrologic Scenarios

Table 6.4 contains the average, maximum, and minimum estimates of SWP Table A deliveries from the Delta under Current Conditions from the *2005 SWP Delivery Reliability Report* and under 2007 assumptions that include Old River and Middle River flow targets. As previously mentioned, SWP deliveries under 2007 conditions are the result of averaging annual deliveries from two scenarios of Old River and Middle River flow targets. The estimated probabilities for a given amount of annual SWP delivery under Current (2007) Conditions are presented in **Figure 6.1**.

Table 6.4 shows that under updated Current (2007) Conditions, average SWP delivery amounts may decrease 5 percent of maximum SWP Table A when compared to the earlier estimate, from 68 percent to 63 percent. Since SWP Table A demands are the same between the earlier and updated studies, this decrease in deliveries is primarily due to the Old River and Middle River flow targets to

Table 6.3 Old and Middle River flow target scenarios assumed in CalSim II studies

Period	Combined Average Old River and Middle River flow[1]	
	Less Restrictive	More Restrictive
Dec 25 – Jan 3	Less than 2,000 cfs flow upstream	Less than 2,000 cfs flow upstream
Jan 4 – Feb 20	Less than 5,000 cfs flow upstream	Less than 5,000 cfs flow upstream
Feb 21 – April 14	Less than 5,000 cfs flow upstream	Less than 750 cfs flow upstream
Apr 15 – May 15	No Old and Middle River flow constraint; VAMP controls exports	No Old and Middle River flow constraint; VAMP controls exports
May 16 – May 31	Less than 5,000 cfs flow upstream	Less than 750 cfs flow upstream
Jun 1 – Jun 30	Less than 5,000 cfs flow upstream	Less than 750 cfs flow upstream

1/ Where: OMR flow = (0.58 * flow at Vernalis) – (0.913 * total export) protect delta smelt reducing the amount of Delta water available for export by the SWP. The maximum delivery of 93 percent for the 2005 study is reduced to 90 percent for the updated study. The estimate of minimum SWP Table A delivery actually increases slightly. This is primarily due to the larger amount of storage available in Lake Oroville at the beginning of the year. The higher amount of storage is due to the fish-protection restrictions on SWP Delta pumping for the previous year reducing the need to release water from Lake Oroville.

Table 6.5 includes estimates of SWP Table A deliveries for Current (2007) Conditions under an assumed repetition of historical drought periods. The years are identified as dry by the Eight River Index, a good indicator of the relative amount of water supply available to the SWP. The Eight River Index is the sum of the unimpaired runoff from the four rivers in the Sacramento Basin used to define water conditions in the basin plus the four rivers in the San Joaquin Basin, which correspondingly define water conditions in that basin. The eight rivers are the Sacramento, Feather, Yuba, American, Stanislaus, Tuolumne, Merced, and San Joaquin. **Table 6.5** also includes the average deliveries for comparison purposes. Once again, deliveries under Current (2007) Conditions are the result of averaging annual deliveries from two scenarios of Old River and Middle River flow targets.

Table 6.5 shows that estimates of updated SWP deliveries under Current (2007) Conditions during dry periods are less than were earlier estimated. SWP deliveries may be reduced to 34 percent of maximum SWP Table A during the two-year drought of 1976-1977. The six-year drought of 1987-1992 is estimated to provide 35 percent of maximum SWP Table A, a reduction of 289 taf/year when compared to the 2005 estimate. The four-year drought of 1931-1934 is an exception with SWP deliveries estimated to increase 3 percent of maximum SWP Table A, from 32 percent to 35 percent.

Table 6.6 summarizes SWP Table A deliveries under an assumed repetition of historical wet periods under Current (2007) Conditions. As with drought years, the Eight River Index is used to identify wet years. **Table 6.6** shows that estimates of SWP

Table 6.4 SWP Table A delivery from the Delta under Current Conditions

Study of Current Conditions	Average Delivery[2]		Maximum Delivery[2]		Minimum Delivery[2]	
	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]
2005 SWP Delivery Reliability Report, Study 2005	2818	68%	3848	93%	159	4%
Updated Studies (2007)[3]	2595	63%	3711	90%	243	6%

1/ 4,133 taf /year
2/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
3/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3.

Table 6.5 Average and dry period SWP Table A deliveries from the Delta under Current Conditions

Study of Current Conditions	SWP Table A delivery from the Delta (in percent of maximum SWP Table A[1])					
	Long-term Average[2]	Single dry year 1977	2-year drought 1976-1977	4-year drought 1931-1934	6-year drought 1987-1992	6-year drought 1929-1934
2005 SWP Delivery Reliability Report, Study 2005	68%	4%	41%	32%	42%	37%
Updated Studies (2007)[3]	63%	6%	34%	35%	35%	34%

1/ 4,133 taf /year
2/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
3/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3

deliveries under updated Current (2007) Conditions do not significantly change from earlier estimates during wet years. Decreases in SWP deliveries for these wet periods generally range from 0 to 2 percent of maximum SWP Table A (0 to 83 taf/year).

Article 21 Deliveries under Different Hydrologic Scenarios

State Water Project water delivery is a combination of both SWP Table A deliveries and the use of Article 21 by some contractors to store water locally at times when extra water and capacity is available beyond that needed by normal SWP operations. **Table 6.7** contains the average, maximum, and minimum SWP Article 21 deliveries over the 1922-1994 period for the earlier study and the 1922-2003 period for the updated simulations. Comparing the estimates of SWP Article 21 deliveries, the updated estimates show significantly less delivery amounts on average and for maximum delivery over the simulation period. Estimated average Article 21 deliveries are 175 taf less under the updated Current (2007) Conditions than was estimated in the 2005 report. Estimated maximum Article 21 delivery is reduced 520 taf. These reductions are primarily due to the storage in San Luis Reservoir being lower in the 2007 studies. The reservoir is lower because Delta pumping is restricted by the court-ordered operation rules for delta smelt. To assure SWP Table A deliveries for the coming year are not reduced, the SWP portion of San Luis Reservoir must be very close to full, if not completely full, before Article 21 deliveries are made.

As noted above, water available for Article 21 occurs only in wet periods and it is difficult to evaluate impacts except to look at specific years. **Table 6.8** shows the updated and earlier estimates of Article 21 deliveries by year during dry periods. Under the updated current (2007) conditions, Article 21 deliveries are estimated to be significantly reduced during the dry periods 1929-1934, 1976-1977, and 1987-1992.

Table 6.9 shows the updated and earlier estimates of Article 21 deliveries by year during the 1978-1987 wet period. Under Current (2007) Conditions, updated estimated Article 21 delivery can decrease up to 550 taf in an individual year, compared to earlier estimates. In only one year, 1980, does the estimated Article 21 deliveries increase when compared to earlier estimates.

Table 6.6 Average and wet years SWP Table A delivery from the Delta under Current Conditions

Study of Current Conditions	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Long-term Average[1]	Single wet year 1983	2-year wet 1982-1983	4-year wet 1980-1983	6-year wet 1978-1983	10-year wet 1978-1987
2005 SWP Delivery Reliability Report, Study 2005	68%	60%	65%	69%	75%	72%
Updated Studies (2007)[2]	63%	60%	66%	68%	73%	71%

1/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
2/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3

Table 6.7 Annual SWP Article 21 delivery from the Delta under Current Conditions

Study of Current Conditions	Average delivery[1] (taf)	Maximum delivery[1] (taf)	Minimum delivery[1] (taf)
2005 SWP Delivery Reliability Report, Study 2005	260	1110	0
Updated Studies (2007)[2]	85	590	0

1/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
2/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3

SWP Table A Delivery Probability

The probability that a given level of SWP Table A amount will be delivered from the Delta is shown for Current (2007) Conditions in **Figure 6.1**. Results from the *2005 SWP Delivery Reliability Report* and updated estimates for 2007 are shown. Updated estimates of probability for Current (2007) Conditions are shown as a single line which results from ranking the averaged deliveries from the two scenarios of Old River and Middle

Table 6.8 Average and dry year SWP Article 21 delivery under Current Conditions (taf per year)

Year	2005 SWP *Reliability Report*, Study 2005	Updated Studies (2007)[2]
1929	0	0
1930	120	0
1931	0	0
1932	240	0
1933	510	40
1934	210	0
1976	190	5
1977	0	0
1987	550	0
1988	0	0
1989	0	0
1990	0	0
1991	0	0
1992	0	0
Long-term average[1]	260	85

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
[2]/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3

Table 6.9 Average and wet year SWP Article 21 delivery under Current Conditions (taf per year)

Year	2005 SWP *Reliability Report*, Study 2005	Updated Studies (2007)[2]
1978	300	100
1979	160	0
1980	140	190
1981	550	0
1982	800	490
1983	400	400
1984	550	460
1985	0	0
1986	120	30
1987	550	0
1978-87 Average	360	170
Long-term Average[1]	260	85

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2007)
[2]/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3

River flow targets. Probability values for each of these two scenarios are presented in Appendix B. To use **Figure 6.1**, one would first locate the percent exceedence of interest along the horizontal axis (x-axis) of the graph, move vertically upward to the curve, then horizontally to the vertical axis (y-axis) and read the annual delivery. For example, for an 80 percent exceedence, corresponding annual SWP Delta deliveries would be 2,277 taf from previous estimates and 1,990 taf for the updated estimates. The numerical data for this figure is included in Appendix B and should be referenced for specific values corresponding to specific exceedences.

Figure 6.1 shows that under Current (2007) Conditions, for probabilities of exceedence above 40 percent, updated annual SWP Table A deliveries can be 250 taf to 500 taf less than the earlier estimates. Annual SWP Table A deliveries associated with exceedences below 40 percent are much less different than the 2005 study. **Table 6.10** contains the values for SWP Delta deliveries corresponding to 25 percent, 50 percent, and 75 percent exceedence. The information in **Table 6.10** can be stated as follows: For any given year,

- There is a 25 percent chance that SWP deliveries will be at or above 3,218 taf.
- There is an equal chance that SWP deliveries will be above or below 2,976 taf.
- There is 75 percent chance that SWP deliveries will be above 2,168 taf. Another way to state this is that there is a 25 percent chance that deliveries will be below this value.

Impact on Total SWP Deliveries under Current (2007) Conditions Due to Flow Restrictions to Protect Delta Smelt

As previously discussed, the updated estimates of current SWP deliveries in this report incorporate

Figure 6.1 Average and wet years SWP Table A delivery from the Delta under Current Conditions

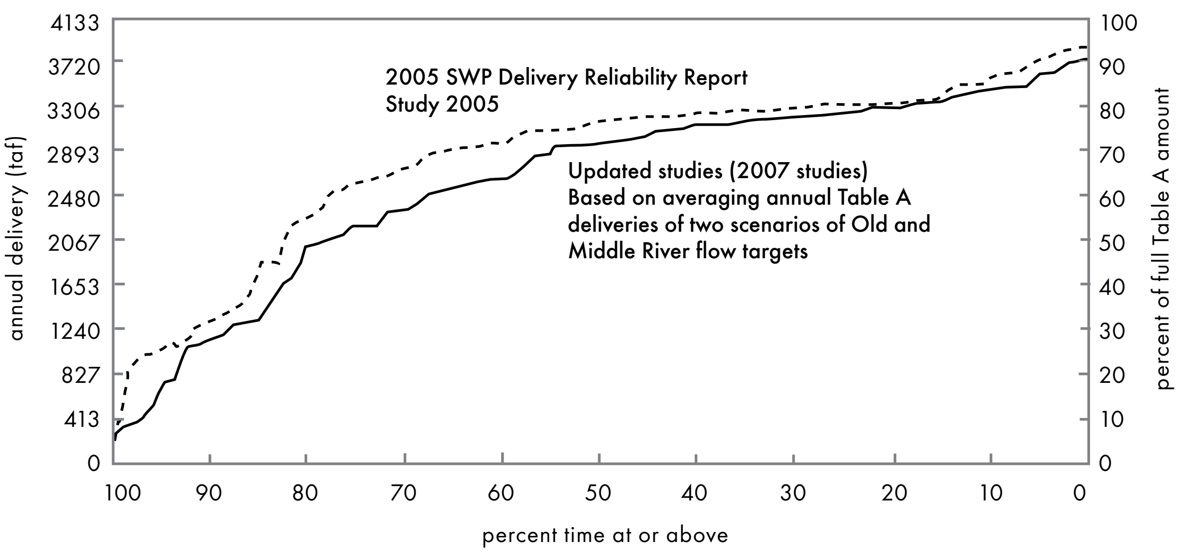


Table 6.10 Highlighted SWP Table A delivery percent exceedence values under Current Conditions

Exceedence	Annual SWP Table A Delivery (taf)		Reduction in delivery compared to 2005 report (taf)
	2005 SWP Reliability Report, Study 2005	Updated Studies (2007)[1]	
25%	3323	3218	105 (3%)
50%	3173	2976	197 (6%)
75%	2588	2168	420 (16%)

1/ Values reflect averaging annual deliveries from the two scenarios of Old and Middle River flow targets described in Table 6.3.

effects on SWP deliveries caused by new restrictions in Old River and Middle River flows ordered by the federal court in December 2007. **Tables 6.4, 6.5, 6.7, and 6.8** indicate that both SWP Table A and Article 21 deliveries under the updated studies tend to be less overall and in particular during dry periods compared to the results presented in the previous 2005 report. This section further characterizes the change in combined SWP Table A and Article 21 SWP deliveries due to the federal court order.

For the updated delivery estimates, CalSim II simulations were run assuming a lower level and a higher level of flow restrictions to give a range of potential SWP water delivery estimates. The lower- and higher-level restrictions are significantly different during Feb. 21 through April

Figure 6.2 Distribution of changes in total annual SWP deliveries under Current Conditions due to implementation of flow restrictions to protect delta smelt

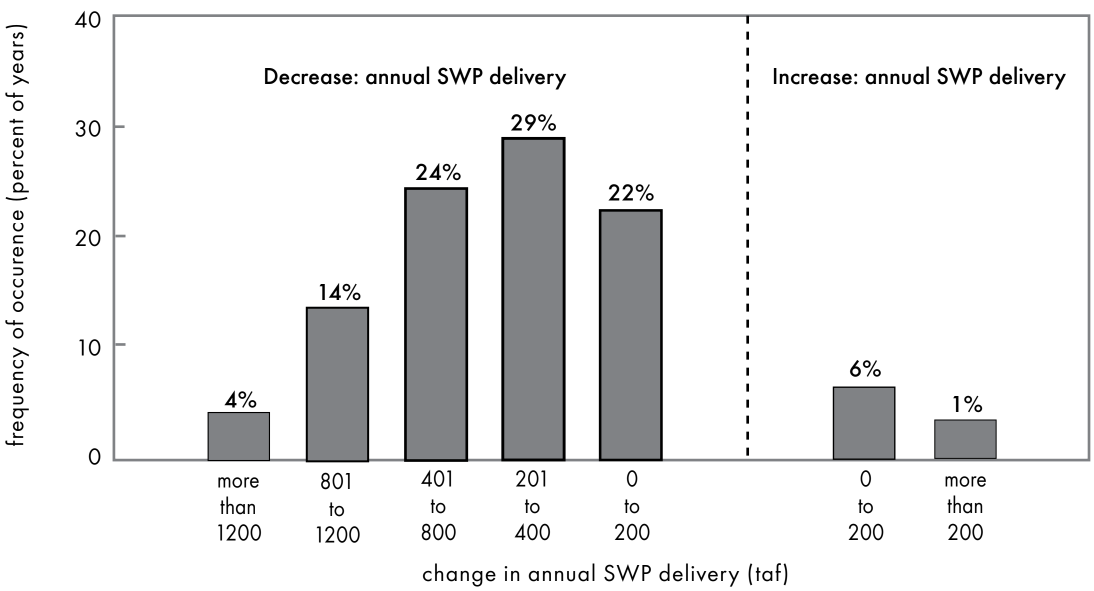
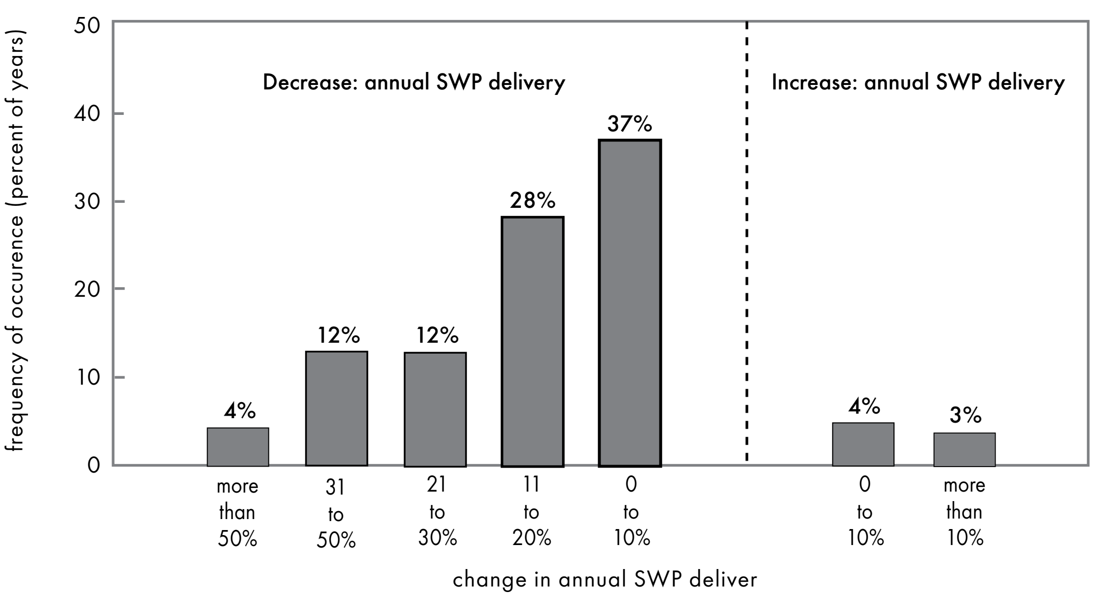


Figure 6.3 Distribution of percent changes in total annual SWP deliveries under Current Conditions due to implementation of flow restrictions to protect delta smelt



14 and May 16 through June 30. The specific rules for these flows are contained in **Table 6.3**. For presentation of combined SWP deliveries, annual SWP Table A and Article 21 deliveries from the two simulations are averaged.

Figures 6.2 and 6.3 show the distribution of changes in total annual SWP deliveries between updated estimates and estimates from the 2005 report over the common 1922 through 1994 simulation period. **Figure 6.2** shows the distribution of changes in total annual delivery in terms of thousand acre-feet and frequency of occurrence while **Figure 6.3** shows the distribution of changes in terms of percent change from the 2005 report estimates and frequency of occurrence. Any differences in SWP deliveries are nearly entirely due to the new flow restrictions for delta smelt in the updated studies. The total annual SWP deliveries which are used to generate **Figures 6.2 and 6.3** are presented in **Table B.22**.

Figures 6.2 and 6.3 show that out of the 73 years of simulation (1922-1994), total annual SWP deliveries decrease 93 percent of the time under the updated estimates. Annual deliveries decrease from 0 to 400 taf over 50 percent of the time and from 401 taf to 1,200 taf 38 percent of the time. In terms of percent decrease in deliveries, total annual SWP deliveries decrease more than 30 percent 16 percent of the time.

Table 6.7 shows that, on average, Article 21 delivery is about 175 taf less under the 2007 study than under the 2005 study. When this is combined with the difference in average SWP Table A delivery projections presented in **Table 6.4**, the difference in total average SWP delivery is about 400 taf, for an overall decrease of about 13 percent in delivery capability from the 2005 to the 2007 study

Assessment of SWP Delivery Reliability under Future (2027) conditions

Future Conditions refer to conditions that are assumed in effect in the year 2027. These conditions as described below include effects of climate change and the same Old River and Middle River flow targets that are assumed under Current (2007) Conditions. Results from the CalSim II simulation for the *2005 SWP Delivery Reliability Report* under 2025 future scenario (Study 2025) are presented throughout this section for comparison purposes. A detailed list of the study assumptions for this report is presented in Appendix A.

Availability of Source Water

DWR's 2006 report, *Progress on Incorporating Climate Change into Management of California's Water Resources*, evaluates possible future impact on California water supply through CalSim II simulations with hydrologic sequences that reflect different scenarios of climate change. The four climate change scenarios consist of two greenhouse gas emissions scenarios, A2 and B1, and two global climate models, the Geophysical Fluid Dynamic Lab model (GFDL) and the Parallel Climate model (PCM). The A2 emissions scenario assumes high growth in population, regional based economic growth, and slow technological changes, which collectively result in significantly higher greenhouse gas emissions. The B1 scenario represents low growth in population, global based economic growth, and sustainable development all of which results in a low increase in greenhouse gas emissions. Both the GFDL model and PCM predict future warming although the GFDL model indicates a greater warming trend than does the PCM. These four scenarios are assumed for the analysis in this report in order to generate the 82-year hydrologic sequence. It should be noted that these scenarios, although focusing on potential water supply conditions in 2050, include the assumption that water use in the water supply basins is at a 2020 level of development, not a 2050 level of development. In this respect, the studies span assumed temporal points of reference. They are, however, the best available estimates for future SWP water deliveries.

Demand for Delta Water

The SWP contractors' SWP Table A demands for deliveries from the Delta assumed for 2027 are shown in **Table 6.11**. The assumed demands for the studies were developed through discussions with SWP water contractors and stakeholders involved in the development of DWR's *Draft Environmental Impact Report (Draft EIR) for the Monterey Amendment to the State Water Project Contracts, including the Kern Water Bank Transfer and associated actions as part of a Settlement Agreement (Monterey Plus)*. Maximum and minimum SWP Table A demand is shown because the demand is assumed to vary each year with the weather. SWP Article 21 demands for water are the same as assumed in the 2005 SWP Delivery Reliability Report and are shown in **Table 6.12**.

Ability to Convey Source Water to the Desired Point of Delivery

One of the most significant assumptions regarding SWP conveyance is that the rules and facilities related to Delta conveyance will remain at the status quo. That is, no new facilities are assumed to be in place to convey water through, around, or through and around the Delta. As noted in Chapter 3, there are several processes under way to identify modifications to the existing method of conveying water through the Delta to reduce the conflict between fishery concerns and water supply reliability. However, these programs are not at a stage where such changes can be used in this report. The CalSim II simulations for 2027 scenarios assume the current Delta water quality regulations (contained in the State Water Resources Control Board's Decision 1641) are in place as well as the flow restrictions for Old River and Middle rivers set forth in the federal court-ordered interim action related to delta smelt. The studies evaluate a lower level and a higher level of flow restrictions to give a range of potential SWP water delivery estimates. The specific rules for these flows are contained in **Table 6.3**. The exports resulting from meeting Old River and Middle River flow targets related to delta smelt are again assumed shared equally between the CVP and the SWP.

The simulation of Future Conditions in the 2005 report (Study 2025) also assumed D-1641 Delta water quality requirements and combined SWP and CVP pumping restrictions according to the 2004 Long-Term Central Valley Project Operations Criteria and Plan. It did not assume the flow restrictions for Old River and Middle Rivers were in place.

To simulate the assumed 2027 conditions, 10 CalSim II simulations are needed: the two levels of flow restrictions combined with four climate change scenarios and a scenario assuming no climate change. SWP deliveries derived from these 10 simulations were modified as explained below before

Table 6.11 SWP Table A demands from the Delta under Future Conditions

Study of Future Conditions	Average Demand		Maximum Demand		Minimum Demand	
	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]
2005 SWP Delivery Reliability Report, Study 2025	4110	99%	4133	100%	3898	94%
Updated Studies (2027)	4111	99%	4133	100%	3935	95%

[1]/ 4,133 taf /year.

Table 6.12 Article 21 demands from the Delta under Future Conditions

Study of Future Conditions	Average Article 21 demand (taf)		Total (taf)
	December - March	April - November	
2005 SWP Delivery Reliability Report, Study 2025	704	607	1311
Updated Studies (2027)	699	598	1297

being used to describe Future (2027) Conditions.

Presentation of CalSim II Results

For the purpose of describing SWP deliveries under Future Conditions in this chapter, the annual deliveries under the four scenarios of climate change simulated by CalSim II were adjusted to better estimate deliveries reflecting 2027 conditions. As previously mentioned, the climate change scenarios for Future Conditions assume projections of climate and hydrology for 2050. Currently, 2027 climate change projections are not available. In order to estimate SWP deliveries 20 years in the future with potential changes in climate, annual SWP deliveries were interpolated between deliveries from a CalSim II simulation of a particular climate change scenario under the low or high operation restrictions for Old River and Middle River flows and deliveries from the corresponding CalSim II simulation which assumes no climate change. All CalSim II simulations for Future Conditions assume a 2027 SWP demand level.

Each climate change scenario then consists of two sequences of modified (interpolated) SWP deliveries, one sequence for each of the two levels of Old River and Middle River flow targets. For each climate change scenario, these two sequences of annual deliveries were then averaged to yield a single sequence designed to reflect a climate change projection to 2027 with an averaged Old River and Middle River flow target operation. The following tables and graph of SWP Table A delivery probability are based on these four sequences of annual SWP deliveries.

The annual SWP Table A and Article 21 deliveries for the 10 simulations on which the information in this section is based are presented in Appendix B.

SWP Table A Deliveries under Different Hydrologic Scenarios

Table 6.13 contains the average, maximum, and minimum estimates of SWP Table A deliveries from the Delta under Future Conditions from Study 2025 from the *2005 SWP Delivery Reliability Report* and under updated 2027 assumptions. The deliveries under 2027 conditions are shown as a range to account for the four climate change scenarios. The estimated probabilities for a given amount of annual SWP delivery under Future (2027) Conditions are presented in **Figure 6.4**.

Table 6.13 shows that under the updated Future (2027) Conditions, average SWP delivery amounts may decrease from 8 to 11 percent of maximum SWP Table A amounts compared to earlier estimates. Since SWP Table A demands are the same in the earlier and updated studies, this decrease in deliveries is primarily due to the incorporation of the Old River and Middle River flow targets related to delta smelt reducing the amount of Delta water available for export by SWP and the assumed hydrologic changes associated with climate change. The estimate of minimum annual SWP Table A delivery for the updated study ranges from 6 to 7 percent of maximum SWP Table A amounts.

Table 6.14 includes estimates of SWP Table A deliveries for a single-year and multiyear droughts. It also includes the average of the SWP Table A

Table 6.13 SWP Table A delivery from the Delta under Future Conditions

Study of Future Conditions	Average Delivery[2]		Maximum Delivery[2]		Minimum Delivery[2]	
	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]	taf / year	% of maximum SWP Table A[1]
2005 SWP Delivery Reliability Report, Study 2025	3178	77%	4133	100%	187	5%
Updated Studies (2027)[3]	2724–2850	66 – 69%	4133	100%	255–293	6 – 7%

1/ 4,133 taf /year
2/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
3/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

deliveries for comparison purposes. Estimates of updated SWP deliveries under Future (2027) Conditions during dry periods can range 5 percent of maximum SWP Table A (32 percent to 37 percent for 1931-1934). This is a range of almost 210 taf/year. With the period 1931-1934 being the exception, all other multiyear droughts show reduced deliveries. The reductions range from 2 percent to 13 percent of maximum SWP Table A amounts, or from 83 taf/yr to 540 taf/yr.

Table 6.15 summarizes SWP Table A deliveries under an assumed repetition of historical wet periods under Future Conditions. As with drought years, the Eight River Index is used to identify wet years. The estimated deliveries for the updated future (2027) condition during wet periods do not generally range as much as those for the dry periods. The maximum range is 3 percent of maximum SWP Table A for the six-year and 10-year wet periods. This equates to a range of 120 taf/yr. Reductions in delivery amounts are significant for the four-, six-, and 10-year wet periods. For example, average annual SWP Table A deliveries decrease to a range of 86 to 87 percent of maximum SWP Table A for the 1980-1983 period. The estimate for the 2025 study for this period is 93 percent. This corresponds to a reduction of 250 taf/yr to 290 taf/yr.

Article 21 Deliveries under Different Hydrologic Scenarios

Table 6.16 contains the average, maximum, and minimum SWP Article 21 deliveries over the

Table 6.14 Average and dry period SWP Table A deliveries from the Delta under Future Conditions

Study of Future Conditions	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Long-term Average[1]	Single dry year 1977	2-year drought 1976-1977	4-year drought 1931-1934	6-year drought 1987-1992	6-year drought 1929-1934
2005 SWP Delivery Reliability Report, Study 2025	77%	5%	40%	33%	42%	38%
Updated Studies (2027)[2]	66 – 69%	7%	26 – 27%	32 – 37%	33 – 35%	33 – 36%

1/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
2/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Table 6.15 Average and wet period SWP Table A deliveries from the Delta under Future Conditions

Study of Future Conditions	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Long-term Average[1]	Single wet year 1983	2-year wet 1982-1983	4-year wet 1980-1983	6-year wet 1978-1983	10-year wet 1978-1987
2005 SWP Delivery Reliability Report, Study 2025	77%	95%	97%	93%	93%	89%
Updated Studies (2027)[2]	66 – 69%	94%	97%	86 – 87%	84 – 87%	80 – 83%

1/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
2/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Table 6.16 Annual SWP Article 21 delivery from the Delta under Future Conditions

Study of Current Conditions	Average delivery[1] (taf)	Maximum delivery[1] (taf)	Minimum delivery[1] (taf)
2005 SWP Delivery Reliability Report, Study 2025	120	550	0
Updated Studies (2027)[2]	30	410 – 420	0

1/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
2/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

1922-1994 period for earlier studies and the 1922-2003 period for the updated simulations of Future (2027) Conditions. Comparing the estimates of SWP Article 21 deliveries, the updated estimates show less delivery amounts on average and for the maximum annual delivery over the simulation period. Estimated average Article 21 deliveries are 90 taf less under updated Future (2027) Conditions than was estimated in the *2005 SWP Delivery Reliability Report*. Estimated maximum

Table 6.17 Average and dry year SWP Article 21 delivery under Future Conditions (taf per year)

Year	2005 SWP Reliability Report, Study 2025	Updated Studies (2007)[2]
1929	0	0
1930	140	0
1931	0	0
1932	110	0 – 40
1933	550	20 – 90
1934	240	0 – 10
1976	0	0
1977	0	0 - 10
1987	180	0
1988	0	0
1989	90	0
1990	0	0
1991	0	0
1992	100	0
Long-term Average[1]	120	30

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
[2]/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Table 6.18 Average and wet year SWP Article 21 delivery under Future Conditions (taf per year)

Year	*2005 SWP Reliability Report*, Study 2025	Updated Studies (2027)[2]
1978	300	40 - 150
1979	140	0
1980	90	90 - 130
1981	70	0
1982	170	0
1983	360	270 – 290
1984	490	410 – 420
1985	0	0
1986	80	0 – 10
1987	180	0
1978-87 Average	190	90 – 100
Long-term Average[1]	120	30

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
[2]/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Article 21 delivery is reduced 120 to 130 taf.

Table 6.17 contains the estimates for Article 21 deliveries during historical dry periods. No Article 21 delivery is estimated for the lower range of the updated Future (2027) Conditions for any of the years. For the higher range, some Article 21 deliveries are shown for 1932 through 1934 and 1977. The availability of Article 21 deliveries during dry periods is greatly reduced in the analysis of the updated future (2027) condition.

Table 6.18 shows updated and earlier estimates of Article 21 deliveries by year during the 1978-1987 wet period. The availability of Article 21 deliveries is also reduced for this wet period. The average Article 21 delivery for the 1978 - 1987 period under Future (2027) Conditions ranges from 90 taf/yr to 100 taf/yr, compared to 190 taf/yr for the 2025 study.

SWP Table A Delivery Probability

The probability that a given level of SWP Table A amount will be delivered from the Delta is shown for Future (2027) Conditions in **Figure 6.4**. Results from both the 2025 study from the *2005 SWP Delivery Reliability Report* and the updated 2027 studies are shown. Probabilities for 2027 conditions are shown as a shaded area to reflect the range in SWP Table A deliveries resulting from the four climate change scenarios analyzed.

Figure 6.4 shows that under Future (2027) Conditions, for probabilities of exceedence under 80 percent, updated annual SWP Table A deliveries can be significantly less than the earlier estimates. For example, given a 60 percent time at or above, an earlier estimate of about 3,400 taf annually decreases to about 2,670 taf to 2,890 taf annually for the updated estimates. Displaying delivery

Figure 6.4 *SWP Table* A delivery probability under future conditions

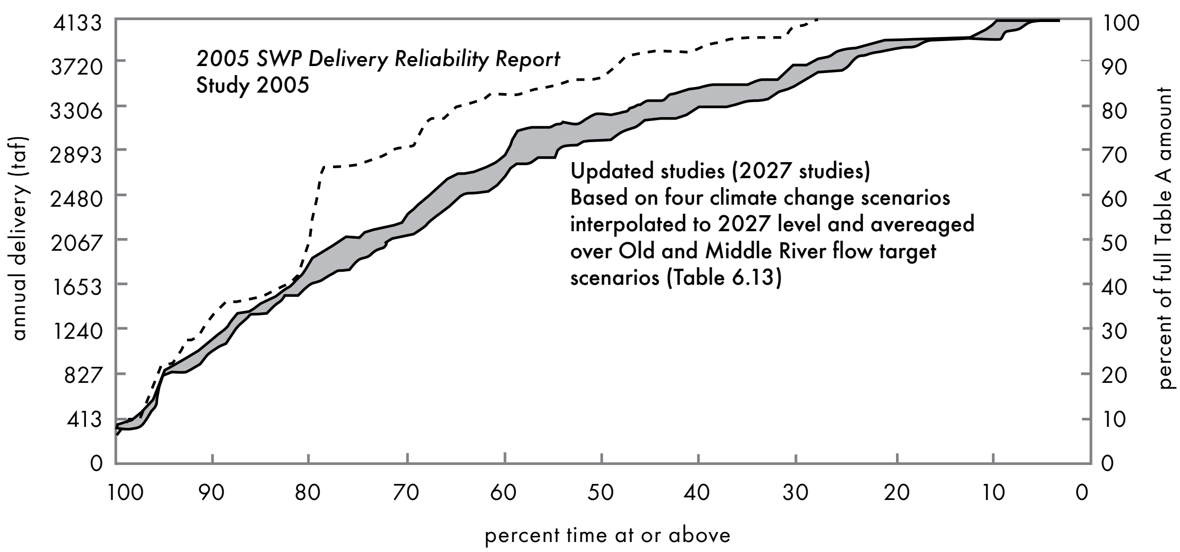


Table 6.19 Highlighted SWP Table A delivery percent exceedence values under Future Conditions

Exceedence	Annual SWP Table A Delivery (taf): *2005 SWP Delivery Reliability Report,* Study 2025	Annual SWP Table A Delivery (taf): Updated Studies (2027)[1]	Reduction in delivery in updated studies compared to 2005 report (taf)
25%	4133	3687 – 3815	318 – 446 (8 – 11%)
50%	3565	2967 – 3205	360 – 598 (10 – 17%)
75%	2738	1860 – 2077	661 – 878 (24 – 32%)

[1]/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets

probabilities as a shaded area on **Figure 6.4** shows the impact of uncertainty on probabilities associated with a given future SWP Table A delivery. The information on which **Figure 6.4** is based is contained in **Tables B.12 through B.15** in Appendix B.

Table 6.19 presents the SWP Table A annual deliveries associated with 25, 50, and 75 percent exceedence from **Figure 6.4**. The information in this table can be stated as follows: For any given year,

- There is 1 chance in 4 that SWP deliveries will be at or above the range of 3,687 taf to 3,815 taf.
- There is an equal chance that SWP deliveries will be above or below the range of 2,967 taf to 3,205 taf.
- There is 75 percent chance that SWP deliveries will be above the range of 1,860 taf to 2,077 taf. Another way to state this is that there is a 25 percent chance that deliveries will be below this range.

Comparing Current and Future SWP Delivery Reliability

CalSim II simulation-based results presented earlier in this chapter compare updated delivery projections with those contained in the *2005 SWP Delivery Reliability Report* and generally show that deliveries are projected to be less than projected in the 2005 report due to adding flow restrictions for Old River and Middle rivers set forth in the recent federal court-ordered interim action related to delta smelt and potential climate change scenarios. This section presents the same CalSim II simulation-based results in a way to facilitate comparing current reliability to future reliability. Results from the *2005 SWP Delivery Reliability Report* are presented as a reference.

SWP Table A Deliveries under Different Hydrologic Scenarios

Tables 6.20, 6.21, and 6.22 contain summaries and highlights of estimated SWP Table A deliveries from the Delta under current and Future (2027) Conditions from the *2005 SWP Delivery Reliability Report* and as derived from updated CalSim II simulations for this report. In the 2005 report, future SWP deliveries on average tended to increase over current deliveries. The updated estimates of future SWP deliveries also tend to increase compared to updated estimated current deliveries. An exception is for dry periods. The 2005 report indicated that future SWP Table A deliveries for dry periods would be approximately the same as for current dry periods. The updated estimates indicate that future SWP Table A deliveries under a two-year drought condition (1976-1977) could be lower by as much as 8 percent of maximum SWP Table A than under Current (2007) Conditions (**Table 6.21**).

Article 21 Deliveries under Different Hydrologic Scenarios

Tables 6.23, 6.24, and 6.25 contain summaries and highlights of estimated SWP Article 21 deliveries

Table 6.20 SWP Table A delivery from the Delta under current and Future Conditions

Study of Future Conditions	Average Delivery[2]		Maximum Delivery[2]		Minimum Delivery[2]	
	taf /year	SWP Table A[1] maximum	taf /year	SWP Table A[1] maximum	taf /year	SWP Table A[1] maximum
2005 SWP Delivery Reliability Report Current (2005) Future (2025)	2818 3178	68% 77%	3848 4133	93% 100%	159 187	4% 5%
Update Studies Current (2007) Future (2027)[3]	2595 2724–2850	63% 66 – 69%	3711 4133	90% 100%	243 255 – 293	6% 6 – 7%

[1]/ 4,133 taf /year

from the Delta under current and Future Conditions from the *2005 SWP Delivery Reliability Report* and as derived from updated CalSim II simulations for this report. Overall, the CalSim II simulations from the 2005 report and the updated simulations for 2007 and 2027 conditions tend to show less Article 21 deliveries in the future. Depending on the climate change scenario, updated estimates of future SWP Article 21 deliveries may increase over updated current values for specific years; however, the long-

Table 6.21 Average and dry period SWP Table A deliveries from the Delta under current and Future Conditions

Study of Future Conditions	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Long-term Average[2]	Single dry year 1977	2-year drought 1976-1977	4-year drought 1931-1934	6-year drought 1987-1992	6-year drought 1929-1934
2005 SWP Delivery Reliability Report Current (2005) Future (2025)	 68% 77%	 4% 5%	 41% 40%	 32% 33%	 42% 42%	 37% 38%
Update studies Current (2007) Future (2027)[3]	 63% 66 – 69%	 6% 7%	 34% 26 – 27%	 35% 32 – 37%	 35% 33 – 35%	 34% 33 – 36%

Table 6.22 Average and wet period SWP Table A deliveries from the Delta under current and Future Conditions

Study of Future Conditions	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Long-term Average[2]	Single wet year 1983	2-year wet 1982-1983	4-year wet 1980-1983	6-year wet 1978-1983	10-year wet 1978-1987
2005 SWP Delivery Reliability Report Current (2005) Future (2025)	 68% 77%	 60% 95%	 65% 97%	 69% 93%	 75% 93%	 72% 89%
Update studies Current (2007) Future (2027)[3]	 63% 66 – 69%	 60% 94%	 66% 97%	 68% 86 – 87%	 73% 84 – 87%	 71% 80 – 83%

Table 6.23 Annual SWP Article 21 delivery from the Delta under current and Future Conditions

Study of Current Conditions	Average delivery[2] (taf)	Maximum delivery[1] (taf)	Minimum delivery[1] (taf)
2005 SWP Delivery Reliability Report Current (2005) Future (2025)	 260 120	 1110 550	 0 0
Update studies Current (2007) Future (2027)[3]	 90 30	 590 410 – 420	 0 0

For Tables 6.20 - 6.23:
[2]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
[3]/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Table 6.24 Average and dry year SWP Article 21 delivery under current and Future Conditions (taf per year)

Year	*2005 SWP Delivery Reliability Report*		Updated Studies	
	Current (2005)	Future (2025)	Current (2007)	Current (2027)[2]
1929	0	0	0	0
1930	120	140	0	0
1931	0	0	0	0
1932	240	110	0	0 – 40
1933	510	550	40	20 – 90
1934	210	240	0	0 - 10
1976	190	0	5	0
1977	0	0	0	0 - 10
1987	550	180	0	0
1988	0	0	0	0
1989	0	90	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	100	0	0
Long-term Average[1]	260	120	85	30

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
[2]/ Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Table 6.25 Average and wet year SWP Article 21 delivery under Current and Future Conditions (taf per year)

Year	*2005 SWP Delivery Reliability Report*		Updated Studies	
	Current (2005)	Future (2025)	Current (2007)	Current (2027)[2]
1978	300	300	100	40 - 150
1979	160	140	0	0
1980	140	90	190	90 - 130
1981	550	70	0	0
1982	800	170	490	0
1983	400	360	400	270 – 290
1984	550	490	460	410 – 420
1985	0	0	0	0
1986	120	80	30	0 – 10
1987	550	180	0	0
1978-87 Average	360	190	170	90 – 100
Long-term Average[1]	260	120	85	30

[1]/ 1922-1994 for *2005 SWP Delivery Reliability Report*; 1922-2003 for Updated Studies (2027)
[2]/ Range in values reflects four modified scenarios of climate change: annual *Table A* deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

term average future Article 21 delivery is less than half of the estimate for the current (2007) scenario.

SWP Table A Delivery Probability

The current and future probability that a given level of SWP Table A amount will be delivered from the Delta is shown in **Figure 6.5** from the *2005 SWP Delivery Reliability Report* and in **Figure 6.6** for update studies for this report. In the 2005 report, future SWP Table A deliveries exceeded current deliveries at the 80 percent exceedence level. Under the updated simulations for this report, future SWP Table A deliveries exceed current deliveries at approximately the 60 percent exceedence level. Above this exceedence, future deliveries are larger than current deliveries,

Figure 6.5 Current and future *SWP Table A* delivery probability from the *2005 SWP Delivery Reliability Report*

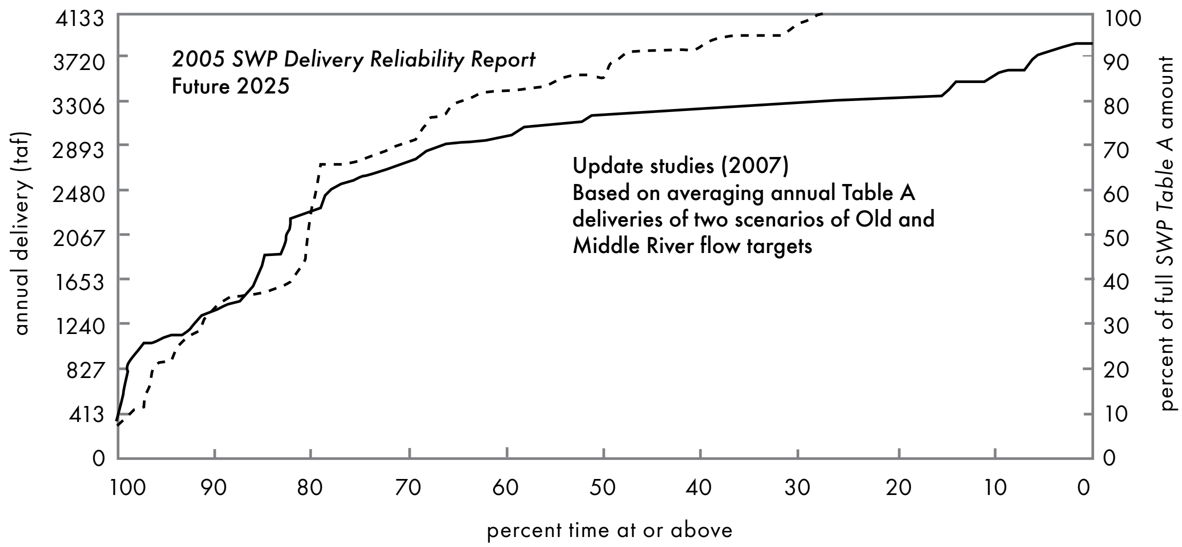
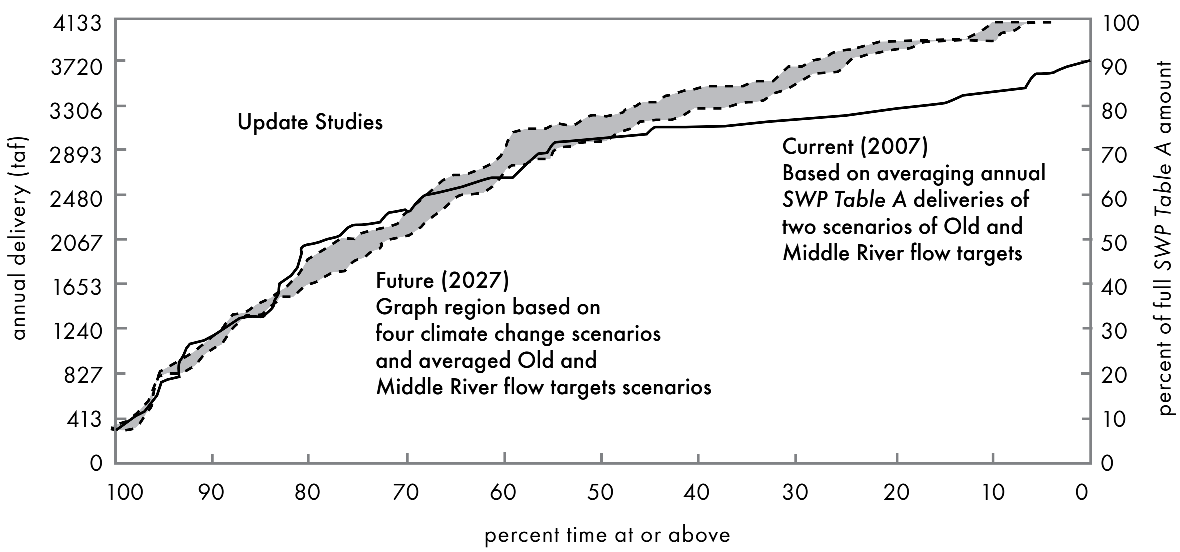


Figure 6.6 Updated current and future *SWP Table A* delivery probability



with the difference in delivery amount depending upon which climate change scenario is assumed.

Table 6.26 presents SWP Table A delivery values which correspond to 25, 50, and 75 percent exceedence for Current and Future Conditions. Previously in the 2005 report, future annual SWP deliveries were estimated to be larger than current deliveries by approximately 900 taf, 400 taf, and 150 taf for 25 percent, 50 percent, and 75 percent exceedences respectively. For the updated studies, future SWP Table A deliveries associated with a given percent exceedence may also be higher than for the deliveries at the current level (2007), but this difference is significantly less. In fact, future deliveries associated with an exceedence level of above 50 percent may be less than under Current (2007) Conditions for certain climate change scenarios.

Table 6.26 Highlighted SWP Table A delivery percent exceedence values under Current and Future Conditions

Exceedence	Annual SWP Table A Delivery (taf)			
	2005 SWP Delivery Reliability Report		Updated Studies	
	Current (2005)	Future (2025)	Current (2007)	Future (2027)[1]
25%	3323	4133	3218	3687 – 3815
50%	3173	3565	2976	2967 – 3205
75%	2588	2738	2168	1860 – 2077

[1] Range in values reflects four modified scenarios of climate change: annual SWP Table A deliveries were first interpolated between full 2050 level and no climate change scenarios, then averaged over the two scenarios of Old and Middle River flow targets.

Interpreting and Applying the Results for Local Planning Use

7

Chapter 6 presents a single set of estimates for current-level deliveries and a range of results for deliveries 20 years in the future. Chapter 6 and Appendix B explain how these estimates are developed. This chapter provides guidance on how to apply the delivery estimates to water management plans.

All results in this report are presented as percentages of the maximum SWP Table A amount for SWP deliveries from the Delta of 4.133 maf/yr. Estimates of deliveries for a specific SWP contractor can be converted to acre-feet/year by multiplying the percentages by that contractor's maximum SWP Table A amount. It is possible that the SWP Table A amount for a specific contractor may not be at the ultimate maximum value, but it should be very close to it. The Delta SWP Table A value for 2007 is 4.127 maf/yr, 99.9 percent of the maximum Delta SWP Table A value of 4.133 maf/yr. Therefore, for almost all purposes, this approach should be sufficient for these analyses. In addition, the percentages may also be used to estimate the SWP Table A deliveries to SWP contractors in Butte and Plumas counties and Yuba City. The deliveries to these contractors would be calculated using the same method.

The following two examples are taken from Chapter 6 of the *2005 State Water Project Delivery Reliability Report* and updated with the data from this report. These examples are developed for a hypothetical SWP contractor with a maximum SWP Table A amount of 100,000 acre-feet per year. Hypothetical examples illustrating applications of the delivery probability curves and adjustments to the data for a SWP contractor that cannot convey its maximum SWP Table A amount are provided in *The State Water Project Delivery Reliability Report 2002*. Questions regarding the use of the information contained in these reports may be directed to the Department of Water Resources' Bay-Delta Office at (916) 653-1099.

Example 1

This example uses data directly from **Table 6.21** for updated current and future estimates of SWP Table A deliveries during dry periods and employs allocation methods that provide a simple means of estimating supplies to each contractor. The analysis includes high and low estimates of the range of values for year 2027. In order to estimate deliveries between current (2007) and Future (2027) Conditions, the data in the table is interpolated for five-year increments and contained in **Table 7.1**. **Table 7.1** shows the average percentage of maximum Delta SWP Table A deliveries for average, single-dry year, and two-, four- and six-year multiple dry year scenarios from 2007 to 2027 in five-year increments.

The maximum SWP Table A amounts of each contractor are listed in Appendix C. SWP Table A amounts can be amended and a contractor's SWP Table A amount over the next 20 years may be less than its maximum over some or all of this period. In this case, the contractor should use the amended SWP Table A amounts for the corresponding years during this period. To use dry years other than those presented in **Table 7.1**, or to show year-to-year supplies instead of averages over a multiple-dry year period, see Example 2.

How to Calculate Supplies

In order to estimate delivery amount for the average and drought periods for each five-year increment from 2007 to 2027, multiply the contractor's SWP Table A amount for a particular year by the corresponding delivery percentages for that year from **Table 7.1**.

Tables 7.2 through 7.4 show the SWP Table A deliveries projected to be available to a hypothetical contractor with a maximum SWP Table A amount of 100,000 af, on average and for the various drought periods. For this example, the supplies shown for the multiple-dry year period are average supplies over the four-year drought from 1931-1934. Data from other year types, although not required in an urban water management plan, could also be presented this way.

Example 2

This example is similar to Example 1 but allows a contractor to select alternative single-year or multiple-dry year sequences other than those presented in **Table 7.1**. This option might be selected if analyzing different hydrologic year(s) makes more sense given a contractor's other supply sources, or given the locally acceptable risk level for water delivery shortages.

This example can also be used to identify supplies projected to be available in each year of a multiple-dry year period. While the Water Code does not specifically require this, the *Urban Water Management Plan Guidebook* suggests showing year-to-year supplies (see the *UWMP Guidebook*, Section 7, Step 3).

Where to Find the Data

Choose a single-year or multiple-year sequences from **Tables B.3 and B.12 through B.15** to represent single-dry year and multiple-dry year scenarios. **Table B.3** contains the percent of maximum SWP Table A deliveries under all 82 hydrologic years in the updated model study for 2007. **Tables B.12 through B.15** contains the percent of maximum SWP Table A deliveries under all 82 hydrologic years in the updated model studies for 2027.

How to Calculate Supplies

Multiply the contractor's SWP Table A amount for a particular year by the percent of maximum SWP Table A deliveries for the selected years, to get an estimated delivery amount for the years selected, for 2007 and 2027. Values for years between 2007 and 2027 can be linearly interpolated.

Tables 7.5 through 7.8 show the SWP Table A deliveries projected to be available to a hypothetical contractor with a maximum SWP Table A amount of 100,000 af, in a single dry year and year-to-year over a multiple dry-year period. For this example, the single dry year selected is for 1988 conditions, and the multiple dry-year period selected is the three-year period from 1990-1992. In showing year-to-year supplies for the multiple-dry year period, these year-to-year supplies should be shown for each five-year increment during the 20-year projection period.

Table 7.1 SWP average and dry year SWP Table A delivery from the Delta in five-year intervals for studies 2007 and 2027

Year	Percent of maximum (4,133 taf /year) SWP Table A delivery from the Delta					
	Average 1922 -2003	Single dry year 1977	2-year drought 1976-1977	4-year drought 1931-1934	6-year drought 1987-1992	6-year drought 1929-1934
2007	63%	6%	34%	35%	35%	34%
2012	64 – 65%	6%	32%	34 – 36%	35%	34 – 35%
2017	65 – 66%	7%	30 – 31%	34 – 36%	34 – 35%	34 – 35%
2022	66 – 68%	7%	28 – 29%	33 – 37%	34 – 35%	33 – 36%
2027	66 – 69%	7%	26 – 27%	32 – 37%	33 – 35%	33 – 36%

Table 7.2 Average annual SWP deliveries assuming a maximum SWP Table A amount of 100,000 acre-feet (acre-feet)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	63,000	64,000 – 65,000	64,000 - 66,000	65,000 - 68,000	66,000 - 69,000
State Water Project (Article 21)[1]					
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

[1]/ Annual Article 21 amounts vary significantly from year to year. Without the ability to store Article 21 supply, it is not likely to contribute to local supply. See discussion of Article 21 supply in Chapter 4.

Table 7.3 Single dry year SWP delivery (1977 conditions) assuming a maximum SWP Table A amount of 100,000 acre-feet (acre-feet)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	6,000	6,000	7,000	7,000	7,000
State Water Project (Article 21)[1]	0	0	0	0	0
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

[1]/ Annual Article 21 amounts vary significantly from year to year. Without the ability to store Article 21 supply, it is not likely to contribute to local supply. See discussion of Article 21 supply in Chapter 4.

Table 7.4 Average SWP Delivery over a multiple dry year period assuming a maximum SWP Table A amount of 100,000 acre-feet 1931-1934 conditions (acre-feet per year)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	35,000	34,000 – 36,000	34,000 – 36,000	33,000 – 37,000	32,000 – 37,000
State Water Project (Article 21)[1]					
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

[1]/ Annual Article 21 amounts vary significantly from year to year. Without the ability to store Article 21 supply, it is not likely to contribute to local supply. See discussion of Article 21 supply in Chapter 4.

Table 7.5 Annual SWP delivery over single dry year (1988 conditions), assuming a maximum Table A amount of 100,000 acre-feet (acre-feet per year)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	11,540	11,490 – 12,000	11,440 – 12,460	11,370 – 12,920	11,320 – 13,380
State Water Project (Article 21)	0	0	0	0	0
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

Table 7.6 Annual SWP delivery over multiple dry year period 1990-1992, assuming a maximum Table A amount of 100,000 acre-feet 1990 conditions (acre-feet per year)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	8,710	8,080 – 8,590	7,450 – 8,470	6,800 – 8,320	6,170 – 8,200
State Water Project (Article 21)	0	0	0	0	0
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

Table 7.7 Annual SWP delivery over multiple dry year period 1990-1992, assuming a maximum SWP Table A amount of 100,000 acre-feet 1991 conditions (acre-feet per year)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	17,640	17,980 – 18,485	18,290 – 19,360	18,630 – 20,200	18,950 – 21,050
State Water Project (Article 21)[1]	0	0	0	0	0
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

Table 7.8 Annual SWP delivery over multiple dry year period 1990-1992,
assuming a maximum SWP Table A amount of 100,000 acre-feet 1992 conditions (acre-feet per year)

Water Supply Source	2007	2012	2017	2022	2027
State Water Project (Table A)	26,300	26,180 – 26,880	26,030 – 27,460	25,910 – 28,040	25,770 – 28,620
State Water Project (Article 21)	0	0	0	0	0
Groundwater					
Local Surface Water					
Transfers					
Exchanges					
Reclaimed Water					
Other (identify)					
Total					

Appendix A. 2007 Delivery Reliability Report

CalSim II Modeling Assumptions

The CalSim II model developed for the 2004 Long-Term Central Valley Project Operations Criteria and Plan (OCAP) was modified specifically for the studies in this report. The model for this report assumes a D-1641 regulatory environment and implements the 2007 federal court decision on remedy actions for the Delta smelt. Two of the proposed actions in that decision, actions 6 and 8, specify a range in upstream flow targets for Old River and Middle River (OMR). The model studies for this report consider both the high and low remedy actions for actions 6 and 8 to bookend the potential effects. The assumptions for the remedy actions are shown in the following table.

The remedy actions incorporate the Vernalis Adaptive Management Plan (VAMP) export curtailments for the period April 15 – May 15 with impacts borne by the projects. The VAMP criteria applied in the model are as follows:

Vernalis flow (cfs)	Combined exports (cfs)
< 5700	< 1500
= 5700	< 2250
> 5700 and = < 8600	< 1500 or < 3000 (alternating standard)
> 8600	< 0.5 * flow at Vernalis

Action	Period	OMR Standard (flow upstream in cfs)	
		Remedy Action High	Remedy Action Low
4	December 25 – January 3	< 2000	< 2000
5	January 4 – February 20	< 5000	< 5000
6	February 21 – April 14	< 750	< 2000
7	April 15 – May 15	No OMR standard. VAMP controls export.	No OMR standard. VAMP controls export.
8	May 16 – June 30	< 750	< 5000

Where: OMR flow = (0.58 * flow at Vernalis) – (0.913 * total export)

The 2004 OCAP model version was also modified to include the three improvements listed below.

1. The previous San Joaquin River Basin representation was replaced by the San Joaquin River Water Quality Module version 1.00 (SJRWQM) developed by U.S. Bureau of Reclamation Mid-Pacific Region. The SJRWQM is an update to previous versions that has gone through extensive agency review and a formal peer review.

2. The previous Artificial Neural Network (ANN) used to estimate flow-salinity relationships has been replaced with a newer more accurate version. The new ANN, and its accompanying implementation to the CalSim II model, produces salinities that match more closely to Delta Simulation Model 2 (DSM2) salinities.

3. The Hydrologic sequence of simulated years has been extended to include the water years 1995 – 2003. The new simulation period spans water years 1922 – 2003 whereas the previous sequence covered water years 1922- 1994.

All studies assume current SWP Delta diversion limits (often referred to as "Banks Pumping Plant capacity"), existing conveyance capacity of the upper Delta-Mendota Canal/California Aqueduct system, and current SWP/CVP operations agreements. **Table A.1** lists key study assumptions. **Table A.2** presents the assumptions behind American River demands.

Table A.1 2007 Delivery Reliability Report CalSim II modeling assumptions

	Period of Simulation: 82 years (1922-2003)	
	Updated Studies (2007)	**Updated Studies (2027)**
HYDROLOGY		
Level of Development (Land Use)	2005 Level, *DWR Bulletin 160-98*[1]	2020 Level, *DWR Bulletin 160-98*[2]
North of Delta (except American River) Demands		
CVP	Land Use based, limited by Full Contract	
SWP (FRSA)	Land Use based, limited by Full Contract	
Non-Project	Land Use based	
CVP Refuges	Firm Level 2	
American River Basin Demands		
Water rights	2001 Level[3]	2020 Level[4]
CVP	2001 Level[3]	2020 Level[4]
San Joaquin River Basin Demands		
Friant Unit	Limited by contract amounts, based on current allocation policy	
Lower Basin	Land-use based, based on district level operations and constraints.	
Stanislaus River Basin	Land-use based, based on New Melones Interim Operations Plan	
South of Delta Demands		
CVP	Full Contract	
CCWD	151 taf/yr	
SWP (with North Bay Aqueduct)	2.3-3.9 maf/yr	3.9-4.1 maf/yr
SWP Article 21 Demand	MWDSC up to 100 taf/month, Dec-Mar, others up to 84 taf/month	
FACILITIES		
Freeport Regional Water Project	None	Included
Banks Pumping Capacity	6680 cfs	
Tracy Pumping Capacity	4200 cfs + deliveries upstream of DMC constriction	

	Period of Simulation: 82 years (1922-2003)	
	Updated Studies (2007)	Updated Studies (2027)
REGULATORY STANDARDS		
Trinity River		
Minimum Flow below Lewiston Dam	369-453 taf/yr	Trinity EIS Preferred Alternative (369-815 taf/yr)
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 taf as able)	
Clear Creek		
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to FWS and NPS, and FWS use of CVPIA 3406(b)(2) water	
Upper Sacramento River		
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 taf)	
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and FWS use of CVPIA 3406(b)(2) water	
Feather River		
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement (600 cfs)	
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement (750 – 1700 cfs)	
Yuba River		
Minimum flow below Daguerre Point Dam	Interim D-1641 operations	Lower Yuba River Accord
American River		
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and FWS use of CVPIA 3406(b)(2) water	
Minimum Flow at H Street Bridge	SWRCB D-893	
Lower Sacramento River		
Minimum Flow near Rio Vista	SWRCB D-1641	
Mokelumne River		
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (100 – 325 cfs)	
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement) (25 – 300 cfs)	
Stanislaus River		
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement , and FWS use of CVPIA 3406(b)(2) water	
Minimum Dissolved Oxygen	SWRCB D-1422	
Merced River		
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 cfs, Nov – Mar), and Cowell Agreement	
Minimum Flow at Shaffer Bridge	FERC 2179 (25 – 100 cfs)	
Tuolumne River		
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 taf/yr)	
San Joaquin River		
Maximum Salinity near Vernalis	SWRCB D-1641	
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement	
Sacramento River-San Joaquin River Delta		
Delta Outflow Index (Flow and Salinity)	SWRCB D-1641	
Delta Cross Channel Gate Operation	SWRCB D-1641	
Delta Exports	SWRCB D-1641, FWS use of CVPIA 3406(b)(2) water and CALFED Fisheries Agencies use of EWA assets	

	Period of Simulation: 82 years (1922-2003)	
	Updated Studies (2007)	**Updated Studies (2027)**
OPERATIONS CRITERIA		
Subsystem		
Upper Sacramento River		
Flow Objective for Navigation (Wilkins Slough)	3,250 – 5,000 cfs based on CVP Ag allocation levels	
American River		
Folsom Dam Flood Control	SAFCA, Interim re-operation of Folsom Dam, Variable 400/670 (without outlet modifications)	
Flow below Nimbus Dam	Operations criteria corresponding to SWRCB D-893 required minimum flow	
Sacramento Water Forum Mitigation Water	None	Sacramento Water Forum (up to 47 taf/yr in dry years)
Feather River		
Flow at Mouth	Maintain the DFG/DWR flow target above Verona or 2800 cfs for Apr– Sep dependent on Oroville inflow and FRSA allocation	
Stanislaus River		
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan	
San Joaquin River		
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program	
System-wide		
CVP Water Allocation		
CVP Settlement and Exchange	100% (75% in Shasta Critical years)	
CVP Refuges	100% (75% in Shasta Critical years)	
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)	
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)	
SWP Water Allocation		
North of Delta (FRSA)	Contract specific	
South of Delta	Based on supply; Monterey Agreement	
CVP/SWP Coordinated Operations		
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement	
Sharing of Surplus Flows	1986 Coordinated Operations Agreement	
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641	
Transfers		
Dry Year Program	None	
Phase 8	None	
MWDSC/CVP Settlement Contractors	None	
CVP/SWP Integration		
Dedicated Conveyance at Banks	None	
NOD Accounting Adjustments	None	

[1]/ The 2005 Level of Development for the Sacramento Valley is defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from *DWR Bulletin 160-98*. The San Joaquin Valley hydrology reflects 2005 land-use assumptions developed by U.S. Bureau of Reclamation to support its studies.
[2]/ The 2020 Level of Development for the Sacramento Valley is from *DWR Bulletin 160-98*. The San Joaquin Valley hydrology reflects draft 2030 land-use assumptions developed by U.S. Bureau of Reclamation to support its studies.
[3]/ Presented in attached table of 2007 Study American River Demand Assumptions.
[4]/ Presented in attached table of 2027 Study American River Demand Assumptions.
[5]/ CalSim II model representation for the Stanislaus River does not necessarily represent U.S. Bureau of Reclamation's current or future operational policies.
[6]/ Delta diversions include operations of Los Vaqueros Reservoir and represents average annual diversion.
[7]/ Includes modified EBMUD operations of the Mokelumne River.
[8]/ This is implemented only in the PCWA Middle Fork Project releases used in defining the CalSim II inflows to Folsom Lake.

Table A.2 2007 Study American River demand assumptions

Location / Purveyor	ALLOCATION TYPE (MAXIMUM)					
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non-CVP / No Cuts	CVP Refuge	Total
Auburn Dam Site (D300)						
Placer County Water Agency	0	0	0	8,500	0	**8,500**
Total	**0**	**0**	**0**	**8,500**	**0**	**8,500**
Folsom Reservoir (D8)						
Sacramento Suburban	0	0	0	0	0	**0**
City of Folsom (includes P.L. 101-514)	0	0	0	20,000	0	**20,000**
Folsom Prison	0	0	0	2,000	0	**2,000**
San Juan Water District (Placer County)	0	0	0	10,000	0	**10,000**
San Juan Water District (Sac. County) (includes P.L. 101-514)	0	11,200	0	33,000	0	**44,200**
El Dorado Irrigation District	0	7,550	0	0	0	**7,550**
El Dorado Irrigation District (P.L. 101-514)	0	0	0	0	0	**0**
City of Roseville	0	32,000	0	0	0	**32,000**
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**50,750**	**0**	**65,000**	**0**	**115,750**
Folsom South Canal (D9)						
So. Cal WC/ Arden Cordova WC	0	0	0	3,500	0	**3,500**
California Parks and Recreation	0	100	0	0	0	**100**
SMUD (export)	0	0	0	15,000	0	**15,000**
South Sacramento County Agriculture (export, SMUD transfer)	0	0	0	0	0	**0**
Canal Losses	0	0	0	1,000	0	**1,000**
Total	**0**	**100**	**0**	**19,500**	**0**	**19,600**
Nimbus to Mouth (D302)						
City of Sacramento	0	0	0	63,335	0	**63,335**
Arcade Water District	0	0	0	2,000	0	**2,000**
Carmichael Water District	0	0	0	8,000	0	**8,000**
Total	**0**	**0**	**0**	**73,335**	**0**	**73,335**
Sacramento River (D162)						
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**0**	**0**	**0**	**0**	**0**
Sacramento River (D167/D168)						
City of Sacramento	0	0	0	38,665	0	**38,665**
Sacramento County Water Agency (SMUD transfer)	0	0	0	0	0	**0**
Sacramento County Water Agency (P.L. 101-514)	0	0	0	0	0	**0**
EBMUD (export)	0	0	0	0	0	**0**
Total	**0**	**0**	**0**	**38,665**	**0**	**38,665**
Total from the American River	**0**	**50,850**	**0**	**166,335**	**0**	**217,185**

Table A.3 2027 Study American River demand assumptions

Location / Purveyor	ALLOCATION TYPE (MAXIMUM)					
	CVP AG	CVP MI	CVP Settlement / Exchange	Water Rights / Non-CVP / No Cuts	CVP Refuge	Total
Auburn Dam Site (D300)						
Placer County Water Agency	0	0	0	35,500	0	**35,500**
Total	**0**	**0**	**0**	**35,500**	**0**	**35,500**
Folsom Reservoir (D8)						
Sacramento Suburban	0	0	0	29,000	0	**29,000**
City of Folsom (includes P.L. 101-514)	0	7,000	0	27,000	0	**34,000**
Folsom Prison	0	0	0	2,000	0	**2,000**
San Juan Water District (Placer County)	0	0	0	25,000	0	**25,000**
San Juan Water District (Sac County) (includes P.L. 101-514)	0	24,200	0	33,000	0	**57,200**
El Dorado Irrigation District	0	7,550	0	0	0	**7,550**
El Dorado Irrigation District (P.L. 101-514)	0	7,500	0	0	0	**7,500**
City of Roseville	0	32,000	0	30,000	0	**62,000**
Placer County Water Agency	0	0	0	0	0	**0**
Total	**0**	**78,250**	**0**	**146,000**	**0**	**224,250**
Folsom South Canal (D9)						
So. Cal WC / Arden Cordova WC	0	0	0	5,000	0	**5,000**
California Parks and Recreation	0	5,000	0	0	0	**5,000**
SMUD (export)	0	15,000	0	15,000	0	**30,000**
South Sacramento County Agriculture (export, SMUD transfer)	35,000	0	0	0	0	**35,000**
Canal Losses	0	0	0	1,000	0	**1,000**
Total	**35,000**	**20,000**	**0**	**21,000**	**0**	**76,000**
Nimbus to Mouth (D302)						
City of Sacramento	0	0	0	96,300	0	**96,300**
Arcade Water District	0	0	0	11,200	0	**11,200**
Carmichael Water District	0	0	0	12,000	0	**12,000**
Total	**0**	**0**	**0**	**119,500**	**0**	**119,500**
Sacramento River (D162)						
Sacramento Suburban	0	0	0	29,000	0	**29,000**
Total	**0**	**0**	**0**	**29,000**	**0**	**29,000**
Sacramento River (D167/D168)						
City of Sacramento	0	0	0	34,300	0	**34,300**
Sacramento County Water Agency (SMUD transfer)	0	30,000	0	0	0	**30,000**
Sacramento County Water Agency (P.L. 101-514)	0	15,000	0	0	0	**15,000**
EBMUD (export)	0	133,000	0	0	0	**133,000**
Total	**0**	**178,000**	**0**	**34,300**	**0**	**212,300**
Total from the American River	**35,000**	**98,250**	**0**	**322,000**	**0**	**455,250**

Folsom Unimpaired Inflow (FUI) FUI = Total taf (Mar – Sep) + 60 taf			Notes
> 1600	> 950	< 400	
35,500	35,500	35,500	
35,500	**35,500**	**35,500**	
29,000	0	0	4,5,10
34,000	34,000	20,000	1,2,3
2,000	2,000	2,000	
25,000	25,000	10,000	
57,200	57,200	44,200	1,2,3
7,550	7,550	7,550	1,2,3
7,500	7,500	1,450	1,2,3
54,900	54,900	39,800	
0	0	0	10
217,150	**188,150**	**125,000**	
5,000	5,000	5,000	
5,000	5,000	5,000	
30,000	30,000	15,000	1,2,3
35,000	0	0	4,5
1,000	1,000	1,000	
76,000	**41,000**	**26,000**	
96,300	96,300	50,000	6,7,8
11,200	11,200	3,500	12
12,000	12,000	12,000	
119,500	**119,500**	**65,500**	
0	29,000	29,000	4,5
0	**29,000**	**29,000**	
34,300	34,300	80,600	8
0	0	0	9
0	0	0	9
0	0	0	
34,300	**34,300**	**80,600**	
448,150	**384,150**	**252,000**	

[1]/ Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 950,000 af.
[2]/ Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 950,000 af but greater than 400,000 af.
[3]/ Driest years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 400,000 af.
[4]/ Wet/average years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is greater than 1,600,000 af.
[5]/ Drier years for this diverter are defined as those years when the projected March through November unimpaired inflow to Folsom Reservoir is less than 1,600,000 af.
[6]/ Wet/average years as it applies to the City of Sacramento are time periods when the flows bypassing the E. A. Fairbairn Water Treatment Plant diversion exceed the "Hodge flows."
[7]/ Drier years are time periods when the flows bypassing the City's E.A. Fairbairn Water Treatment Plant diversion do not exceed the "Hodge flows."
[8]/ For modeling purposes, it is assumed that the City of Sacramento's total annual diversions from the American and Sacramento River in year 2030 would be 130,600 af.
[9]/ The total demand for Sacramento County Water Agency would be up to 78,000 af. The 45,000 af represents firm entitlements; the additional 33,000 af of demand is expected to be met by intermittent surplus supply. The intermittent supply is subject to Reclamation reduction (50%) in dry years.
[10]/ Water Rights Water provided by releases from PCWA's Middle Fork Project; inputs into upper American River model must be consistent with these assumptions.
[11]/ Demand requires "Replacement Water" as indicated below
[12]/ Arcade WD demand modeled as step function: one demand when FUI > 400, another demand when FUI < 400.

Appendix B. Results of Report CalSim II Studies

The supply reliability of the State Water Project is estimated in studies by using a computer program that simulates the operation of the SWP on a monthly basis over an 82-year historical record of rainfall and runoff (1922–2003). The simulation model integrates all the relevant water resource components and calculates key water management parameters, such as:

- the amount of water released from reservoirs in the Sacramento-San Joaquin valleys,
- the amount of water required to maintain Delta water quality standards,
- the amount of water to be pumped from the Delta by the SWP and the Central Valley Project (CVP), and
- the amount of water that can be delivered by each of these projects.

The information required to run the simulation is referred to as the "model input." The most significant categories of input are:

- the physical description of the water system facilities (maximum pumping or release capacity, maximum reservoir storages, etc.);
- institutional requirements (delivery contract requirements, Delta water quality standards, the operations agreement between the SWP and CVP, endangered species requirements, and other requirements of federal and state laws, etc);
- hydrology (river and stream flows adjusted for water use in the source areas); and
- the level of SWP water demand.

CalSim II is the current version of the computer simulation model used to estimate SWP delivery reliability. All versions of CalSim employ commercially available linear programming software as a solution device. The application of the software, graphical user interface, and input/output devices are discussed in the documentation for CalSim which is available at **http://baydeltaoffice.water.ca.gov/ modeling/hydrology/CalSimII/.**

The model studies selected for this report are intended to estimate current SWP delivery reliability and future SWP delivery reliability in the year 2027. Estimating current SWP delivery reliability assumes the SWP and CVP operate to meet Old River and Middle River flow targets specified in the 2007 federal court ruling on interim measures to protect delta smelt. Estimating future SWP delivery reliability in 2027 assumes an altered hydrology due to climate change, no new facilities or improvements to existing facilities, an increased SWP water demand, and existing institutional requirements, including the 2007 federal court ruling.

As listed in **Table B.1**, 12 CalSim II simulations were used in this report: two for estimating current (2007) SWP delivery reliability and 10 for estimating future (2027) SWP delivery reliability. Two simulations were needed for estimating current reliability due to uncertainty in which Old River and Middle River flow target might apply. The 2007 proposed federal court ruling gave discretion to USFWS to determine whether at times a more or less restrictive flow target should be met based upon USFWS's assessment of the vulnerability of delta smelt at that time. The yearly annual SWP deliveries from these two studies were averaged to yield a single sequence of annual SWP deliveries to describe Current Conditions while incorporating average impacts to deliveries due to Old River and Middle River flow targets contained in the federal court ruling.

Ten CalSim II simulations were needed to estimate future (2027) reliability due to three factors:

1. uncertainty in how climate change may affect the source water for SWP,
2. the need to adjust CalSim II results to account for the climate change scenarios assuming a 2050 level of emissions, and
3. uncertainty in which Old River and Middle River flow target might apply.

The ten simulations consist of four climate change scenarios and a no-climate-change scenario which each assume two scenarios of Old River and Middle River flow targets. The four climate change scenarios are defined by the climate change model used and the assumed greenhouse gas emissions scenario. One emissions scenario, referred to as "A2," assumes high growth in population, regional based economic growth, and slow technological changes, which results in significantly higher greenhouse gas emissions. The other emissions scenario, "B1," represents low growth in population, global based economic growth and sustainable development that results in a low increase in greenhouse gas emissions. The climate change models used are the Geophysical Fluid Dynamic Lab model (GFDL) and the Parallel Climate model (PCM). Both models project future warming although the GFDL model indicates a greater warming tread than the PCM.

Table B.1 Summary of CalSim II simulations used to update SWP delivery estimates

Time Frame	Climate Change Model	Greenhouse Gas Emissions Scenario	Old River and Middle River flow target targets[1]
Current	None	None	Less restrictive
			More restrictive
Future	None	None	Less restrictive
			More restrictive
Future	Geophysical Fluid Dynamic Lab Model	A2	Less restrictive
			More restrictive
		B1	Less restrictive
			More restrictive
Future	Parallel Climate Model	A2	Less restrictive
			More restrictive
		B1	Less restrictive
			More restrictive

Note: The Geophysical Fluid Dynamic Lab model and PCM refers to the Parallel Climate model. The GFDL model indicates a greater warming tread than the PCM. A2 emissions scenario assumes high growth in population, regional based economic growth, and slow technological changes, which results in significantly higher greenhouse gas emissions. B2 emissions scenario represents low growth in population, global based economic growth and sustainable development that results in a low increase in greenhouse gas emissions.

1/ Less restrictive Old River and Middle River flow targets refer to combined Old River and Middle River flow not more than 5,000 cfs in upstream direction in February 21 – April 14; June 1-30. More restrictive Old River and Middle River flow targets refer to combined Old River and Middle River flow being not more than 750 cfs in upstream direction during February 21 – April 14 and June 1 – 30 (see Table 6.3). maf = million acre-feet; taf = thousand acre-feet

The climate change scenarios used in this report to describe future SWP delivery reliability then are:

1. A2 emissions scenario with the GFDL model,
2. B1 emissions with the GFDL model,
3. A2 emissions with the PCM model,
4. B1 emissions with the PCM model.

Each climate change scenario generates two sequences of future SWP deliveries due to each assuming two scenarios of Old River and Middle River flow targets.

The ten CalSim II simulations were used to generate four sequences of future (2027) SWP deliveries which are used to describe future SWP delivery reliability in Chapter 6 of this report. This process consisted of first interpolating between sequences to estimate SWP deliveries under climate change affects for 2027 instead of 2050, then averaging each pair of sequences differentiated by Old River and Middle River flow targets scenario. The A2 and B1 greenhouse gas emissions scenarios assume a 2050 level of emissions. Scenarios for 2027 were not available at the time of composing this report. A key assumption in estimating 2027 SWP delivery reliability for this report is that SWP deliveries for a CalSim II simulation which assumes 2027 SWP demands and 2027 climate change, would fall somewhere between CalSim II simulations which assume 2027 SWP demands and no climate change and 2027 SWP demands and climate change corresponding to 2050 emissions. Just where these SWP deliveries would fall is estimated in this report by interpolating between each sequence from a scenario which assumes 2050 emissions and a scenario which assumes no climate change. The interpolation is as follows:

Future (2027) annual SWP delivery = NCC + (20/43) (CC – NCC)

Where
NCC = annual SWP delivery for future, no climate change scenario
CC = annual SWP delivery for future with climate change scenario, which assumes 2050 emission levels

The ratio of 20/43 corresponds to the ratio of calendar years: (2027-2007)/(2050-2007)

The key study assumptions are described in detail in Chapter 3 and Appendix A. Additional discussions of the Operations Criteria and Plan (OCAP) studies are on the US Bureau of Reclamation's website at **http://www.usbr.gov/mp/cvo/ocap_page.html**.

Study Results

The annual delivery amounts estimated by the twelve CalSim II simulations are contained in **Tables B.3 through B.15**. The tables show the demand level, the amount of delivery from the Delta, and percent of maximum total SWP Table A amounts for the SWP contractors receiving water from the Delta. Of the 29 SWP contractors, 26 receive their deliveries from the Delta. The total maximum SWP Table A amount for all SWP contractors is 4.173 maf/year. Of this amount, 4,133 taf/yr is the maximum Delta SWP Table A amount. Also presented are the results of interpolating and averaging SWP delivery sequences which provide the information used in Chapter 6 in assessing current and future SWP delivery reliability. Current and future SWP deliveries are presented both in time sequence and by ranking to correspond to the data presented in the summary/highlight tables and used to generate the probability curves in Chapter 6.

These values must be interpreted within the context of the assumptions upon which they are calculated. For example, for the year 1958 in the 2027 study which assumes PCM model with high emissions and less restrictive Old River and Middle River flow targets, the annual delivery is calculated to be 4,133 taf or 100 percent of maximum Delta SWP Table A (see **Table B.8**). This result should be stated as follows under the assumptions of:

1. rainfall that was similar to what it was in 1958 but modified to reflect climate change effects as predicted by PCM model under assumed higher emissions;
2. the level of water use in the source area is increased to the level it would be in 2027;

3. SWP facilities and operation requirements are the same as they are today with less restrictive Old River and Middle River flow targets in effect;
4. SWP contractor demands are at their maximum Delta SWP Table A level, then SWP would deliver approximately 4,133 taf or 100 percent of the maximum Delta SWP Table A.

Actually, the conditional statement associated with the result for any particular year is even more complicated than this because the result is also dependent upon the rainfall that has occurred in previous years. For example, if the previous year (1957) was wet, runoff for 1958 for the same amount of rainfall would be greater than if 1957 were dry. In addition, reservoir storage for the beginning of 1958 varies depending upon the weather conditions in 1957. Thus, each year's simulation is dependent on the previous year's simulation and, hence, any year in the entire historical sequence is linked to all previous years.

Table B.2 summarizes the delivery estimates for the SWP for important dry sequences computed in the studies for current (2007) and Future (2027) Conditions. The percentages of maximum SWP Table A amounts are based on averaging current deliveries and interpolating and then averaging future annual SWP Table A deliveries as previously discussed. This information can be helpful in analyzing the delivery reliability of a specific water system that receives a portion of its water supply from the SWP.

The series of data contained in **Tables B.3 through B.15** are also helpful in analyzing longer periods of time that contain not only dry periods but wetter periods which can replenish water supplies.

Table B.16 presents the annual SWP Article 21 deliveries under Current Conditions and **Tables B.17 through B.20** present annual SWP Article 21 deliveries under the four climate change scenarios under Future Conditions for both the higher and lower Old and Middle River flow targets.

Probability distribution curves derived from the CalSim II simulations used in this report are presented in **Figures B.1 through B.4** to visually show the estimated percentage of years a given annual delivery is equaled or exceeded. In this report, this value represents the probability of receiving at least a given level of delivery in any particular year. As a reference, probability distribution curves for the 2005 and 2025 studies from the 2005 State Water Project Delivery Reliability Report are presented along with the curves from the 2007 and 2027 studies in this report. SWP Table A delivery values for 25%, 50%, and 75% exceedences are shown for all scenarios in **Table B.21**.

Finally, the combined SWP Table A and Article 21 amounts under current conditions as calculated in the 2005 Reliability Report and the 2007 updated report are presented in **Table B.22** to show the estimated impact on total SWP deliveries due to flow restrictions to protect delta smelt.

Table B.2 SWP average and dry year SWP Table A delivery from the Delta (in percent of maximum SWP Table A amounts[1])

Time Frame	Climate Change Model	Emissions Scenario	Average 1922 - 2003	Single dry year 1977	2-year drought 1976-1977	4-year drought 1931-1934	6-year drought 1987-1992	6-year drought 1929-1934
Current 2007	none	none	63%	6%	34%	35%	35%	34%
Future 2027	Geophysical Fluid Dynamic Lab Model	A2	66%	7%	26%	32%	34%	34%
		B1	66%	7%	27%	32%	33%	33%
	Parallel Climate Model	A2	67%	7%	26%	33%	33%	34%
		B1	69%	7%	27%	37%	35%	36%

1/ 4,133 taf/year

Table B.3 SWP Table A deliveries under Current (2007) Conditions
Derived values for estimating probability curve

Year	SWP Table A demands (taf)	SWP Table A deliveries for 2007 studies				Probability Curve[1]		
		lower flow target[2] (taf)	higher flow target[2] (taf)	average flow targets (taf)	percent of max SWP Table A[3]	Year	SWP Table A Delivery (taf)	Exceedence Frequency
1922	3,752	3,737	3,611	3,674	89%	1993	3,711	0%
1923	3,253	3,250	3,067	3,159	76%	1927	3,699	1%
1924	3,491	529	272	400	10%	1922	3,674	3%
1925	3,355	1,528	1,759	1,644	40%	1978	3,599	4%
1926	3,395	2,449	1,923	2,186	53%	1956	3,581	5%
1927	3,862	3,782	3,616	3,699	89%	1951	3,497	6%
1928	3,460	2,165	1,953	2,059	50%	1959	3,465	8%
1929	2,909	840	667	753	18%	2000	3,451	9%
1930	3,328	2,076	1,980	2,028	49%	1996	3,440	10%
1931	2,935	1,158	1,053	1,105	27%	1999	3,439	11%
1932	3,141	1,449	1,161	1,305	32%	1963	3,406	12%
1933	3,429	2,211	1,751	1,981	48%	1938	3,394	14%
1934	3,472	1,272	1,357	1,315	32%	1935	3,334	15%
1935	3,800	3,619	3,050	3,334	81%	1953	3,323	16%
1936	3,598	3,422	2,826	3,124	76%	1971	3,317	17%
1937	3,544	3,210	3,227	3,219	78%	1968	3,297	19%
1938	3,396	3,394	3,394	3,394	82%	1966	3,265	20%
1939	3,264	3,257	3,256	3,256	79%	1970	3,257	21%
1940	3,241	3,208	3,122	3,165	77%	1939	3,256	22%
1941	2,528	2,526	2,526	2,526	61%	1984	3,227	24%
1942	3,169	3,167	3,167	3,167	77%	1937	3,219	25%
1943	3,156	3,154	3,154	3,154	76%	1975	3,218	26%
1944	3,092	2,971	2,888	2,930	71%	1954	3,201	27%
1945	3,114	3,088	3,082	3,085	75%	1946	3,199	28%
1946	3,217	3,215	3,183	3,199	77%	1985	3,198	30%
1947	3,424	2,637	1,992	2,314	56%	1974	3,184	31%
1948	3,397	2,637	2,582	2,609	63%	1942	3,167	32%
1949	3,315	1,423	1,119	1,271	31%	1940	3,165	33%
1950	3,467	2,629	2,294	2,462	60%	1923	3,159	35%
1951	3,499	3,497	3,497	3,497	85%	1943	3,154	36%
1952	2,587	2,585	2,585	2,585	63%	1989	3,130	37%
1953	3,325	3,323	3,323	3,323	80%	1979	3,128	38%
1954	3,296	3,293	3,110	3,201	77%	1981	3,128	40%
1955	3,230	1,202	1,071	1,137	28%	1936	3,124	41%
1956	3,583	3,581	3,581	3,581	87%	1997	3,101	42%
1957	3,237	2,670	2,420	2,545	62%	1973	3,085	43%
1958	3,032	3,029	3,030	3,030	73%	1945	3,085	45%
1959	3,549	3,389	3,541	3,465	84%	1958	3,030	46%
1960	3,557	1,665	1,255	1,460	35%	1998	3,008	47%
1961	3,582	2,517	2,197	2,357	57%	1995	2,993	48%
1962	3,692	2,908	3,015	2,962	72%	1967	2,990	49%
1963	3,825	3,717	3,095	3,406	82%	1962	2,962	51%
1964	3,494	2,018	2,404	2,211	53%	2003	2,943	52%
1965	3,061	3,028	2,693	2,861	69%	1982	2,940	53%

Table B.3 (cont.) SWP water delivery from the Delta under Current (2007) Conditions
Derived values for estimating probability curve

Year	SWP Table A demands (taf)	SWP Table A deliveries for 2007 studies				Probability Curve[1]		
		lower flow target[2] (taf)	higher flow target[2] (taf)	average flow targets (taf)	percent of max SWP Table A[3]	Year	SWP Table A Delivery (taf)	Exceedence Frequency
1966	3,284	3,282	3,249	3,265	79%	1944	2,930	54%
1967	3,002	2,989	2,991	2,990	72%	1965	2,861	56%
1968	3,326	3,324	3,270	3,297	80%	1987	2,825	57%
1969	2,638	2,626	2,625	2,626	64%	1980	2,710	58%
1970	3,259	3,257	3,257	3,257	79%	1969	2,626	59%
1971	3,343	3,329	3,305	3,317	80%	1948	2,609	61%
1972	3,459	1,881	1,533	1,707	41%	1976	2,604	62%
1973	3,099	3,094	3,077	3,085	75%	1952	2,585	63%
1974	3,186	3,184	3,183	3,184	77%	1957	2,545	64%
1975	3,231	3,229	3,206	3,218	78%	1941	2,526	66%
1976	3,473	2,973	2,234	2,604	63%	1983	2,497	67%
1977	3,423	225	260	243	6%	1950	2,462	68%
1978	3,625	3,598	3,601	3,599	87%	1961	2,357	69%
1979	3,514	3,249	3,007	3,128	76%	1947	2,314	70%
1980	2,717	2,711	2,709	2,710	66%	1986	2,294	72%
1981	3,360	3,273	2,982	3,128	76%	1964	2,211	73%
1982	2,942	2,940	2,940	2,940	71%	1926	2,186	74%
1983	2,499	2,497	2,497	2,497	60%	2002	2,162	75%
1984	3,229	3,227	3,227	3,227	78%	1994	2,105	77%
1985	3,216	3,213	3,184	3,198	77%	1928	2,059	78%
1986	2,323	2,294	2,294	2,294	56%	1930	2,028	79%
1987	2,898	2,868	2,782	2,825	68%	1933	1,981	80%
1988	2,969	544	409	477	12%	1972	1,707	82%
1989	3,553	3,132	3,129	3,130	76%	1925	1,644	83%
1990	3,630	500	220	360	9%	1960	1,460	84%
1991	3,427	806	652	729	18%	1934	1,315	85%
1992	3,368	1,096	1,078	1,087	26%	1932	1,305	87%
1993	3,864	3,846	3,576	3,711	90%	1949	1,271	88%
1994	3,672	2,071	2,138	2,105	51%	2001	1,164	89%
1995	3,015	2,995	2,992	2,993	72%	1955	1,137	90%
1996	3,441	3,440	3,440	3,440	83%	1931	1,105	91%
1997	3,308	3,026	3,176	3,101	75%	1992	1,087	93%
1998	3,015	3,008	3,007	3,008	73%	1929	753	94%
1999	3,441	3,440	3,439	3,439	83%	1991	729	95%
2000	3,469	3,463	3,439	3,451	84%	1988	477	96%
2001	3,710	1,334	994	1,164	28%	1924	400	98%
2002	3,847	2,470	1,853	2,162	52%	1990	360	99%
2003	3,469	3,130	2,756	2,943	71%	1977	243	100%
Avg	**3,309**	**2,658**	**2,531**	**2,595**	**63%**		**2,595**	
Min	**2,323**	**225**	**220**	**243**	**6%**		**243**	
Max	**3,864**	**3,846**	**3,616**	**3,711**	**90%**		**3,711**	

1/ Values used to describe Current Conditions in Chapter 6 2/ See Table 6.3 3/ 4,133 taf/year

Table B.4 SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with A2 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		GFDL with A2 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	4,057	98%	4,068	98%	4,062	98%
1923	4,133	3,114	75%	2,056	50%	2,622	63%
1924	4,133	438	11%	750	18%	583	14%
1925	4,133	1,628	39%	1,470	36%	1,554	38%
1926	4,133	2,414	58%	2,149	52%	2,291	55%
1927	4,133	4,133	100%	3,816	92%	3,986	96%
1928	4,133	2,109	51%	2,160	52%	2,133	52%
1929	4,133	847	20%	881	21%	863	21%
1930	4,133	2,357	57%	2,470	60%	2,410	58%
1931	4,133	1,098	27%	1,066	26%	1,083	26%
1932	4,133	1,512	37%	1,352	33%	1,437	35%
1933	4,133	2,274	55%	1,357	33%	1,847	45%
1934	4,133	1,327	32%	1,312	32%	1,320	32%
1935	4,133	3,734	90%	3,205	78%	3,488	84%
1936	4,133	3,569	86%	3,682	89%	3,622	88%
1937	4,133	3,510	85%	2,292	55%	2,943	71%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,527	85%	2,488	60%	3,044	74%
1940	4,133	3,642	88%	3,749	91%	3,691	89%
1941	3,898	3,908	95%	3,907	95%	3,907	95%
1942	4,133	4,133	100%	3,633	88%	3,900	94%
1943	4,133	3,849	93%	3,535	86%	3,703	90%
1944	4,133	2,924	71%	2,131	52%	2,555	62%
1945	4,133	3,394	82%	3,354	81%	3,375	82%
1946	4,133	3,795	92%	3,283	79%	3,557	86%
1947	4,133	1,697	41%	2,004	48%	1,839	45%
1948	4,133	3,256	79%	2,393	58%	2,854	69%
1949	4,133	1,387	34%	1,504	36%	1,441	35%
1950	4,133	2,738	66%	2,569	62%	2,660	64%
1951	4,133	4,133	100%	3,983	96%	4,063	98%
1952	3,898	3,907	95%	3,907	95%	3,907	95%
1953	4,133	4,091	99%	3,164	77%	3,660	89%
1954	4,133	3,079	74%	2,795	68%	2,947	71%
1955	4,133	980	24%	967	23%	974	24%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	2,460	60%	2,002	48%	2,247	54%
1958	4,133	4,133	100%	4,132	100%	4,133	100%
1959	4,133	3,219	78%	2,268	55%	2,777	67%
1960	4,133	1,557	38%	2,077	50%	1,799	44%
1961	4,133	2,746	66%	2,092	51%	2,442	59%
1962	4,133	3,016	73%	2,962	72%	2,991	72%
1963	4,133	3,923	95%	3,629	88%	3,786	92%
1964	4,133	1,605	39%	1,557	38%	1,583	38%
1965	4,133	3,368	81%	3,285	79%	3,329	81%

Table B.4 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions GFDL Model with A2 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		GFDL with A2 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,476	84%	2,984	72%	3,247	79%
1967	4,133	4,133	100%	4,133	100%	4,133	100%
1968	4,133	2,988	72%	2,614	63%	2,814	68%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	3,971	96%	4,058	98%
1971	4,133	3,665	89%	3,456	84%	3,568	86%
1972	4,133	1,458	35%	1,563	38%	1,507	36%
1973	4,133	4,133	100%	3,571	86%	3,872	94%
1974	4,133	4,133	100%	4,133	100%	4,133	100%
1975	4,133	3,624	88%	3,179	77%	3,417	83%
1976	4,133	2,167	52%	1,720	42%	1,959	47%
1977	4,133	287	7%	332	8%	308	7%
1978	3,898	3,905	94%	3,904	94%	3,905	94%
1979	4,133	3,292	80%	2,937	71%	3,127	76%
1980	3,898	3,766	91%	3,492	84%	3,639	88%
1981	4,133	2,737	66%	2,535	61%	2,643	64%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,025	97%	4,083	99%
1985	4,133	3,226	78%	2,518	61%	2,897	70%
1986	3,898	2,863	69%	2,957	72%	2,907	70%
1987	4,133	2,679	65%	2,551	62%	2,619	63%
1988	4,133	450	11%	628	15%	533	13%
1989	4,133	3,486	84%	3,060	74%	3,288	80%
1990	4,133	281	7%	514	12%	389	9%
1991	4,133	889	22%	869	21%	880	21%
1992	4,133	1,124	27%	1,091	26%	1,109	27%
1993	4,133	4,036	98%	3,989	97%	4,014	97%
1994	4,133	1,866	45%	1,193	29%	1,553	38%
1995	3,898	3,903	94%	3,903	94%	3,903	94%
1996	4,133	4,133	100%	3,653	88%	3,910	95%
1997	4,133	3,301	80%	3,235	78%	3,271	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	3,777	91%	3,967	96%
2000	4,133	3,960	96%	3,264	79%	3,636	88%
2001	4,133	769	19%	872	21%	817	20%
2002	4,133	2,586	63%	2,387	58%	2,493	60%
2003	4,133	3,213	78%	3,224	78%	3,218	78%
Avg	**4,106**	**2,947**	**71%**	**2,729**	**66%**	**2,846**	**69%**
Min	**3,898**	**281**	**7%**	**332**	**8%**	**308**	**7%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

1/ See Table 6.3 2/ Values used to describe Future Conditions in Chapter 6 3/ 4,133 taf/year

Table B.5 SWP Table A from the Delta under Future (2027) Conditions
GFDL Model with A2 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		GFDL with A2 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	3,664	89%	3,597	87%	3,633	88%
1923	4,133	2,991	72%	2,312	56%	2,676	65%
1924	4,133	125	3%	437	11%	270	7%
1925	4,133	1,565	38%	1,350	33%	1,465	35%
1926	4,133	1,968	48%	1,727	42%	1,856	45%
1927	4,133	3,706	90%	3,688	89%	3,697	89%
1928	4,133	1,895	46%	1,754	42%	1,829	44%
1929	4,133	646	16%	702	17%	672	16%
1930	4,133	2,114	51%	2,461	60%	2,275	55%
1931	4,133	1,046	25%	804	19%	934	23%
1932	4,133	1,165	28%	1,350	33%	1,251	30%
1933	4,133	1,915	46%	885	21%	1,436	35%
1934	4,133	1,427	35%	1,315	32%	1,375	33%
1935	4,133	3,087	75%	2,933	71%	3,015	73%
1936	4,133	2,959	72%	3,552	86%	3,235	78%
1937	4,133	3,774	91%	2,391	58%	3,131	76%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,158	76%	2,237	54%	2,730	66%
1940	4,133	3,136	76%	3,317	80%	3,220	78%
1941	3,898	3,798	92%	3,532	85%	3,674	89%
1942	4,133	3,626	88%	3,192	77%	3,424	83%
1943	4,133	3,466	84%	3,498	85%	3,481	84%
1944	4,133	2,550	62%	1,627	39%	2,121	51%
1945	4,133	3,315	80%	3,442	83%	3,374	82%
1946	4,133	3,430	83%	3,007	73%	3,233	78%
1947	4,133	1,819	44%	1,588	38%	1,711	41%
1948	4,133	2,891	70%	2,343	57%	2,636	64%
1949	4,133	1,096	27%	1,127	27%	1,110	27%
1950	4,133	2,232	54%	2,339	57%	2,282	55%
1951	4,133	4,133	100%	3,991	97%	4,067	98%
1952	3,898	3,907	95%	3,876	94%	3,893	94%
1953	4,133	3,163	77%	2,476	60%	2,843	69%
1954	4,133	3,034	73%	2,505	61%	2,788	67%
1955	4,133	998	24%	854	21%	931	23%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	1,991	48%	1,770	43%	1,888	46%
1958	4,133	4,133	100%	3,627	88%	3,898	94%
1959	4,133	2,933	71%	2,399	58%	2,684	65%
1960	4,133	1,237	30%	1,680	41%	1,443	35%
1961	4,133	2,492	60%	2,077	50%	2,299	56%
1962	4,133	3,124	76%	2,927	71%	3,033	73%
1963	4,133	3,119	75%	2,835	69%	2,987	72%
1964	4,133	2,189	53%	1,864	45%	2,038	49%
1965	4,133	2,979	72%	3,041	74%	3,008	73%

Table B.5 cont SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with A2 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		GFDL with A2 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,376	82%	2,624	63%	3,026	73%
1967	4,133	4,047	98%	4,133	100%	4,087	99%
1968	4,133	2,368	57%	2,083	50%	2,235	54%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	3,645	88%	3,906	95%
1971	4,133	3,124	76%	3,117	75%	3,121	76%
1972	4,133	1,487	36%	1,463	35%	1,476	36%
1973	4,133	3,455	84%	2,916	71%	3,204	78%
1974	4,133	3,748	91%	3,850	93%	3,795	92%
1975	4,133	3,232	78%	2,602	63%	2,939	71%
1976	4,133	1,632	39%	1,866	45%	1,741	42%
1977	4,133	278	7%	279	7%	278	7%
1978	3,898	3,905	94%	3,904	94%	3,904	94%
1979	4,133	3,044	74%	2,635	64%	2,853	69%
1980	3,898	3,905	94%	3,584	87%	3,756	91%
1981	4,133	2,545	62%	2,298	56%	2,430	59%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,119	100%	4,127	100%
1985	4,133	3,030	73%	2,314	56%	2,697	65%
1986	3,898	2,841	69%	2,964	72%	2,898	70%
1987	4,133	2,280	55%	2,067	50%	2,181	53%
1988	4,133	427	10%	738	18%	572	14%
1989	4,133	3,197	77%	2,811	68%	3,017	73%
1990	4,133	191	5%	293	7%	238	6%
1991	4,133	733	18%	700	17%	718	17%
1992	4,133	1,100	27%	1,078	26%	1,090	26%
1993	4,133	3,504	85%	3,684	89%	3,588	87%
1994	4,133	2,283	55%	1,237	30%	1,797	43%
1995	3,898	3,902	94%	3,903	94%	3,903	94%
1996	4,133	3,604	87%	3,383	82%	3,501	85%
1997	4,133	3,211	78%	3,344	81%	3,273	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	3,544	86%	3,859	93%
2000	4,133	3,316	80%	2,874	70%	3,110	75%
2001	4,133	982	24%	771	19%	884	21%
2002	4,133	2,063	50%	2,074	50%	2,068	50%
2003	4,133	2,836	69%	2,819	68%	2,828	68%
Avg	**4,106**	**2,734**	**66%**	**2,540**	**61%**	**2,643**	**64%**
Min	**3,898**	**125**	**3%**	**279**	**7%**	**238**	**6%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

[1]/ See Table 6.3 [2]/ Values used to describe Future Conditions in Chapter 6 [3]/ 4,133 taf/year

Table B.6 SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with B1 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		GFDL with B1 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	4,057	98%	3,945	95%	4,005	97%
1923	4,133	3,114	75%	2,000	48%	2,596	63%
1924	4,133	438	11%	797	19%	605	15%
1925	4,133	1,628	39%	1,455	35%	1,548	37%
1926	4,133	2,414	58%	1,893	46%	2,172	53%
1927	4,133	4,133	100%	3,772	91%	3,965	96%
1928	4,133	2,109	51%	2,098	51%	2,104	51%
1929	4,133	847	20%	997	24%	917	22%
1930	4,133	2,357	57%	2,055	50%	2,217	54%
1931	4,133	1,098	27%	1,099	27%	1,098	27%
1932	4,133	1,512	37%	1,367	33%	1,445	35%
1933	4,133	2,274	55%	1,219	29%	1,783	43%
1934	4,133	1,327	32%	1,452	35%	1,385	34%
1935	4,133	3,734	90%	3,366	81%	3,563	86%
1936	4,133	3,569	86%	3,125	76%	3,363	81%
1937	4,133	3,510	85%	2,225	54%	2,912	70%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,527	85%	2,620	63%	3,105	75%
1940	4,133	3,642	88%	3,565	86%	3,606	87%
1941	3,898	3,908	95%	3,907	95%	3,907	95%
1942	4,133	4,133	100%	3,494	85%	3,836	93%
1943	4,133	3,849	93%	3,567	86%	3,718	90%
1944	4,133	2,924	71%	2,070	50%	2,527	61%
1945	4,133	3,394	82%	2,823	68%	3,128	76%
1946	4,133	3,795	92%	3,449	83%	3,634	88%
1947	4,133	1,697	41%	1,910	46%	1,796	43%
1948	4,133	3,256	79%	2,427	59%	2,870	69%
1949	4,133	1,387	34%	1,397	34%	1,392	34%
1950	4,133	2,738	66%	2,514	61%	2,634	64%
1951	4,133	4,133	100%	4,012	97%	4,077	99%
1952	3,898	3,907	95%	3,907	95%	3,907	95%
1953	4,133	4,091	99%	3,136	76%	3,647	88%
1954	4,133	3,079	74%	2,965	72%	3,026	73%
1955	4,133	980	24%	954	23%	968	23%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	2,460	60%	1,973	48%	2,234	54%
1958	4,133	4,133	100%	4,132	100%	4,133	100%
1959	4,133	3,219	78%	2,330	56%	2,805	68%
1960	4,133	1,557	38%	1,809	44%	1,674	41%
1961	4,133	2,746	66%	2,308	56%	2,542	62%
1962	4,133	3,016	73%	2,937	71%	2,979	72%
1963	4,133	3,923	95%	3,710	90%	3,824	93%
1964	4,133	1,605	39%	1,554	38%	1,581	38%
1965	4,133	3,368	81%	3,277	79%	3,326	80%

Table B.6 cont SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with B1 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		GFDL with B1 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,476	84%	2,895	70%	3,206	78%
1967	4,133	4,133	100%	4,133	100%	4,133	100%
1968	4,133	2,988	72%	2,570	62%	2,794	68%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	4,010	97%	4,076	99%
1971	4,133	3,665	89%	3,525	85%	3,600	87%
1972	4,133	1,458	35%	1,564	38%	1,507	36%
1973	4,133	4,133	100%	3,574	86%	3,873	94%
1974	4,133	4,133	100%	3,807	92%	3,981	96%
1975	4,133	3,624	88%	3,020	73%	3,343	81%
1976	4,133	2,167	52%	2,113	51%	2,142	52%
1977	4,133	287	7%	306	7%	296	7%
1978	3,898	3,905	94%	3,905	94%	3,905	94%
1979	4,133	3,292	80%	2,612	63%	2,976	72%
1980	3,898	3,766	91%	3,515	85%	3,649	88%
1981	4,133	2,737	66%	2,498	60%	2,626	64%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,057	98%	4,098	99%
1985	4,133	3,226	78%	2,471	60%	2,875	70%
1986	3,898	2,863	69%	2,976	72%	2,915	71%
1987	4,133	2,679	65%	2,378	58%	2,539	61%
1988	4,133	450	11%	602	15%	521	13%
1989	4,133	3,486	84%	3,225	78%	3,365	81%
1990	4,133	281	7%	484	12%	376	9%
1991	4,133	889	22%	924	22%	905	22%
1992	4,133	1,124	27%	1,014	25%	1,073	26%
1993	4,133	4,036	98%	3,975	96%	4,007	97%
1994	4,133	1,866	45%	1,169	28%	1,542	37%
1995	3,898	3,903	94%	3,903	94%	3,903	94%
1996	4,133	4,133	100%	3,579	87%	3,875	94%
1997	4,133	3,301	80%	3,244	78%	3,275	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	3,812	92%	3,984	96%
2000	4,133	3,960	96%	3,061	74%	3,542	86%
2001	4,133	769	19%	874	21%	818	20%
2002	4,133	2,586	63%	2,264	55%	2,436	59%
2003	4,133	3,213	78%	3,327	81%	3,266	79%
Avg	**4,106**	**2,947**	**71%**	**2,696**	**65%**	**2,830**	**68%**
Min	**3,898**	**281**	**7%**	**306**	**7%**	**296**	**7%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

1/ See Table 6.3   2/ Values used to describe Future Conditions in Chapter 6   3/ 4,133 taf/year

Table B.7 SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with B1 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		GFDL with B1 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	3,664	89%	3,556	86%	3,614	87%
1923	4,133	2,991	72%	2,293	55%	2,666	65%
1924	4,133	125	3%	301	7%	207	5%
1925	4,133	1,565	38%	1,363	33%	1,471	36%
1926	4,133	1,968	48%	1,561	38%	1,779	43%
1927	4,133	3,706	90%	3,632	88%	3,671	89%
1928	4,133	1,895	46%	1,757	43%	1,831	44%
1929	4,133	646	16%	768	19%	703	17%
1930	4,133	2,114	51%	2,048	50%	2,083	50%
1931	4,133	1,046	25%	889	22%	973	24%
1932	4,133	1,165	28%	1,352	33%	1,252	30%
1933	4,133	1,915	46%	892	22%	1,439	35%
1934	4,133	1,427	35%	1,181	29%	1,313	32%
1935	4,133	3,087	75%	2,839	69%	2,972	72%
1936	4,133	2,959	72%	2,894	70%	2,929	71%
1937	4,133	3,774	91%	2,132	52%	3,010	73%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,158	76%	2,358	57%	2,786	67%
1940	4,133	3,136	76%	3,075	74%	3,108	75%
1941	3,898	3,798	92%	3,433	83%	3,628	88%
1942	4,133	3,626	88%	3,107	75%	3,384	82%
1943	4,133	3,466	84%	3,499	85%	3,481	84%
1944	4,133	2,550	62%	1,547	37%	2,083	50%
1945	4,133	3,315	80%	3,018	73%	3,177	77%
1946	4,133	3,430	83%	3,166	77%	3,307	80%
1947	4,133	1,819	44%	1,484	36%	1,663	40%
1948	4,133	2,891	70%	2,426	59%	2,675	65%
1949	4,133	1,096	27%	1,085	26%	1,090	26%
1950	4,133	2,232	54%	2,162	52%	2,200	53%
1951	4,133	4,133	100%	3,928	95%	4,038	98%
1952	3,898	3,907	95%	3,841	93%	3,876	94%
1953	4,133	3,163	77%	2,539	61%	2,872	70%
1954	4,133	3,034	73%	2,683	65%	2,871	69%
1955	4,133	998	24%	838	20%	924	22%
1956	4,133	4,133	100%	4,040	98%	4,090	99%
1957	4,133	1,991	48%	1,796	43%	1,900	46%
1958	4,133	4,133	100%	3,720	90%	3,941	95%
1959	4,133	2,933	71%	2,347	57%	2,660	64%
1960	4,133	1,237	30%	1,291	31%	1,263	31%
1961	4,133	2,492	60%	2,313	56%	2,409	58%
1962	4,133	3,124	76%	2,786	67%	2,967	72%
1963	4,133	3,119	75%	3,101	75%	3,111	75%
1964	4,133	2,189	53%	1,676	41%	1,951	47%
1965	4,133	2,979	72%	3,063	74%	3,018	73%

Table B.7 cont SWP Table A deliveries from the Delta under Future (2027) Conditions
GFDL Model with B1 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		GFDL with B1 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,376	82%	2,551	62%	2,992	72%
1967	4,133	4,047	98%	4,006	97%	4,028	97%
1968	4,133	2,368	57%	2,121	51%	2,253	55%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	3,736	90%	3,948	96%
1971	4,133	3,124	76%	3,117	75%	3,121	76%
1972	4,133	1,487	36%	1,460	35%	1,475	36%
1973	4,133	3,455	84%	2,949	71%	3,219	78%
1974	4,133	3,748	91%	3,622	88%	3,689	89%
1975	4,133	3,232	78%	2,665	64%	2,968	72%
1976	4,133	1,632	39%	1,969	48%	1,789	43%
1977	4,133	278	7%	280	7%	279	7%
1978	3,898	3,905	94%	3,905	94%	3,905	94%
1979	4,133	3,044	74%	2,117	51%	2,613	63%
1980	3,898	3,905	94%	3,622	88%	3,773	91%
1981	4,133	2,545	62%	1,974	48%	2,280	55%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,013	97%	4,078	99%
1985	4,133	3,030	73%	2,281	55%	2,681	65%
1986	3,898	2,841	69%	3,046	74%	2,936	71%
1987	4,133	2,280	55%	1,865	45%	2,087	50%
1988	4,133	427	10%	689	17%	549	13%
1989	4,133	3,197	77%	3,064	74%	3,135	76%
1990	4,133	191	5%	198	5%	194	5%
1991	4,133	733	18%	681	16%	709	17%
1992	4,133	1,100	27%	1,010	24%	1,058	26%
1993	4,133	3,504	85%	3,614	87%	3,555	86%
1994	4,133	2,283	55%	1,154	28%	1,758	43%
1995	3,898	3,902	94%	3,903	94%	3,903	94%
1996	4,133	3,604	87%	2,991	72%	3,319	80%
1997	4,133	3,211	78%	3,352	81%	3,276	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	3,348	81%	3,768	91%
2000	4,133	3,316	80%	2,900	70%	3,123	76%
2001	4,133	982	24%	635	15%	821	20%
2002	4,133	2,063	50%	2,064	50%	2,063	50%
2003	4,133	2,836	69%	2,879	70%	2,856	69%
Avg	**4,106**	**2,734**	**66%**	**2,482**	**60%**	**2,617**	**63%**
Min	**3,898**	**125**	**3%**	**198**	**5%**	**194**	**5%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

[1]/ See Table 6.3 [2]/ Values used to describe Future Conditions in Chapter 6 [3]/ 4,133 taf/year

Table B.8 SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with A2 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		PCM with A2 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	4,057	98%	4,062	98%	4,060	98%
1923	4,133	3,114	75%	2,377	58%	2,771	67%
1924	4,133	438	11%	568	14%	498	12%
1925	4,133	1,628	39%	1,473	36%	1,556	38%
1926	4,133	2,414	58%	1,907	46%	2,178	53%
1927	4,133	4,133	100%	4,107	99%	4,133	100%
1928	4,133	2,109	51%	1,909	46%	2,016	49%
1929	4,133	847	20%	970	23%	904	22%
1930	4,133	2,357	57%	1,974	48%	2,179	53%
1931	4,133	1,098	27%	1,164	28%	1,128	27%
1932	4,133	1,512	37%	1,353	33%	1,438	35%
1933	4,133	2,274	55%	1,378	33%	1,857	45%
1934	4,133	1,327	32%	1,381	33%	1,352	33%
1935	4,133	3,734	90%	3,527	85%	3,638	88%
1936	4,133	3,569	86%	3,562	86%	3,566	86%
1937	4,133	3,510	85%	2,518	61%	3,049	74%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,527	85%	2,997	73%	3,280	79%
1940	4,133	3,642	88%	3,834	93%	3,731	90%
1941	3,898	3,908	95%	3,906	95%	3,907	95%
1942	4,133	4,133	100%	3,805	92%	3,981	96%
1943	4,133	3,849	93%	3,587	87%	3,727	90%
1944	4,133	2,924	71%	2,058	50%	2,521	61%
1945	4,133	3,394	82%	3,896	94%	3,627	88%
1946	4,133	3,795	92%	3,080	75%	3,463	84%
1947	4,133	1,697	41%	1,704	41%	1,700	41%
1948	4,133	3,256	79%	2,786	67%	3,037	73%
1949	4,133	1,387	34%	1,370	33%	1,379	33%
1950	4,133	2,738	66%	2,810	68%	2,771	67%
1951	4,133	4,133	100%	4,133	100%	4,133	100%
1952	3,898	3,907	95%	3,907	95%	3,907	95%
1953	4,133	4,091	99%	3,373	82%	3,757	91%
1954	4,133	3,079	74%	2,962	72%	3,025	73%
1955	4,133	980	24%	929	22%	956	23%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	2,460	60%	1,945	47%	2,221	54%
1958	4,133	4,133	100%	4,133	100%	4,133	100%
1959	4,133	3,219	78%	2,489	60%	2,880	70%
1960	4,133	1,557	38%	1,874	45%	1,705	41%
1961	4,133	2,746	66%	2,627	64%	2,691	65%
1962	4,133	3,016	73%	2,902	70%	2,963	72%
1963	4,133	3,923	95%	3,687	89%	3,813	92%
1964	4,133	1,605	39%	1,535	37%	1,572	38%
1965	4,133	3,368	81%	3,225	78%	3,301	80%

Table B.8 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with A2 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		PCM with A2 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,476	84%	3,208	78%	3,352	81%
1967	4,133	4,133	100%	4,133	100%	4,133	100%
1968	4,133	2,988	72%	2,743	66%	2,874	70%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	4,133	100%	4,133	100%
1971	4,133	3,665	89%	3,452	84%	3,566	86%
1972	4,133	1,458	35%	1,422	34%	1,441	35%
1973	4,133	4,133	100%	3,758	91%	3,959	96%
1974	4,133	4,133	100%	4,133	100%	4,133	100%
1975	4,133	3,624	88%	3,404	82%	3,521	85%
1976	4,133	2,167	52%	2,000	48%	2,089	51%
1977	4,133	287	7%	274	7%	281	7%
1978	3,898	3,905	94%	3,903	94%	3,904	94%
1979	4,133	3,292	80%	3,056	74%	3,182	77%
1980	3,898	3,766	91%	3,491	84%	3,638	88%
1981	4,133	2,737	66%	2,570	62%	2,659	64%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,133	100%	4,133	100%
1985	4,133	3,226	78%	2,581	62%	2,926	71%
1986	3,898	2,863	69%	3,004	73%	2,928	71%
1987	4,133	2,679	65%	2,567	62%	2,627	64%
1988	4,133	450	11%	446	11%	448	11%
1989	4,133	3,486	84%	3,424	83%	3,457	84%
1990	4,133	281	7%	377	9%	325	8%
1991	4,133	889	22%	875	21%	883	21%
1992	4,133	1,124	27%	1,090	26%	1,108	27%
1993	4,133	4,036	98%	4,057	98%	4,046	98%
1994	4,133	1,866	45%	1,494	36%	1,693	41%
1995	3,898	3,903	94%	3,903	94%	3,903	94%
1996	4,133	4,133	100%	3,813	92%	3,984	96%
1997	4,133	3,301	80%	3,199	77%	3,254	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	3,960	96%	4,052	98%
2000	4,133	3,960	96%	3,602	87%	3,794	92%
2001	4,133	769	19%	824	20%	795	19%
2002	4,133	2,586	63%	1,996	48%	2,312	56%
2003	4,133	3,213	78%	3,241	78%	3,226	78%
Avg	**4,106**	**2,947**	**71%**	**2,782**	**67%**	**2,870**	**69%**
Min	**3,898**	**281**	**7%**	**274**	**7%**	**281**	**7%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

[1]/ See Table 6.3 [2]/ Values used to describe Future Conditions in Chapter 6 [3]/ 4,133 taf/year

Table B.9 SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with A2 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		PCM with A2 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	3,664	89%	3,545	86%	3,609	87%
1923	4,133	2,991	72%	2,850	69%	2,925	71%
1924	4,133	125	3%	150	4%	137	3%
1925	4,133	1,565	38%	1,394	34%	1,485	36%
1926	4,133	1,968	48%	1,463	35%	1,733	42%
1927	4,133	3,706	90%	3,736	90%	3,720	90%
1928	4,133	1,895	46%	1,701	41%	1,805	44%
1929	4,133	646	16%	712	17%	677	16%
1930	4,133	2,114	51%	1,849	45%	1,991	48%
1931	4,133	1,046	25%	1,051	25%	1,049	25%
1932	4,133	1,165	28%	1,286	31%	1,222	30%
1933	4,133	1,915	46%	1,172	28%	1,569	38%
1934	4,133	1,427	35%	1,264	31%	1,351	33%
1935	4,133	3,087	75%	3,437	83%	3,250	79%
1936	4,133	2,959	72%	3,265	79%	3,101	75%
1937	4,133	3,774	91%	2,662	64%	3,257	79%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,158	76%	2,727	66%	2,958	72%
1940	4,133	3,136	76%	3,226	78%	3,178	77%
1941	3,898	3,798	92%	3,826	93%	3,811	92%
1942	4,133	3,626	88%	3,421	83%	3,531	85%
1943	4,133	3,466	84%	3,754	91%	3,600	87%
1944	4,133	2,550	62%	1,272	31%	1,955	47%
1945	4,133	3,315	80%	4,000	97%	3,634	88%
1946	4,133	3,430	83%	2,729	66%	3,104	75%
1947	4,133	1,819	44%	1,441	35%	1,643	40%
1948	4,133	2,891	70%	2,535	61%	2,726	66%
1949	4,133	1,096	27%	1,068	26%	1,083	26%
1950	4,133	2,232	54%	1,992	48%	2,120	51%
1951	4,133	4,133	100%	4,133	100%	4,133	100%
1952	3,898	3,907	95%	3,906	95%	3,906	95%
1953	4,133	3,163	77%	2,660	64%	2,929	71%
1954	4,133	3,034	73%	2,938	71%	2,989	72%
1955	4,133	998	24%	676	16%	848	21%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	1,991	48%	1,760	43%	1,883	46%
1958	4,133	4,133	100%	4,133	100%	4,133	100%
1959	4,133	2,933	71%	2,481	60%	2,722	66%
1960	4,133	1,237	30%	1,522	37%	1,370	33%
1961	4,133	2,492	60%	2,162	52%	2,339	57%
1962	4,133	3,124	76%	3,127	76%	3,126	76%
1963	4,133	3,119	75%	3,065	74%	3,094	75%
1964	4,133	2,189	53%	1,582	38%	1,907	46%
1965	4,133	2,979	72%	2,955	72%	2,968	72%

Table B.9 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with A2 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		PCM with A2 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,376	82%	2,891	70%	3,150	76%
1967	4,133	4,047	98%	4,110	99%	4,077	99%
1968	4,133	2,368	57%	2,085	50%	2,236	54%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	4,133	100%	4,133	100%
1971	4,133	3,124	76%	3,090	75%	3,108	75%
1972	4,133	1,487	36%	1,408	34%	1,450	35%
1973	4,133	3,455	84%	3,275	79%	3,371	82%
1974	4,133	3,748	91%	3,684	89%	3,718	90%
1975	4,133	3,232	78%	3,000	73%	3,124	76%
1976	4,133	1,632	39%	1,558	38%	1,598	39%
1977	4,133	278	7%	248	6%	264	6%
1978	3,898	3,905	94%	3,904	94%	3,904	94%
1979	4,133	3,044	74%	2,768	67%	2,915	71%
1980	3,898	3,905	94%	3,893	94%	3,899	94%
1981	4,133	2,545	62%	2,169	52%	2,370	57%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,133	100%	4,133	100%
1985	4,133	3,030	73%	2,420	59%	2,746	66%
1986	3,898	2,841	69%	3,253	79%	3,032	73%
1987	4,133	2,280	55%	1,709	41%	2,014	49%
1988	4,133	427	10%	636	15%	524	13%
1989	4,133	3,197	77%	3,184	77%	3,191	77%
1990	4,133	191	5%	177	4%	184	4%
1991	4,133	733	18%	626	15%	683	17%
1992	4,133	1,100	27%	1,047	25%	1,075	26%
1993	4,133	3,504	85%	3,554	86%	3,527	85%
1994	4,133	2,283	55%	1,372	33%	1,859	45%
1995	3,898	3,902	94%	3,903	94%	3,903	94%
1996	4,133	3,604	87%	3,661	89%	3,631	88%
1997	4,133	3,211	78%	3,287	80%	3,246	79%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	4,112	99%	4,123	100%
2000	4,133	3,316	80%	3,237	78%	3,279	79%
2001	4,133	982	24%	617	15%	812	20%
2002	4,133	2,063	50%	1,845	45%	1,961	47%
2003	4,133	2,836	69%	2,831	69%	2,834	69%
Avg	**4,106**	**2,734**	**66%**	**2,592**	**63%**	**2,668**	**65%**
Min	**3,898**	**125**	**3%**	**150**	**4%**	**137**	**3%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	4,133	100%

[1]/ See Table 6.3 [2]/ Values used to describe Future Conditions in Chapter 6 [3]/ 4,133 taf/year

Table B.10 SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with B1 Emissions and less restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Lower flow target scenario[1]		PCM with B1 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	4,057	98%	4,132	100%	4,092	99%
1923	4,133	3,114	75%	3,064	74%	3,091	75%
1924	4,133	438	11%	295	7%	371	9%
1925	4,133	1,628	39%	1,821	44%	1,718	42%
1926	4,133	2,414	58%	2,070	50%	2,254	55%
1927	4,133	4,133	100%	4,032	98%	4,086	99%
1928	4,133	2,109	51%	2,273	55%	2,186	53%
1929	4,133	847	20%	1,058	26%	945	23%
1930	4,133	2,357	57%	2,233	54%	2,299	56%
1931	4,133	1,098	27%	1,167	28%	1,130	27%
1932	4,133	1,512	37%	1,638	40%	1,570	38%
1933	4,133	2,274	55%	2,415	58%	2,340	57%
1934	4,133	1,327	32%	1,323	32%	1,325	32%
1935	4,133	3,734	90%	3,831	93%	3,779	91%
1936	4,133	3,569	86%	3,649	88%	3,606	87%
1937	4,133	3,510	85%	3,137	76%	3,337	81%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,527	85%	3,283	79%	3,414	83%
1940	4,133	3,642	88%	3,929	95%	3,775	91%
1941	3,898	3,908	95%	3,907	95%	3,907	95%
1942	4,133	4,133	100%	4,133	100%	4,133	100%
1943	4,133	3,849	93%	3,682	89%	3,772	91%
1944	4,133	2,924	71%	2,964	72%	2,943	71%
1945	4,133	3,394	82%	3,743	91%	3,556	86%
1946	4,133	3,795	92%	3,494	85%	3,655	88%
1947	4,133	1,697	41%	1,817	44%	1,752	42%
1948	4,133	3,256	79%	3,345	81%	3,297	80%
1949	4,133	1,387	34%	1,559	38%	1,467	35%
1950	4,133	2,738	66%	2,896	70%	2,812	68%
1951	4,133	4,133	100%	4,133	100%	4,133	100%
1952	3,898	3,907	95%	3,907	95%	3,907	95%
1953	4,133	4,091	99%	3,727	90%	3,922	95%
1954	4,133	3,079	74%	3,306	80%	3,184	77%
1955	4,133	980	24%	1,074	26%	1,024	25%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	2,460	60%	2,424	59%	2,443	59%
1958	4,133	4,133	100%	4,133	100%	4,133	100%
1959	4,133	3,219	78%	3,175	77%	3,199	77%
1960	4,133	1,557	38%	1,911	46%	1,722	42%
1961	4,133	2,746	66%	2,540	61%	2,650	64%
1962	4,133	3,016	73%	3,519	85%	3,250	79%
1963	4,133	3,923	95%	3,314	80%	3,640	88%
1964	4,133	1,605	39%	2,055	50%	1,814	44%
1965	4,133	3,368	81%	3,325	80%	3,348	81%

Table B.10 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with B1 Emissions and less restrictive Old River and Middle River flow targets

		No Climate Change Lower flow target scenario[1]		PCM with B1 Emissions Lower flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
Year	SWP Table A demands (taf)	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,476	84%	3,497	85%	3,486	84%
1967	4,133	4,133	100%	4,133	100%	4,133	100%
1968	4,133	2,988	72%	2,991	72%	2,990	72%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	4,133	100%	4,133	100%
1971	4,133	3,665	89%	3,651	88%	3,658	89%
1972	4,133	1,458	35%	1,525	37%	1,489	36%
1973	4,133	4,133	100%	3,847	93%	4,000	97%
1974	4,133	4,133	100%	4,133	100%	4,133	100%
1975	4,133	3,624	88%	3,776	91%	3,695	89%
1976	4,133	2,167	52%	2,296	56%	2,227	54%
1977	4,133	287	7%	315	8%	300	7%
1978	3,898	3,905	94%	3,905	94%	3,905	94%
1979	4,133	3,292	80%	3,462	84%	3,371	82%
1980	3,898	3,766	91%	3,596	87%	3,687	89%
1981	4,133	2,737	66%	2,745	66%	2,740	66%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,133	100%	4,133	100%
1985	4,133	3,226	78%	3,369	82%	3,293	80%
1986	3,898	2,863	69%	2,726	66%	2,799	68%
1987	4,133	2,679	65%	2,520	61%	2,605	63%
1988	4,133	450	11%	521	13%	483	12%
1989	4,133	3,486	84%	3,526	85%	3,504	85%
1990	4,133	281	7%	466	11%	367	9%
1991	4,133	889	22%	1,052	25%	965	23%
1992	4,133	1,124	27%	1,380	33%	1,243	30%
1993	4,133	4,036	98%	3,943	95%	3,993	97%
1994	4,133	1,866	45%	1,884	46%	1,874	45%
1995	3,898	3,903	94%	3,903	94%	3,903	94%
1996	4,133	4,133	100%	3,893	94%	4,021	97%
1997	4,133	3,301	80%	3,285	79%	3,294	80%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	4,068	98%	4,103	99%
2000	4,133	3,960	96%	3,858	93%	3,913	95%
2001	4,133	769	19%	1,017	25%	884	21%
2002	4,133	2,586	63%	2,605	63%	2,595	63%
2003	4,133	3,213	78%	3,188	77%	3,201	77%
Avg	**4,106**	**2,947**	**71%**	**2,962**	**72%**	**2,954**	**71%**
Min	**3,898**	**281**	**7%**	**295**	**7%**	**300**	**7%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

[1]/ See Table 6.3 [2]/ Values used to describe Future Conditions in Chapter 6 [3]/ 4,133 taf/year

Table B.11 SWP Table A deliveries from the Delta under Future (2027) Conditions
PCM Model with B1 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		PCM with B1 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1922	4,133	3,664	89%	3,626	88%	3,647	88%
1923	4,133	2,991	72%	3,082	75%	3,033	73%
1924	4,133	125	3%	178	4%	150	4%
1925	4,133	1,565	38%	1,789	43%	1,669	40%
1926	4,133	1,968	48%	1,966	48%	1,967	48%
1927	4,133	3,706	90%	3,650	88%	3,680	89%
1928	4,133	1,895	46%	1,952	47%	1,921	46%
1929	4,133	646	16%	824	20%	729	18%
1930	4,133	2,114	51%	1,886	46%	2,008	49%
1931	4,133	1,046	25%	1,140	28%	1,090	26%
1932	4,133	1,165	28%	1,457	35%	1,301	31%
1933	4,133	1,915	46%	1,979	48%	1,944	47%
1934	4,133	1,427	35%	1,343	32%	1,388	34%
1935	4,133	3,087	75%	3,170	77%	3,126	76%
1936	4,133	2,959	72%	3,222	78%	3,081	75%
1937	4,133	3,774	91%	3,385	82%	3,593	87%
1938	4,133	4,133	100%	4,133	100%	4,133	100%
1939	4,133	3,158	76%	2,893	70%	3,035	73%
1940	4,133	3,136	76%	3,327	81%	3,225	78%
1941	3,898	3,798	92%	3,887	94%	3,839	93%
1942	4,133	3,626	88%	3,653	88%	3,639	88%
1943	4,133	3,466	84%	3,547	86%	3,503	85%
1944	4,133	2,550	62%	2,449	59%	2,503	61%
1945	4,133	3,315	80%	3,641	88%	3,467	84%
1946	4,133	3,430	83%	3,288	80%	3,364	81%
1947	4,133	1,819	44%	1,907	46%	1,860	45%
1948	4,133	2,891	70%	2,837	69%	2,866	69%
1949	4,133	1,096	27%	1,417	34%	1,245	30%
1950	4,133	2,232	54%	2,726	66%	2,462	60%
1951	4,133	4,133	100%	3,757	91%	3,958	96%
1952	3,898	3,907	95%	3,907	95%	3,907	95%
1953	4,133	3,163	77%	3,050	74%	3,110	75%
1954	4,133	3,034	73%	3,080	75%	3,056	74%
1955	4,133	998	24%	1,053	25%	1,024	25%
1956	4,133	4,133	100%	4,133	100%	4,133	100%
1957	4,133	1,991	48%	1,959	47%	1,976	48%
1958	4,133	4,133	100%	4,133	100%	4,133	100%
1959	4,133	2,933	71%	2,962	72%	2,946	71%
1960	4,133	1,237	30%	1,651	40%	1,430	35%
1961	4,133	2,492	60%	2,312	56%	2,408	58%
1962	4,133	3,124	76%	3,230	78%	3,174	77%
1963	4,133	3,119	75%	2,936	71%	3,034	73%
1964	4,133	2,189	53%	2,240	54%	2,213	54%
1965	4,133	2,979	72%	2,774	67%	2,884	70%

Table B.11 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions PCM Model with B1 Emissions and more restrictive Old River and Middle River flow targets

Year	SWP Table A demands (taf)	No Climate Change Higher flow target scenario[1]		PCM with B1 Emissions Higher flow target scenario[1]		Estimated Delivery Interpolated to 2027[2]	
		SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]	SWP Table A Delivery (taf)	percent of max SWP Table A[3]
1966	4,133	3,376	82%	3,376	82%	3,376	82%
1967	4,133	4,047	98%	4,050	98%	4,048	98%
1968	4,133	2,368	57%	2,357	57%	2,363	57%
1969	3,898	3,903	94%	3,903	94%	3,903	94%
1970	4,133	4,133	100%	4,133	100%	4,133	100%
1971	4,133	3,124	76%	3,149	76%	3,136	76%
1972	4,133	1,487	36%	1,503	36%	1,495	36%
1973	4,133	3,455	84%	3,381	82%	3,420	83%
1974	4,133	3,748	91%	3,837	93%	3,789	92%
1975	4,133	3,232	78%	3,211	78%	3,222	78%
1976	4,133	1,632	39%	1,631	39%	1,631	39%
1977	4,133	278	7%	284	7%	281	7%
1978	3,898	3,905	94%	3,905	94%	3,905	94%
1979	4,133	3,044	74%	3,002	73%	3,024	73%
1980	3,898	3,905	94%	3,855	93%	3,881	94%
1981	4,133	2,545	62%	2,549	62%	2,547	62%
1982	4,133	4,133	100%	4,133	100%	4,133	100%
1983	3,898	3,903	94%	3,903	94%	3,903	94%
1984	4,133	4,133	100%	4,133	100%	4,133	100%
1985	4,133	3,030	73%	3,035	73%	3,032	73%
1986	3,898	2,841	69%	2,775	67%	2,810	68%
1987	4,133	2,280	55%	2,379	58%	2,326	56%
1988	4,133	427	10%	484	12%	454	11%
1989	4,133	3,197	77%	3,351	81%	3,269	79%
1990	4,133	191	5%	449	11%	311	8%
1991	4,133	733	18%	826	20%	776	19%
1992	4,133	1,100	27%	1,152	28%	1,124	27%
1993	4,133	3,504	85%	3,434	83%	3,471	84%
1994	4,133	2,283	55%	2,228	54%	2,258	55%
1995	3,898	3,902	94%	3,903	94%	3,902	94%
1996	4,133	3,604	87%	3,647	88%	3,624	88%
1997	4,133	3,211	78%	3,380	82%	3,289	80%
1998	3,898	3,908	95%	3,908	95%	3,908	95%
1999	4,133	4,133	100%	4,133	100%	4,133	100%
2000	4,133	3,316	80%	3,408	82%	3,359	81%
2001	4,133	982	24%	1,050	25%	1,014	25%
2002	4,133	2,063	50%	2,176	53%	2,115	51%
2003	4,133	2,836	69%	2,803	68%	2,820	68%
Avg	**4,106**	**2,734**	**66%**	**2,760**	**67%**	**2,746**	**66%**
Min	**3,898**	**125**	**3%**	**178**	**4%**	**150**	**4%**
Max	**4,133**	**4,133**	**100%**	**4,133**	**100%**	**4,133**	**100%**

1/ See Table 6.3   2/ Values used to describe Future Conditions in Chapter 6   3/ 4,133 taf/year

Table B.12 SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve GFDL Model with A2 emissions

Year	deliveries derived from interpolating between "no climate change" and "GFDL + A2 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1922	4,062	3,633	3,848	93%	0%	1938	4,133	100%
1923	2,622	2,676	2,649	64%	1%	1956	4,133	100%
1924	583	270	427	10%	3%	1982	4,133	100%
1925	1,554	1,465	1,510	37%	4%	1967	4,110	99%
1926	2,291	1,856	2,074	50%	5%	1984	4,105	99%
1927	3,986	3,697	3,842	93%	6%	1951	4,065	98%
1928	2,133	1,829	1,981	48%	8%	1958	4,015	97%
1929	863	672	767	19%	9%	1970	3,982	96%
1930	2,410	2,275	2,343	57%	10%	1974	3,964	96%
1931	1,083	934	1,008	24%	11%	1999	3,913	95%
1932	1,437	1,251	1,344	33%	12%	1998	3,908	95%
1933	1,847	1,436	1,641	40%	14%	1978	3,905	94%
1934	1,320	1,375	1,348	33%	15%	1969	3,903	94%
1935	3,488	3,015	3,252	79%	16%	1983	3,903	94%
1936	3,622	3,235	3,428	83%	17%	1995	3,903	94%
1937	2,943	3,131	3,037	73%	19%	1952	3,900	94%
1938	4,133	4,133	4,133	100%	20%	1922	3,848	93%
1939	3,044	2,730	2,887	70%	21%	1927	3,842	93%
1940	3,691	3,220	3,456	84%	22%	1993	3,801	92%
1941	3,907	3,674	3,791	92%	24%	1941	3,791	92%
1942	3,900	3,424	3,662	89%	25%	1996	3,705	90%
1943	3,703	3,481	3,592	87%	26%	1980	3,697	89%
1944	2,555	2,121	2,338	57%	27%	1942	3,662	89%
1945	3,375	3,374	3,375	82%	28%	1943	3,592	87%
1946	3,557	3,233	3,395	82%	30%	1973	3,538	86%
1947	1,839	1,711	1,775	43%	31%	1940	3,456	84%
1948	2,854	2,636	2,745	66%	32%	1936	3,428	83%
1949	1,441	1,110	1,276	31%	33%	1946	3,395	82%
1950	2,660	2,282	2,471	60%	35%	1963	3,387	82%
1951	4,063	4,067	4,065	98%	36%	1945	3,375	82%
1952	3,907	3,893	3,900	94%	37%	2000	3,373	82%
1953	3,660	2,843	3,252	79%	38%	1971	3,344	81%
1954	2,947	2,788	2,867	69%	40%	1997	3,272	79%
1955	974	931	952	23%	41%	1953	3,252	79%
1956	4,133	4,133	4,133	100%	42%	1935	3,252	79%
1957	2,247	1,888	2,068	50%	43%	1975	3,178	77%
1958	4,133	3,898	4,015	97%	45%	1965	3,169	77%
1959	2,777	2,684	2,731	66%	46%	1989	3,153	76%
1960	1,799	1,443	1,621	39%	47%	1966	3,137	76%
1961	2,442	2,299	2,371	57%	48%	1937	3,037	73%
1962	2,991	3,033	3,012	73%	49%	2003	3,023	73%
1963	3,786	2,987	3,387	82%	51%	1962	3,012	73%
1964	1,583	2,038	1,810	44%	52%	1979	2,990	72%
1965	3,329	3,008	3,169	77%	53%	1986	2,902	70%

Table B.12 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve GFDL Model with A2 emissions

Year	deliveries derived from interpolating between "no climate change" and "GFDL +A2 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1966	3,247	3,026	3,137	76%	54%	1939	2,887	70%
1967	4,133	4,087	4,110	99%	56%	1954	2,867	69%
1968	2,814	2,235	2,525	61%	57%	1985	2,797	68%
1969	3,903	3,903	3,903	94%	58%	1948	2,745	66%
1970	4,058	3,906	3,982	96%	59%	1959	2,731	66%
1971	3,568	3,121	3,344	81%	61%	1923	2,649	64%
1972	1,507	1,476	1,491	36%	62%	1981	2,536	61%
1973	3,872	3,204	3,538	86%	63%	1968	2,525	61%
1974	4,133	3,795	3,964	96%	64%	1950	2,471	60%
1975	3,417	2,939	3,178	77%	66%	1987	2,400	58%
1976	1,959	1,741	1,850	45%	67%	1961	2,371	57%
1977	308	278	293	7%	68%	1930	2,343	57%
1978	3,905	3,904	3,905	94%	69%	1944	2,338	57%
1979	3,127	2,853	2,990	72%	70%	2002	2,281	55%
1980	3,639	3,756	3,697	89%	72%	1926	2,074	50%
1981	2,643	2,430	2,536	61%	73%	1957	2,068	50%
1982	4,133	4,133	4,133	100%	74%	1928	1,981	48%
1983	3,903	3,903	3,903	94%	75%	1976	1,850	45%
1984	4,083	4,127	4,105	99%	77%	1964	1,810	44%
1985	2,897	2,697	2,797	68%	78%	1947	1,775	43%
1986	2,907	2,898	2,902	70%	79%	1994	1,675	41%
1987	2,619	2,181	2,400	58%	80%	1933	1,641	40%
1988	533	572	552	13%	82%	1960	1,621	39%
1989	3,288	3,017	3,153	76%	83%	1925	1,510	37%
1990	389	238	314	8%	84%	1972	1,491	36%
1991	880	718	799	19%	85%	1934	1,348	33%
1992	1,109	1,090	1,099	27%	87%	1932	1,344	33%
1993	4,014	3,588	3,801	92%	88%	1949	1,276	31%
1994	1,553	1,797	1,675	41%	89%	1992	1,099	27%
1995	3,903	3,903	3,903	94%	90%	1931	1,008	24%
1996	3,910	3,501	3,705	90%	91%	1955	952	23%
1997	3,271	3,273	3,272	79%	93%	2001	850	21%
1998	3,908	3,908	3,908	95%	94%	1991	799	19%
1999	3,967	3,859	3,913	95%	95%	1929	767	19%
2000	3,636	3,110	3,373	82%	96%	1988	552	13%
2001	817	884	850	21%	98%	1924	427	10%
2002	2,493	2,068	2,281	55%	99%	1990	314	8%
2003	3,218	2,828	3,023	73%	100%	1977	293	7%
Avg	**2,846**	**2,643**	**2,745**	**66%**			**2,745**	
Min	**308**	**238**	**293**	**7%**			**293**	
Max	**4,133**	**4,133**	**4,133**	**100%**			**4,133**	

[1]/ See Table 6.3 [2]/ 4,133 taf/year

Table B.13 SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve GFDL Model with B1 Emissions

Year	deliveries derived from interpolating between "no climate change" and "GFDL + B1 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1922	4,005	3,614	3,810	92%	0%	1938	4,133	100%
1923	2,596	2,666	2,631	64%	1%	1956	4,133	100%
1924	605	207	406	10%	3%	1982	4,111	99%
1925	1,548	1,471	1,509	37%	4%	1984	4,088	99%
1926	2,172	1,779	1,975	48%	5%	1967	4,081	99%
1927	3,965	3,671	3,818	92%	6%	1951	4,057	98%
1928	2,104	1,831	1,967	48%	8%	1958	4,037	98%
1929	917	703	810	20%	9%	1970	4,012	97%
1930	2,217	2,083	2,150	52%	10%	1998	3,908	95%
1931	1,098	973	1,036	25%	11%	1978	3,905	94%
1932	1,445	1,252	1,348	33%	12%	1969	3,903	94%
1933	1,783	1,439	1,611	39%	14%	1983	3,903	94%
1934	1,385	1,313	1,349	33%	15%	1995	3,903	94%
1935	3,563	2,972	3,267	79%	16%	1952	3,892	94%
1936	3,363	2,929	3,146	76%	17%	1999	3,876	94%
1937	2,912	3,010	2,961	72%	19%	1974	3,835	93%
1938	4,133	4,133	4,133	100%	20%	1927	3,818	92%
1939	3,105	2,786	2,945	71%	21%	1922	3,810	92%
1940	3,606	3,108	3,357	81%	22%	1993	3,781	91%
1941	3,907	3,628	3,768	91%	24%	1941	3,768	91%
1942	3,836	3,384	3,610	87%	25%	1980	3,711	90%
1943	3,718	3,481	3,600	87%	26%	1942	3,610	87%
1944	2,527	2,083	2,305	56%	27%	1996	3,600	87%
1945	3,128	3,177	3,152	76%	28%	1943	3,597	87%
1946	3,634	3,307	3,471	84%	30%	1973	3,546	86%
1947	1,796	1,663	1,729	42%	31%	1946	3,471	84%
1948	2,870	2,675	2,773	67%	32%	1963	3,467	84%
1949	1,392	1,090	1,241	30%	33%	1971	3,361	81%
1950	2,634	2,200	2,417	58%	35%	1940	3,357	81%
1951	4,077	4,038	4,057	98%	36%	2000	3,332	81%
1952	3,907	3,876	3,892	94%	37%	1997	3,276	79%
1953	3,647	2,872	3,260	79%	38%	1935	3,267	79%
1954	3,026	2,871	2,949	71%	40%	1953	3,260	79%
1955	968	924	946	23%	41%	1989	3,250	79%
1956	4,133	4,090	4,111	99%	42%	1965	3,172	77%
1957	2,234	1,900	2,067	50%	43%	1975	3,156	76%
1958	4,133	3,941	4,037	98%	45%	1945	3,152	76%
1959	2,805	2,660	2,733	66%	46%	1936	3,146	76%
1960	1,674	1,263	1,468	36%	47%	1966	3,099	75%
1961	2,542	2,409	2,476	60%	48%	2003	3,061	74%
1962	2,979	2,967	2,973	72%	49%	1962	2,973	72%
1963	3,824	3,111	3,467	84%	51%	1937	2,961	72%
1964	1,581	1,951	1,766	43%	52%	1954	2,949	71%
1965	3,326	3,018	3,172	77%	53%	1939	2,945	71%

Table B.13 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve GFDL Model with B1 Emissions

Year	deliveries derived from interpolating between "no climate change" and "GFDL + B1 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1966	3,206	2,992	3,099	75%	54%	1986	2,926	71%
1967	4,133	4,028	4,081	99%	56%	1979	2,794	68%
1968	2,794	2,253	2,523	61%	57%	1985	2,778	67%
1969	3,903	3,903	3,903	94%	58%	1948	2,773	67%
1970	4,076	3,948	4,012	97%	59%	1959	2,733	66%
1971	3,600	3,121	3,361	81%	61%	1923	2,631	64%
1972	1,507	1,475	1,491	36%	62%	1968	2,523	61%
1973	3,873	3,219	3,546	86%	63%	1961	2,476	60%
1974	3,981	3,689	3,835	93%	64%	1981	2,453	59%
1975	3,343	2,968	3,156	76%	66%	1950	2,417	58%
1976	2,142	1,789	1,965	48%	67%	1987	2,313	56%
1977	296	279	287	7%	68%	1944	2,305	56%
1978	3,905	3,905	3,905	94%	69%	2002	2,250	54%
1979	2,976	2,613	2,794	68%	70%	1930	2,150	52%
1980	3,649	3,773	3,711	90%	72%	1957	2,067	50%
1981	2,626	2,280	2,453	59%	73%	1926	1,975	48%
1982	4,133	4,133	4,133	100%	74%	1928	1,967	48%
1983	3,903	3,903	3,903	94%	75%	1976	1,965	48%
1984	4,098	4,077	4,088	99%	77%	1964	1,766	43%
1985	2,875	2,681	2,778	67%	78%	1947	1,729	42%
1986	2,915	2,936	2,926	71%	79%	1994	1,650	40%
1987	2,539	2,087	2,313	56%	80%	1933	1,611	39%
1988	521	549	535	13%	82%	1925	1,509	37%
1989	3,365	3,135	3,250	79%	83%	1972	1,491	36%
1990	376	194	285	7%	84%	1960	1,468	36%
1991	905	709	807	20%	85%	1934	1,349	33%
1992	1,073	1,058	1,065	26%	87%	1932	1,348	33%
1993	4,007	3,555	3,781	91%	88%	1949	1,241	30%
1994	1,542	1,758	1,650	40%	89%	1992	1,065	26%
1995	3,903	3,903	3,903	94%	90%	1931	1,036	25%
1996	3,875	3,319	3,597	87%	91%	1955	946	23%
1997	3,275	3,276	3,276	79%	93%	2001	819	20%
1998	3,908	3,908	3,908	95%	94%	1929	810	20%
1999	3,984	3,768	3,876	94%	95%	1991	807	20%
2000	3,542	3,123	3,332	81%	96%	1988	535	13%
2001	818	821	819	20%	98%	1924	406	10%
2002	2,436	2,063	2,250	54%	99%	1977	287	7%
2003	3,266	2,856	3,061	74%	100%	1990	285	7%
Avg	**2,830**	**2,617**	**2,723**	**66%**			**2,723**	
Min	**296**	**194**	**285**	**7%**			**285**	
Max	**4,133**	**4,133**	**4,133**	**100%**			**4,133**	

[1]/ See Table 6.3 [2]/ 4,133 taf/year

Table B.14 SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve PCM Model with A2 Emissions

Year	deliveries derived from interpolating between "no climate change" and "PCM + A2 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1922	4,060	3,609	3,834	93%	0%	1938	4,133	100%
1923	2,771	2,925	2,848	69%	1%	1951	4,133	100%
1924	498	137	317	8%	3%	1956	4,133	100%
1925	1,556	1,485	1,521	37%	4%	1958	4,133	100%
1926	2,178	1,733	1,956	47%...	5%	1970	4,133	100%
1927	4,121	3,720	3,920	95%	6%	1982	4,133	100%
1928	2,016	1,805	1,910	46%	8%	1984	4,133	100%
1929	904	677	790	19%	9%	1967	4,105	99%
1930	2,179	1,991	2,085	50%	10%	1999	4,088	99%
1931	1,128	1,049	1,089	26%	11%	1974	3,926	95%
1932	1,438	1,222	1,330	32%	12%	1927	3,920	95%
1933	1,857	1,569	1,713	41%	14%	1998	3,908	95%
1934	1,352	1,351	1,352	33%	15%	1952	3,907	95%
1935	3,638	3,250	3,444	83%	16%	1978	3,904	94%
1936	3,566	3,101	3,334	81%	17%	1969	3,903	94%
1937	3,049	3,257	3,153	76%	19%	1983	3,903	94%
1938	4,133	4,133	4,133	100%	20%	1995	3,903	94%
1939	3,280	2,958	3,119	75%	21%	1941	3,859	93%
1940	3,731	3,178	3,454	84%	22%	1922	3,834	93%
1941	3,907	3,811	3,859	93%	24%	1996	3,807	92%
1942	3,981	3,531	3,756	91%	25%	1993	3,787	92%
1943	3,727	3,600	3,664	89%	26%	1980	3,769	91%
1944	2,521	1,955	2,238	54%	27%	1942	3,756	91%
1945	3,627	3,634	3,630	88%	28%	1973	3,665	89%
1946	3,463	3,104	3,283	79%	30%	1943	3,664	89%
1947	1,700	1,643	1,672	40%	31%	1945	3,630	88%
1948	3,037	2,726	2,881	70%	32%	2000	3,537	86%
1949	1,379	1,083	1,231	30%	33%	1940	3,454	84%
1950	2,771	2,120	2,446	59%	35%	1963	3,453	84%
1951	4,133	4,133	4,133	100%	36%	1935	3,444	83%
1952	3,907	3,906	3,907	95%	37%	1953	3,343	81%
1953	3,757	2,929	3,343	81%	38%	1971	3,337	81%
1954	3,025	2,989	3,007	73%	40%	1936	3,334	81%
1955	956	848	902	22%	41%	1989	3,324	80%
1956	4,133	4,133	4,133	100%	42%	1975	3,323	80%
1957	2,221	1,883	2,052	50%	43%	1946	3,283	79%
1958	4,133	4,133	4,133	100%	45%	1966	3,251	79%
1959	2,880	2,722	2,801	68%	46%	1997	3,250	79%
1960	1,705	1,370	1,537	37%	47%	1937	3,153	76%
1961	2,691	2,339	2,515	61%	48%	1965	3,135	76%
1962	2,963	3,126	3,044	74%	49%	1939	3,119	75%
1963	3,813	3,094	3,453	84%	51%	1979	3,049	74%
1964	1,572	1,907	1,739	42%	52%	1962	3,044	74%
1965	3,301	2,968	3,135	76%	53%	2003	3,030	73%

Table B.14 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve PCM Model with A2 Emissions

Year	deliveries derived from interpolating between "no climate change" and "PCM + A2 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1966	3,352	3,150	3,251	79%	54%	1954	3,007	73%
1967	4,133	4,077	4,105	99%	56%	1986	2,980	72%
1968	2,874	2,236	2,555	62%	57%	1948	2,881	70%
1969	3,903	3,903	3,903	94%	58%	1923	2,848	69%
1970	4,133	4,133	4,133	100%	59%	1985	2,836	69%
1971	3,566	3,108	3,337	81%	61%	1959	2,801	68%
1972	1,441	1,450	1,446	35%	62%	1968	2,555	62%
1973	3,959	3,371	3,665	89%	63%	1961	2,515	61%
1974	4,133	3,718	3,926	95%	64%	1981	2,515	61%
1975	3,521	3,124	3,323	80%	66%	1950	2,446	59%
1976	2,089	1,598	1,843	45%	67%	1987	2,320	56%
1977	281	264	273	7%	68%	1944	2,238	54%
1978	3,904	3,904	3,904	94%	69%	2002	2,137	52%
1979	3,182	2,915	3,049	74%	70%	1930	2,085	50%
1980	3,638	3,899	3,769	91%	72%	1957	2,052	50%
1981	2,659	2,370	2,515	61%	73%	1926	1,956	47%
1982	4,133	4,133	4,133	100%	74%	1928	1,910	46%
1983	3,903	3,903	3,903	94%	75%	1976	1,843	45%
1984	4,133	4,133	4,133	100%	77%	1994	1,776	43%
1985	2,926	2,746	2,836	69%	78%	1964	1,739	42%
1986	2,928	3,032	2,980	72%	79%	1933	1,713	41%
1987	2,627	2,014	2,320	56%	80%	1947	1,672	40%
1988	448	524	486	12%	82%	1960	1,537	37%
1989	3,457	3,191	3,324	80%	83%	1925	1,521	37%
1990	325	184	255	6%	84%	1972	1,446	35%
1991	883	683	783	19%	85%	1934	1,352	33%
1992	1,108	1,075	1,092	26%	87%	1932	1,330	32%
1993	4,046	3,527	3,787	92%	88%	1949	1,231	30%
1994	1,693	1,859	1,776	43%	89%	1992	1,092	26%
1995	3,903	3,903	3,903	94%	90%	1931	1,089	26%
1996	3,984	3,631	3,807	92%	91%	1955	902	22%
1997	3,254	3,246	3,250	79%	93%	2001	804	19%
1998	3,908	3,908	3,908	95%	94%	1929	790	19%
1999	4,052	4,123	4,088	99%	95%	1991	783	19%
2000	3,794	3,279	3,537	86%	96%	1988	486	12%
2001	795	812	804	19%	98%	1924	317	8%
2002	2,312	1,961	2,137	52%	99%	1977	273	7%
2003	3,226	2,834	3,030	73%	100%	1990	255	6%
Avg	**2,870**	**2,668**	**2,769**	**67%**			**2,769**	
Min	**281**	**137**	**255**	**6%**			**255**	
Max	**4,133**	**4,133**	**4,133**	**100%**			**4,133**	

[1]/ See Table 6.3 [2]/ 4,133 taf/year

Table B.15 SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve PCM Model with B1 Emissions

Year	deliveries derived from interpolating between "no climate change" and "PCM + B1 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1922	4,092	3,647	3,869	94%	0%	1938	4,133	100%
1923	3,091	3,033	3,062	74%	1%	1956	4,133	100%
1924	371	150	261	6%	3%	1958	4,133	100%
1925	1,718	1,669	1,693	41%	4%	1970	4,133	100%
1926	2,254	1,967	2,111	51%	5%	1982	4,133	100%
1927	4,086	3,680	3,883	94%	6%	1984	4,133	100%
1928	2,186	1,921	2,054	50%	8%	1999	4,118	100%
1929	945	729	837	20%	9%	1967	4,091	99%
1930	2,299	2,008	2,154	52%	10%	1951	4,046	98%
1931	1,130	1,090	1,110	27%	11%	1974	3,961	96%
1932	1,570	1,301	1,436	35%	12%	1998	3,908	95%
1933	2,340	1,944	2,142	52%	14%	1952	3,907	95%
1934	1,325	1,388	1,357	33%	15%	1978	3,905	94%
1935	3,779	3,126	3,452	84%	16%	1969	3,903	94%
1936	3,606	3,081	3,344	81%	17%	1983	3,903	94%
1937	3,337	3,593	3,465	84%	19%	1995	3,903	94%
1938	4,133	4,133	4,133	100%	20%	1942	3,886	94%
1939	3,414	3,035	3,224	78%	21%	1927	3,883	94%
1940	3,775	3,225	3,500	85%	22%	1941	3,873	94%
1941	3,907	3,839	3,873	94%	24%	1922	3,869	94%
1942	4,133	3,639	3,886	94%	25%	1996	3,823	92%
1943	3,772	3,503	3,637	88%	26%	1980	3,784	92%
1944	2,943	2,503	2,723	66%	27%	1993	3,732	90%
1945	3,556	3,467	3,511	85%	28%	1973	3,710	90%
1946	3,655	3,364	3,509	85%	30%	1943	3,637	88%
1947	1,752	1,860	1,806	44%	31%	2000	3,636	88%
1948	3,297	2,866	3,082	75%	32%	1953	3,516	85%
1949	1,467	1,245	1,356	33%	33%	1945	3,511	85%
1950	2,812	2,462	2,637	64%	35%	1946	3,509	85%
1951	4,133	3,958	4,046	98%	36%	1940	3,500	85%
1952	3,907	3,907	3,907	95%	37%	1937	3,465	84%
1953	3,922	3,110	3,516	85%	38%	1975	3,458	84%
1954	3,184	3,056	3,120	75%	40%	1935	3,452	84%
1955	1,024	1,024	1,024	25%	41%	1966	3,431	83%
1956	4,133	4,133	4,133	100%	42%	1971	3,397	82%
1957	2,443	1,976	2,210	53%	43%	1989	3,387	82%
1958	4,133	4,133	4,133	100%	45%	1936	3,344	81%
1959	3,199	2,946	3,073	74%	46%	1963	3,337	81%
1960	1,722	1,430	1,576	38%	47%	1997	3,291	80%
1961	2,650	2,408	2,529	61%	48%	1939	3,224	78%
1962	3,250	3,174	3,212	78%	49%	1962	3,212	78%
1963	3,640	3,034	3,337	81%	51%	1979	3,197	77%
1964	1,814	2,213	2,013	49%	52%	1985	3,163	77%
1965	3,348	2,884	3,116	75%	53%	1954	3,120	75%

Table B.15 cont. SWP Table A deliveries from the Delta under Future (2027) Conditions, derived values for estimating probability curve PCM Model with B1 Emissions

Year	deliveries derived from interpolating between "no climate change" and "PCM + B1 emissions"				ranking of calculated SWP Table A deliveries for probability curve			
	lower flow target[1] (taf)	higher flow target[1] (taf)	average flow targets (taf)	percent of max SWP Table A[2]	Exceedence Frequency	Year	SWP Table A Delivery (taf)	percent of max SWP Table A[2]
1966	3,486	3,376	3,431	83%	54%	1965	3,116	75%
1967	4,133	4,048	4,091	99%	56%	1948	3,082	75%
1968	2,990	2,363	2,676	65%	57%	1959	3,073	74%
1969	3,903	3,903	3,903	94%	58%	1923	3,062	74%
1970	4,133	4,133	4,133	100%	59%	2003	3,011	73%
1971	3,658	3,136	3,397	82%	61%	1986	2,805	68%
1972	1,489	1,495	1,492	36%	62%	1944	2,723	66%
1973	4,000	3,420	3,710	90%	63%	1968	2,676	65%
1974	4,133	3,789	3,961	96%	64%	1981	2,644	64%
1975	3,695	3,222	3,458	84%	66%	1950	2,637	64%
1976	2,227	1,631	1,929	47%	67%	1961	2,529	61%
1977	300	281	291	7%	68%	1987	2,465	60%
1978	3,905	3,905	3,905	94%	69%	2002	2,355	57%
1979	3,371	3,024	3,197	77%	70%	1957	2,210	53%
1980	3,687	3,881	3,784	92%	72%	1930	2,154	52%
1981	2,740	2,547	2,644	64%	73%	1933	2,142	52%
1982	4,133	4,133	4,133	100%	74%	1926	2,111	51%
1983	3,903	3,903	3,903	94%	75%	1994	2,066	50%
1984	4,133	4,133	4,133	100%	77%	1928	2,054	50%
1985	3,293	3,032	3,163	77%	78%	1964	2,013	49%
1986	2,799	2,810	2,805	68%	79%	1976	1,929	47%
1987	2,605	2,326	2,465	60%	80%	1947	1,806	44%
1988	483	454	468	11%	82%	1925	1,693	41%
1989	3,504	3,269	3,387	82%	83%	1960	1,576	38%
1990	367	311	339	8%	84%	1972	1,492	36%
1991	965	776	870	21%	85%	1932	1,436	35%
1992	1,243	1,124	1,183	29%	87%	1934	1,357	33%
1993	3,993	3,471	3,732	90%	88%	1949	1,356	33%
1994	1,874	2,258	2,066	50%	89%	1992	1,183	29%
1995	3,903	3,902	3,903	94%	90%	1931	1,110	27%
1996	4,021	3,624	3,823	92%	91%	1955	1,024	25%
1997	3,294	3,289	3,291	80%	93%	2001	949	23%
1998	3,908	3,908	3,908	95%	94%	1991	870	21%
1999	4,103	4,133	4,118	100%	95%	1929	837	20%
2000	3,913	3,359	3,636	88%	96%	1988	468	11%
2001	884	1,014	949	23%	98%	1990	339	8%
2002	2,595	2,115	2,355	57%	99%	1977	291	7%
2003	3,201	2,820	3,011	73%	100%	1924	261	6%
Avg	**2,954**	**2,746**	**2,850**	**69%**			**2,850**	
Min	**300**	**150**	**261**	**6%**			**261**	
Max	**4,133**	**4,133**	**4,133**	**100%**			**4,133**	

[1]/ See Table 6.3 [2]/ 4,133 taf/year

Table B.16 *SWP Article 21* deliveries under Current (2007) Conditions

Year	Article 21 demands (taf)	Article 21 deliveries		
		less restrictive flow targets (taf)[1]	more restrictive flow targets (taf)[1]	average of flow targets (taf)[1]
1922	1,408	0	0	0
1923	1,408	0	0	0
1924	1,408	0	0	0
1925	1,408	0	0	0
1926	1,408	0	0	0
1927	1,408	0	0	0
1928	1,408	0	0	0
1929	1,408	0	0	0
1930	1,408	0	0	0
1931	1,408	0	0	0
1932	1,408	0	0	0
1933	1,408	77	0	38
1934	1,408	0	0	0
1935	1,408	0	0	0
1936	1,408	0	0	0
1937	1,408	0	0	0
1938	1,408	589	586	587
1939	1,408	124	59	92
1940	1,408	0	0	0
1941	652	100	0	50
1942	1,408	672	324	498
1943	1,156	555	471	513
1944	1,408	0	0	0
1945	1,408	0	0	0
1946	1,408	0	0	0
1947	1,408	0	0	0
1948	1,408	0	0	0
1949	1,408	0	0	0
1950	1,408	0	0	0
1951	1,408	308	134	221
1952	652	100	100	100
1953	1,408	90	90	90
1954	1,156	0	0	0
1955	1,408	0	0	0
1956	1,408	319	194	256
1957	1,408	0	0	0
1958	1,408	563	154	359
1959	1,408	50	42	46
1960	1,408	0	0	0
1961	1,408	0	0	0
1962	1,408	0	0	0
1963	1,408	0	0	0
1964	1,408	0	0	0
1965	1,408	0	0	0

Table B.16 cont. *SWP Article 21* deliveries under Current (2007) Conditions

Year	Article 21 demands (taf)	Article 21 deliveries		
		less restrictive flow targets (taf) [1]	more restrictive flow targets (taf) [1]	average of flow targets (taf)
1966	1,408	0	0	0
1967	1,408	270	0	135
1968	1,408	165	0	82
1969	652	199	199	199
1970	1,408	552	368	460
1971	1,156	0	0	0
1972	1,408	0	0	0
1973	1,408	0	0	0
1974	1,408	96	0	48
1975	1,408	346	0	173
1976	1,408	10	0	5
1977	1,408	0	0	0
1978	652	200	0	100
1979	1,408	0	0	0
1980	400	189	188	189
1981	1,408	0	0	0
1982	1,156	527	453	490
1983	652	400	400	400
1984	1,408	552	368	460
1985	1,156	0	0	0
1986	652	53	0	27
1987	1,408	0	0	0
1988	1,156	0	0	0
1989	1,408	0	0	0
1990	1,408	0	0	0
1991	1,408	0	0	0
1992	1,408	0	0	0
1993	1,408	0	0	0
1994	1,408	0	0	0
1995	652	100	35	67
1996	1,408	423	387	405
1997	1,156	458	227	342
1998	652	178	100	139
1999	1,408	469	285	377
2000	1,156	0	0	0
2001	1,408	0	0	0
2002	1,408	0	0	0
2003	1,408	0	0	0
Avg	**1,297**	**106**	**63**	**85**
Min	**400**	**0**	**0**	**0**
Max	**1,408**	**672**	**586**	**587**

[1]/ See Table 6.3

Table B.17 *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario GFDL with A2 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries *GFDL-A2[2] (taf)*
		no climate change (taf)	GFDL with A2 emissions (taf)	*interpolated GFDL-A2[2] (taf)*	*no climate change* (taf)	GFDL with A2 emissions (taf)	*interpolated GFDL-A2[2] (taf)*	
1922	1,408	0	0	0	0	0	0	0
1923	1,408	0	0	0	0	0	0	0
1924	1,408	0	0	0	0	0	0	0
1925	1,408	6	5	6	22	116	66	36
1926	1,408	0	0	0	0	0	0	0
1927	1,408	0	0	0	0	0	0	0
1928	1,408	0	0	0	0	0	0	0
1929	1,408	0	0	0	0	0	0	0
1930	1,408	0	0	0	0	0	0	0
1931	1,408	0	0	0	0	0	0	0
1932	1,408	0	125	58	0	66	31	44
1933	1,408	87	0	47	0	0	0	23
1934	1,408	0	0	0	0	17	8	4
1935	1,408	0	273	127	0	121	56	92
1936	1,408	0	0	0	0	0	0	0
1937	1,408	0	22	10	0	0	0	5
1938	1,408	165	333	243	0	334	155	199
1939	1,408	0	0	0	0	0	0	0
1940	1,408	0	0	0	0	0	0	0
1941	652	0	0	0	0	0	0	0
1942	1,408	0	0	0	0	0	0	0
1943	1,156	17	0	9	0	0	0	4
1944	1,408	0	0	0	0	0	0	0
1945	1,408	0	0	0	0	0	0	0
1946	1,408	0	0	0	0	0	0	0
1947	1,408	0	0	0	0	0	0	0
1948	1,408	0	0	0	0	0	0	0
1949	1,408	0	0	0	0	0	0	0
1950	1,408	0	0	0	0	0	0	0
1951	1,408	171	264	214	115	115	115	164
1952	652	0	0	0	0	0	0	0
1953	1,408	0	0	0	0	0	0	0
1954	1,156	0	0	0	0	0	0	0
1955	1,408	0	0	0	0	0	0	0
1956	1,408	338	466	397	172	268	217	307
1957	1,408	0	0	0	0	0	0	0
1958	1,408	105	0	56	0	0	0	28
1959	1,408	0	0	0	0	0	0	0
1960	1,408	0	0	0	0	0	0	0
1961	1,408	0	0	0	0	0	0	0
1962	1,408	0	0	0	0	0	0	0
1963	1,408	0	0	0	0	0	0	0
1964	1,408	0	0	0	0	0	0	0
1965	1,408	0	203	94	0	0	0	47

[1]/ See Table 6-3 [2]/ As described in Appendix B

Table B.17 cont. *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario GFDL with A2 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries *GFDL-A2*[2] *(taf)*
		no climate change (taf)	GFDL with A2 emissions (taf)	*interpolated GFDL-A2*[2] *(taf)*	*no climate change* (taf)	GFDL with A2 emissions (taf)	*interpolated GFDL-A2*[2] *(taf)*	
1966	1,408	0	0	0	0	0	0	0
1967	1,408	0	0	0	0	0	0	0
1968	1,408	0	0	0	0	0	0	0
1969	652	61	124	90	62	95	77	84
1970	1,408	444	31	252	294	0	157	204
1971	1,156	0	0	0	0	0	0	0
1972	1,408	0	0	0	0	0	0	0
1973	1,408	0	0	0	0	0	0	0
1974	1,408	0	0	0	0	0	0	0
1975	1,408	0	0	0	0	0	0	0
1976	1,408	0	0	0	0	0	0	0
1977	1,408	0	30	14	0	0	0	7
1978	652	106	300	196	0	200	93	145
1979	1,408	0	0	0	0	0	0	0
1980	400	131	155	142	63	97	78	110
1981	1,408	0	0	0	0	0	0	0
1982	1,156	0	0	0	0	0	0	0
1983	652	340	239	293	241	239	240	267
1984	1,408	491	491	491	341	371	355	423
1985	1,156	0	0	0	0	0	0	0
1986	652	0	49	23	0	0	0	12
1987	1,408	0	0	0	0	0	0	0
1988	1,156	0	0	0	0	0	0	0
1989	1,408	0	0	0	0	0	0	0
1990	1,408	0	0	0	0	0	0	0
1991	1,408	0	0	0	0	0	0	0
1992	1,408	0	0	0	0	0	0	0
1993	1,408	0	0	0	0	0	0	0
1994	1,408	0	0	0	0	0	0	0
1995	652	0	0	0	0	0	0	0
1996	1,408	38	0	20	0	0	0	10
1997	1,156	158	157	157	0	126	59	108
1998	652	0	0	0	0	0	0	0
1999	1,408	284	153	223	117	0	63	143
2000	1,156	0	0	0	0	0	0	0
2001	1,408	0	0	0	0	0	0	0
2002	1,408	0	0	0	0	0	0	0
2003	1,408	0	0	0	0	0	0	0
Avg	**1,297**	**36**	**42**	**39**	**17**	**26**	**22**	**30**
Min	**400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**1,408**	**491**	**491**	**491**	**341**	**371**	**355**	**423**

1/ See Table 6-3 2/ As described in Appendix B

Table B.18 *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario GFDL with B1 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries *GFDL-B1*[2] *(taf)*
		no climate change (taf)	GFDL with B1 emissions (taf)	*interpolated GFDL-B1*[2] *(taf)*	*no climate change* (taf)	GFDL with B1 emissions (taf)	*interpolated GFDL-B1*[2] *(taf)*	
1922	1,408	0	0	0	0	0	0	0
1923	1,408	0	0	0	0	0	0	0
1924	1,408	0	0	0	0	0	0	0
1925	1,408	6	20	13	22	65	42	27
1926	1,408	0	0	0	0	0	0	0
1927	1,408	0	0	0	0	0	0	0
1928	1,408	0	0	0	0	0	0	0
1929	1,408	0	0	0	0	0	0	0
1930	1,408	0	0	0	0	0	0	0
1931	1,408	0	0	0	0	0	0	0
1932	1,408	0	15	7	0	88	41	24
1933	1,408	87	0	47	0	0	0	23
1934	1,408	0	0	0	0	0	0	0
1935	1,408	0	142	66	0	225	105	85
1936	1,408	0	0	0	0	0	0	0
1937	1,408	0	112	52	0	0	0	26
1938	1,408	165	213	187	0	239	111	149
1939	1,408	0	0	0	0	0	0	0
1940	1,408	0	0	0	0	0	0	0
1941	652	0	0	0	0	0	0	0
1942	1,408	0	0	0	0	0	0	0
1943	1,156	17	35	25	0	0	0	13
1944	1,408	0	0	0	0	0	0	0
1945	1,408	0	0	0	0	0	0	0
1946	1,408	0	0	0	0	0	0	0
1947	1,408	0	0	0	0	0	0	0
1948	1,408	0	0	0	0	0	0	0
1949	1,408	0	0	0	0	0	0	0
1950	1,408	0	0	0	0	0	0	0
1951	1,408	171	259	212	115	54	86	149
1952	652	0	0	0	0	0	0	0
1953	1,408	0	0	0	0	0	0	0
1954	1,156	0	0	0	0	0	0	0
1955	1,408	0	0	0	0	0	0	0
1956	1,408	338	463	396	172	257	212	304
1957	1,408	0	0	0	0	0	0	0
1958	1,408	105	0	56	0	0	0	28
1959	1,408	0	0	0	0	0	0	0
1960	1,408	0	0	0	0	0	0	0
1961	1,408	0	0	0	0	0	0	0
1962	1,408	0	0	0	0	0	0	0
1963	1,408	0	0	0	0	0	0	0
1964	1,408	0	0	0	0	0	0	0
1965	1,408	0	22	10	0	0	0	5

[1]/ See Table 6.3 [2]/ As described in Appendix B

Table B.18 cont. *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario GFDL with B1 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries *GFDL-B1*[2] *(taf)*
		no climate change (taf)	GFDL with B1 emissions (taf)	*interpolated GFDL-B1*[2] *(taf)*	*no climate change* (taf)	GFDL with B1 emissions (taf)	*interpolated GFDL-B1*[2] *(taf)*	
1966	1,408	0	0	0	0	0	0	0
1967	1,408	0	0	0	0	0	0	0
1968	1,408	0	0	0	0	0	0	0
1969	652	61	144	100	62	144	100	100
1970	1,408	444	43	257	294	0	157	207
1971	1,156	0	0	0	0	0	0	0
1972	1,408	0	0	0	0	0	0	0
1973	1,408	0	0	0	0	0	0	0
1974	1,408	0	0	0	0	0	0	0
1975	1,408	0	0	0	0	0	0	0
1976	1,408	0	0	0	0	0	0	0
1977	1,408	0	0	0	0	0	0	0
1978	652	106	247	171	0	54	25	98
1979	1,408	0	0	0	0	0	0	0
1980	400	131	174	151	63	168	112	131
1981	1,408	0	0	0	0	0	0	0
1982	1,156	0	0	0	0	0	0	0
1983	652	340	239	293	241	239	240	267
1984	1,408	491	491	491	341	326	334	413
1985	1,156	0	0	0	0	0	0	0
1986	652	0	54	25	0	0	0	13
1987	1,408	0	0	0	0	0	0	0
1988	1,156	0	0	0	0	0	0	0
1989	1,408	0	0	0	0	0	0	0
1990	1,408	0	0	0	0	0	0	0
1991	1,408	0	0	0	0	0	0	0
1992	1,408	0	0	0	0	0	0	0
1993	1,408	0	0	0	0	0	0	0
1994	1,408	0	0	0	0	0	0	0
1995	652	0	0	0	0	0	0	0
1996	1,408	38	0	20	0	0	0	10
1997	1,156	158	229	191	0	115	53	122
1998	652	0	0	0	0	0	0	0
1999	1,408	284	332	306	117	0	63	184
2000	1,156	0	0	0	0	0	0	0
2001	1,408	0	0	0	0	0	0	0
2002	1,408	0	0	0	0	0	0	0
2003	1,408	0	0	0	0	0	0	0
Avg	**1,297**	**36**	**39**	**38**	**17**	**24**	**20**	**29**
Min	**400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	1,408	491	491	491	341	326	334	413

[1]/ See Table 6.3 [2]/ As described in Appendix B

Table B.19 *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario PCM with A2 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries PCM-A2[2] *(taf)*
		no climate change (taf)	PCM with A2 emissions (taf)	*interpolated* PCM-A2 [2] *(taf)*	*no climate change* (taf)	PCM with A2 emissions (taf)	*interpolated* PCM-A2[2] *(taf)*	
1922	1,408	0	0	0	0	0	0	0
1923	1,408	0	0	0	0	0	0	0
1924	1,408	0	0	0	0	0	0	0
1925	1,408	6	189	91	22	276	140	116
1926	1,408	0	0	0	0	0	0	0
1927	1,408	0	0	0	0	0	0	0
1928	1,408	0	0	0	0	0	0	0
1929	1,408	0	0	0	0	0	0	0
1930	1,408	0	0	0	0	0	0	0
1931	1,408	0	0	0	0	0	0	0
1932	1,408	0	80	37	0	0	0	19
1933	1,408	87	270	172	0	0	0	86
1934	1,408	0	59	28	0	0	0	14
1935	1,408	0	160	75	0	125	58	66
1936	1,408	0	0	0	0	0	0	0
1937	1,408	0	133	62	0	0	0	31
1938	1,408	165	320	237	0	282	131	184
1939	1,408	0	0	0	0	0	0	0
1940	1,408	0	0	0	0	0	0	0
1941	652	0	0	0	0	0	0	0
1942	1,408	0	0	0	0	0	0	0
1943	1,156	17	117	63	0	0	0	32
1944	1,408	0	0	0	0	0	0	0
1945	1,408	0	0	0	0	63	29	15
1946	1,408	0	0	0	0	0	0	0
1947	1,408	0	0	0	0	0	0	0
1948	1,408	0	0	0	0	0	0	0
1949	1,408	0	0	0	0	0	0	0
1950	1,408	0	0	0	0	0	0	0
1951	1,408	171	245	205	115	283	193	199
1952	652	0	0	0	0	0	0	0
1953	1,408	0	0	0	0	0	0	0
1954	1,156	0	0	0	0	0	0	0
1955	1,408	0	0	0	0	0	0	0
1956	1,408	338	455	392	172	268	217	304
1957	1,408	0	0	0	0	0	0	0
1958	1,408	105	82	94	0	0	0	47
1959	1,408	0	0	0	0	0	0	0
1960	1,408	0	0	0	0	0	0	0
1961	1,408	0	0	0	0	0	0	0
1962	1,408	0	0	0	0	0	0	0
1963	1,408	0	0	0	0	0	0	0
1964	1,408	0	0	0	0	0	0	0
1965	1,408	0	46	21	0	0	0	11

[1]/ See Table 6.3　　[2]/ As described in Appendix B

Table B.19 cont. *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario PCM with A2 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries PCM-A2[2] *(taf)*
		no climate change (taf)	PCM with A2 emissions (taf)	*interpolated* PCM-A2 [2] *(taf)*	*no climate change* (taf)	PCM with A2 emissions (taf)	*interpolated* PCM-A2[2] *(taf)*	
1966	1,408	0	0	0	0	0	0	0
1967	1,408	0	0	0	0	0	0	0
1968	1,408	0	0	0	0	0	0	0
1969	652	61	61	61	62	61	62	61
1970	1,408	444	279	367	294	114	210	289
1971	1,156	0	0	0	0	0	0	0
1972	1,408	0	0	0	0	0	0	0
1973	1,408	0	0	0	0	0	0	0
1974	1,408	0	0	0	0	0	0	0
1975	1,408	0	0	0	0	0	0	0
1976	1,408	0	0	0	0	0	0	0
1977	1,408	0	0	0	0	0	0	0
1978	652	106	300	196	0	200	93	145
1979	1,408	0	0	0	0	0	0	0
1980	400	131	100	116	63	60	61	89
1981	1,408	0	0	0	0	0	0	0
1982	1,156	0	0	0	0	0	0	0
1983	652	340	239	293	241	239	240	267
1984	1,408	491	491	491	341	341	341	416
1985	1,156	0	0	0	0	0	0	0
1986	652	0	49	23	0	0	0	11
1987	1,408	0	0	0	0	0	0	0
1988	1,156	0	0	0	0	0	0	0
1989	1,408	0	0	0	0	0	0	0
1990	1,408	0	0	0	0	0	0	0
1991	1,408	0	0	0	0	0	0	0
1992	1,408	0	0	0	0	0	0	0
1993	1,408	0	0	0	0	0	0	0
1994	1,408	0	0	0	0	0	0	0
1995	652	0	0	0	0	0	0	0
1996	1,408	38	0	20	0	0	0	10
1997	1,156	158	195	175	0	0	0	87
1998	652	0	0	0	0	0	0	0
1999	1,408	284	295	289	117	40	81	185
2000	1,156	0	0	0	0	0	0	0
2001	1,408	0	0	0	0	0	0	0
2002	1,408	0	0	0	0	0	0	0
2003	1,408	0	0	0	0	0	0	0
Avg	**1,297**	**36**	**51**	**43**	**17**	**29**	**23**	**33**
Min	**400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**1,408**	**491**	**491**	**491**	**341**	**341**	**341**	**416**

[1]/ See Table 6.3 [2]/ As described in Appendix B

Table B.20 *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario PCM with B1 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries PCM-B1 [2] *(taf)*
		no climate change (taf)	PCM with B1 emissions (taf)	*interpolated* PCM-B1 [2] *(taf)*	*no climate change* (taf)	PCM with B1 emissions (taf)	*interpolated* PCM-B1 [2] *(taf)*	
1922	1,408	0	0	0	0	0	0	0
1923	1,408	0	0	0	0	0	0	0
1924	1,408	0	0	0	0	0	0	0
1925	1,408	6	48	25	22	29	25	25
1926	1,408	0	0	0	0	0	0	0
1927	1,408	0	0	0	0	0	0	0
1928	1,408	0	0	0	0	0	0	0
1929	1,408	0	0	0	0	0	0	0
1930	1,408	0	0	0	0	0	0	0
1931	1,408	0	0	0	0	0	0	0
1932	1,408	0	0	0	0	0	0	0
1933	1,408	87	104	95	0	0	0	47
1934	1,408	0	0	0	0	0	0	0
1935	1,408	0	0	0	0	0	0	0
1936	1,408	0	0	0	0	0	0	0
1937	1,408	0	0	0	0	0	0	0
1938	1,408	165	0	88	0	0	0	44
1939	1,408	0	0	0	0	0	0	0
1940	1,408	0	0	0	0	0	0	0
1941	652	0	0	0	0	0	0	0
1942	1,408	0	0	0	0	0	0	0
1943	1,156	17	49	32	0	0	0	16
1944	1,408	0	0	0	0	0	0	0
1945	1,408	0	0	0	0	0	0	0
1946	1,408	0	0	0	0	0	0	0
1947	1,408	0	0	0	0	0	0	0
1948	1,408	0	0	0	0	0	0	0
1949	1,408	0	0	0	0	0	0	0
1950	1,408	0	0	0	0	0	0	0
1951	1,408	171	168	169	115	0	61	115
1952	652	0	0	0	0	0	0	0
1953	1,408	0	0	0	0	0	0	0
1954	1,156	0	0	0	0	0	0	0
1955	1,408	0	0	0	0	0	0	0
1956	1,408	338	325	331	172	176	174	253
1957	1,408	0	0	0	0	0	0	0
1958	1,408	105	122	113	0	0	0	57
1959	1,408	0	0	0	0	0	0	0
1960	1,408	0	0	0	0	0	0	0
1961	1,408	0	0	0	0	0	0	0
1962	1,408	0	0	0	0	0	0	0
1963	1,408	0	0	0	0	0	0	0
1964	1,408	0	0	0	0	0	0	0
1965	1,408	0	0	0	0	0	0	0

[1]/ See Table 6.3 [2]/ As described in Appendix B

Table B.20 cont. *SWP Article 21* deliveries under Future (2027) Conditions
Climate change scenario PCM with B1 emissions

Year	Article 21 demand (taf)	Article 21 deliveries under less restrictive flow targets[1]			Article 21 deliveries under more restrictive flow targets[1]			Averaged Article 21 deliveries PCM-B1 [2] *(taf)*
		no climate change (taf)	PCM with B1 emissions (taf)	*interpolated PCM-B1* [2] *(taf)*	*no climate change* (taf)	PCM with B1 emissions (taf)	*interpolated PCM-B1* [2] *(taf)*	
1966	1,408	0	0	0	0	0	0	0
1967	1,408	0	0	0	0	0	0	0
1968	1,408	0	0	0	0	0	0	0
1969	652	61	75	67	62	62	62	65
1970	1,408	444	424	435	294	274	285	360
1971	1,156	0	0	0	0	0	0	0
1972	1,408	0	0	0	0	0	0	0
1973	1,408	0	0	0	0	0	0	0
1974	1,408	0	0	0	0	0	0	0
1975	1,408	0	0	0	0	0	0	0
1976	1,408	0	0	0	0	0	0	0
1977	1,408	0	0	0	0	0	0	0
1978	652	106	54	82	0	0	0	41
1979	1,408	0	0	0	0	0	0	0
1980	400	131	125	128	63	87	74	101
1981	1,408	0	0	0	0	0	0	0
1982	1,156	0	0	0	0	0	0	0
1983	652	340	340	340	241	239	240	290
1984	1,408	491	491	491	341	341	341	416
1985	1,156	0	0	0	0	0	0	0
1986	652	0	0	0	0	0	0	0
1987	1,408	0	0	0	0	0	0	0
1988	1,156	0	0	0	0	0	0	0
1989	1,408	0	0	0	0	0	0	0
1990	1,408	0	0	0	0	0	0	0
1991	1,408	0	0	0	0	0	0	0
1992	1,408	0	0	0	0	0	0	0
1993	1,408	0	0	0	0	0	0	0
1994	1,408	0	0	0	0	0	0	0
1995	652	0	0	0	0	0	0	0
1996	1,408	38	50	44	0	0	0	22
1997	1,156	158	255	203	0	0	0	102
1998	652	0	0	0	0	0	0	0
1999	1,408	284	310	296	117	115	116	206
2000	1,156	0	0	0	0	0	0	0
2001	1,408	0	0	0	0	0	0	0
2002	1,408	0	0	0	0	0	0	0
2003	1,408	0	0	0	0	0	0	0
Avg	**1,297**	**36**	**36**	**36**	**17**	**16**	**17**	**26**
Min	**400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**1,408**	**491**	**491**	**491**	**341**	**341**	**341**	**416**

[1]/ See Table 6.3　　[2]/ As described in Appendix B

Figure B.1 SWP Table A delivery probability under Current Conditions

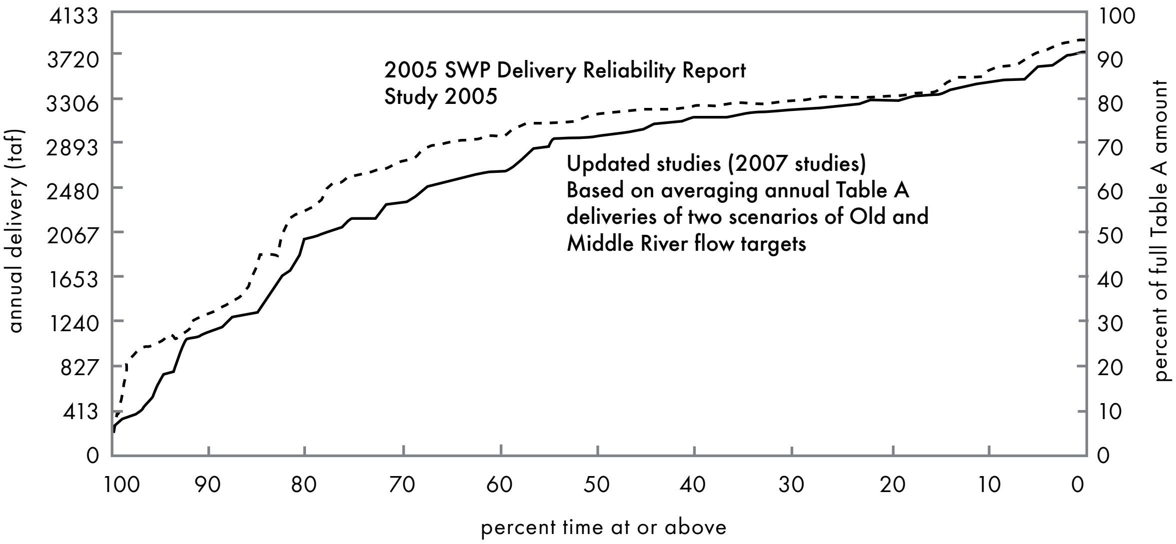


Figure B.2 SWP Table A delivery probability under Future Conditions

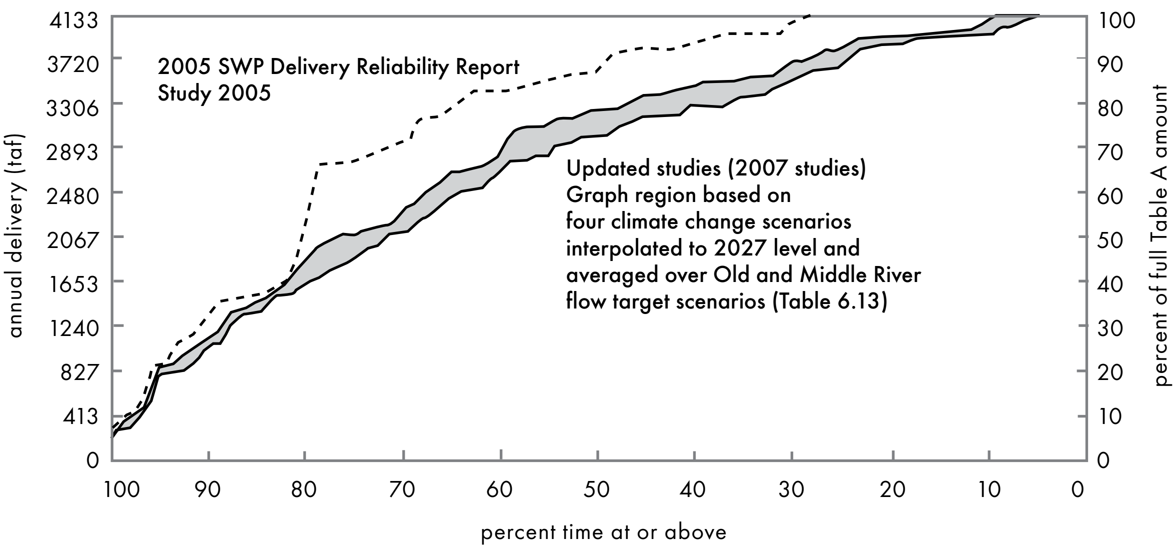


Figure B.3 SWP Table A delivery probability under Future Conditions for climate change scenarios with A2 emissions

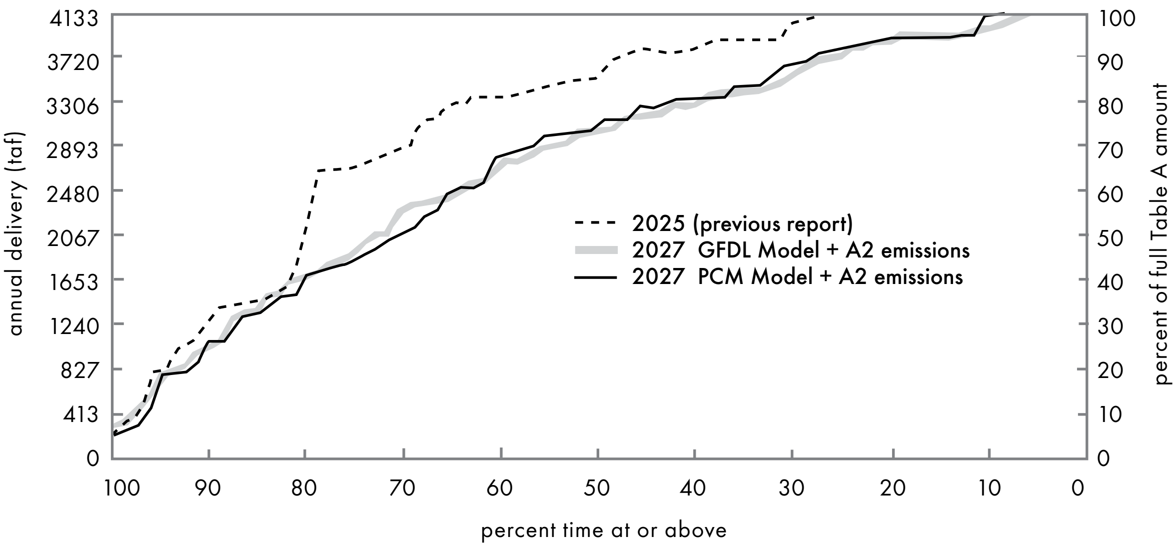


Figure B.4 SWP Table A delivery probability under Future Conditions for climate change scenarios with B1 emissions

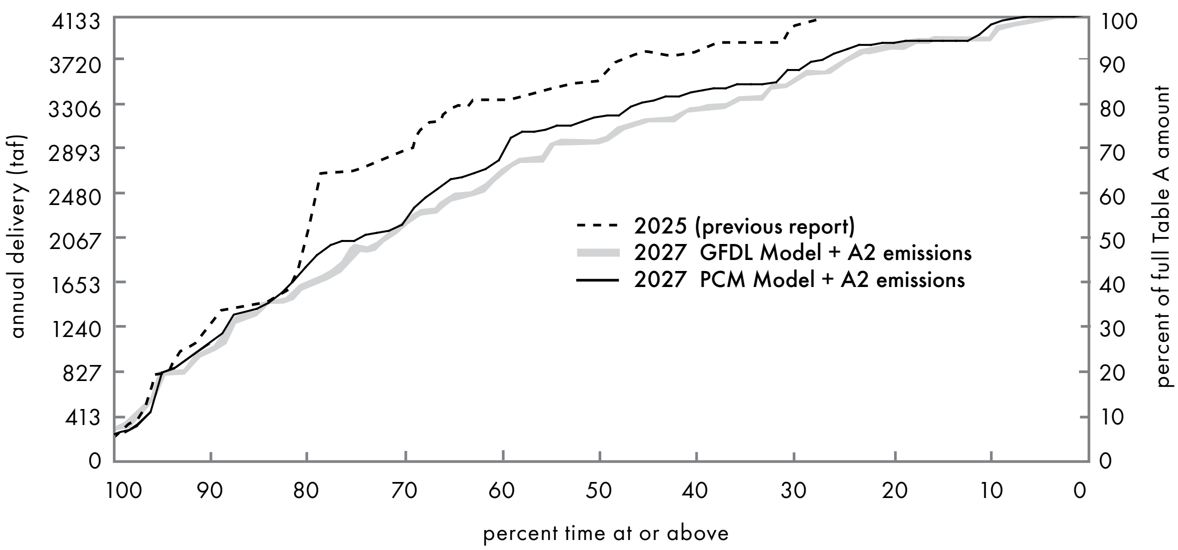


Table B.21 Highlighted SWP Table A delivery percent exceedence values under Current and Future Conditions

	Exceedence values (taf)		
	25%	**50%**	**75%**
2005 SWP Delivery Reliability Report			
Current (2005)	3323	3173	2588
Future (2025)	4133	3565	2738
Updated studies			
Current (2007)	3218	2976	2168
Future (2027)[1]			
GFDL+A2	3703	3017	1883
GFDL+B1	3686	2967	1966
PCM+A2	3782	3084	1860
PCM+B1	3813	3205	2077

1/ Based upon **SWP Table A** deliveries that have been interpolated between the "no climate change" scenario and the climate change scenarios determined by climate change model (GFDL or PCM) and greenhouse gas emissions scenario (A2 or B1). **SWP Table A** deliveries for two scenarios of Old River and Middle River flow targets were then averaged.

Table B.22 Comparing total SWP deliveries under Current Conditions from updated studies to deliveries from 2005 Report

Year	Total SWP Deliveries (Table A + Article 21)			Year	Total SWP Deliveries (Table A + Article 21)		
	study 2005 (2005 Report) (taf)	updated study 2007[1] (taf)	Change in total SWP deliveries (taf)		study 2005 (2005 Report) (taf)	updated study 2007[1] (taf)	Change in total SWP deliveries (taf)
1922	3,847	3,674	-173	**1963**	4,020	3,406	-614
1923	3,358	3,159	-199	**1964**	3,323	2,211	-1,113
1924	1,244	400	-844	**1965**	3,236	2,861	-376
1925	1,870	1,644	-226	**1966**	3,800	3,265	-534
1926	3,035	2,186	-849	**1967**	3,870	3,125	-745
1927	4,058	3,699	-359	**1968**	3,881	3,379	-501
1928	3,518	2,059	-1,459	**1969**	2,907	2,825	-82
1929	1,108	753	-355	**1970**	3,809	3,717	-92
1930	2,972	2,028	-944	**1971**	3,341	3,317	-24
1931	1,018	1,105	88	**1972**	3,756	1,707	-2,049
1932	1,649	1,305	-344	**1973**	3,476	3,085	-390
1933	1,842	2,019	177	**1974**	4,038	3,232	-806
1934	1,746	1,315	-432	**1975**	4,132	3,391	-741
1935	3,998	3,334	-663	**1976**	3,455	2,609	-846
1936	3,573	3,124	-449	**1977**	159	243	84
1937	3,442	3,219	-223	**1978**	3,903	3,699	-203
1938	4,058	3,982	-76	**1979**	3,661	3,128	-533
1939	3,612	3,348	-264	**1980**	2,847	2,898	52
1940	3,374	3,165	-209	**1981**	3,904	3,128	-777
1941	2,773	2,576	-197	**1982**	3,691	3,430	-260
1942	4,086	3,665	-420	**1983**	2,898	2,897	-1
1943	3,727	3,667	-60	**1984**	3,318	3,687	370
1944	3,091	2,930	-161	**1985**	3,214	3,198	-16
1945	3,460	3,085	-375	**1986**	2,417	2,321	-97
1946	3,464	3,199	-265	**1987**	3,442	2,825	-617
1947	3,292	2,314	-978	**1988**	856	477	-380
1948	2,942	2,609	-333	**1989**	3,174	3,130	-43
1949	2,264	1,271	-993	**1990**	1,099	360	-739
1950	3,199	2,462	-737	**1991**	1,052	729	-323
1951	3,886	3,718	-167	**1992**	1,426	1,087	-339
1952	2,863	2,685	-178	**1993**	4,007	3,711	-296
1953	3,836	3,413	-423	**1994**	3,306	2,105	-1,201
1954	3,817	3,201	-616	**1995**		3,061	
1955	2,207	1,137	-1,070	**1996**		3,845	
1956	3,911	3,838	-73	**1997**		3,443	
1957	3,492	2,545	-947	**1998**		3,147	
1958	4,086	3,388	-698	**1999**		3,816	
1959	3,846	3,511	-335	**2000**		3,451	
1960	1,865	1,460	-405	**2001**		1,164	
1961	2,756	2,357	-399	**2002**		2,162	
1962	3,262	2,962	-300	**2003**		2,943	

[1]/ Average of the two scenarios of Old River and Middle River flow targets described in Table 6-3.

Appendix C. State Water Project SWP Table A Amounts

The contracts between the Department of Water Resources and the 29 State Water Project water contractors define the terms and conditions governing the water delivery and cost repayment for the SWP. SWP Table A is an exhibit to these contracts. Comprehension of SWP Table A is important in understanding the information in this report. To understand the table, it is necessary to understand how the contracts work.

All water-supply related costs of the SWP are paid by the contractors, and SWP Table A serves as a basis for allocating some of the costs among the contractors. In addition, SWP Table A plays a key role in the annual allocation of available supply among contractors. When the SWP was being planned, the amount of water projected to be available for delivery to the contractors was 4.2 million acre-feet (maf) per year. This was referred to as the maximum project yield, and it was recognized that in some years the project would be unable to deliver that amount and in other years project supply could exceed that amount. The 4.2 maf number was used as the basis for apportioning available supply to each contractor and as a factor in calculating each contractor's share of the project's costs. This apportionment is accomplished by SWP Table A in each contract. SWP Table A lists by year and acre-feet the portion of the 4.2 maf deliverable to each contractor. Other contract provisions permit changes to an individual contractor's SWP Table A under special circumstances. The total of the maximums in all the contracts now equals 4.173 maf.

A copy of the consolidated SWP Table A from all the contracts is presented in **Table C.1**. The amounts listed in SWP Table A cannot be viewed as an indication of the SWP water delivery reliability, nor should these amounts be used to support an expectation that a certain amount of water will be delivered to a contractor in any particular time span. SWP Table A is simply a tool for apportioning available supply and cost obligations under the contract. In this report, reference to "SWP Table A amounts" means the amounts listed in SWP Table A. Contractors also receive other classifications of water from the project, as distinguished from SWP Table A (for example, Article 21 water, and turnback pool water). These other contract provisions are discussed in Appendix D.

Table C.1 Maximum annual SWP Table A amounts (af)

SWP Contractors	Maximum SWP Table A
North Bay	
Napa County FC&WCD	29,025
Solano County WA	47,756
Subtotal	**76,781**
South Bay	
Alameda County FC&WCD, Zone 7	80,619
Alameda County WD	42,000
Santa Clara Valley WD	100,000
Subtotal	**222,619**
San Joaquin Valley	
Oak Flat WD	5,700
County of Kings	9,305
Dudley Ridge WD	57,343
Empire West Side ID	3,000
Kern County WA	998,730
Tulare Lake Basin WSD	95,922
Subtotal	**1,170,000**
Central Coastal	
San Luis Obispo County FC&WCD	25,000
Santa Barbara County FC&WCD	45,486
Subtotal	**70,486**
Southern California	
Antelope Valley-East Kern WA	141,400
Castaic Lake WA	95,200
Coachella Valley WD	121,100
Crestline-Lake Arrowhead WA	5,800
Desert WA	50,000
Littlerock Creek ID	2,300
Mojave WA	75,800
Metropolitan WDSC	1,911,500
Palmdale WD	21,300
San Bernardino Valley MWD	102,600
San Gabriel Valley MWD	28,800
San Gorgonio Pass WA	17,300
Ventura County FCD	20,000
Subtotal	**2,593,100**
Delta Subtotal	**4,132,986**
Feather River	
County of Butte	27,500
Plumas County FC&WCD	2,700
City of Yuba City	9,600
Subtotal	**39,800**
Grand Total	**4,172,786**

Appendix D. Recent State Water Project Deliveries

SWP Contract Water Types

The State Water Project contracts define several classifications of water available for delivery to contractors under specific circumstances. All classifications are considered "project" water. Many contractors make frequent use of these additional water types to increase or decrease the amount available to them under SWP Table A.

SWP Table A Water

Each contract's SWP Table A amount is the value in acre-feet that is used to determine the portion of available supply to be delivered to that contractor. *Table A* water is water delivered according to this apportionment methodology and is given first priority for delivery.

Article 21 Water

Article 21 of the contracts permits delivery of water excess to delivery of SWP Table A and some other water types to those contractors requesting it. It is available under specific conditions discussed in Chapter 4. Article 21 water is apportioned to those contractors requesting it in the same proportion as their SWP Table A.

Turnback Pool Water

Contractors may choose to offer their allocated SWP Table A water in excess to their needs to other contractors through two pools in February and March. Contributing contractors receive a reduction in charges, and taking contractors pay extra.

Carryover Water

Pursuant to the long-term water supply contracts, the Department of Water Resources (DWR) has offered contractors the opportunity to carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. The carryover program was designed to encourage the most effective and beneficial use of water and to avoid obligating the contractors to use or lose the water by December 31 of each year. The water supply contracts state the criteria of carrying over SWP Table A water from one year to the next. Normally, carryover water is water that has been exported during the year, has not been delivered to the contractor during that year, and has remained stored in the SWP share of San Luis Reservoir to be delivered during the following year. Storage for carryover water no longer becomes available to the contractors if it interferes with storage of SWP water for project needs.

Updated Historical Deliveries

Table D.1 through D.10 list annual historical deliveries by various water classifications for each contractor for 1997 through 2006. Similar delivery tables for years 1995 through 2004 are included in the *State Water Project Delivery Reliability Report 2005*. Amounts listed for 2004 are slightly different due to accounting adjustments made by DWR's State Water Project Analysis Office.

Table D.1 Historical State Water Project Deliveries: 1997

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	185	0	0	0	**185**
Plumas County FC&WCD	231	0	0	0	**231**
City of Yuba City	1,005	0	0	0	**1,005**
Napa County FC&WCD	4,341	0	0	0	**4,341**
Solano County WA	35,530	0	0	0	**35,530**
Alameda County FC&WCD, Zone 7	27,522	0	0	0	**27,522**
Alameda County WD	24,063	0	0	0	**24,063**
Santa Clara Valley WD	95,601	0	0	0	**95,601**
Oak Flat WD	5,238	0	0	0	**5,238**
Dudley Ridge WD	51,623	7,141	12,544	0	**71,308**
Kern County WA	1,092,543	10,264	0	0	**1,102,807**
Tulare Lake Basin WSD	21,156	1,213	0	0	**22,369**
San Luis Obispo County FC&WCD	1,199	0	0	0	**1,199**
Santa Barbara County FC&WCD	7,439	0	0	0	**7,439**
Antelope Valley-East Kern WA	61,752	641	0	0	**62,393**
Castaic Lake WA (+Rch 31A, 5 & 7)	27,712	0	0	0	**27,712**
Coachella Valley WD	23,100	0	35,000	0	**58,100**
Crestline-Lake Arrowhead WA	651	0	0	0	**651**
Desert WA	38,100	0	15,000	0	**53,100**
Littlerock Creeck ID	444	0	0	0	**444**
Mojave WA	10,374	0	0	0	**10,374**
Metropolitan WDSC	738,990	0	0	0	**738,990**
Palmdale WD	11,861	0	0	0	**11,861**
San Bernardino Valley MWD	9,654	0	0	0	**9,654**
San Gabriel Valley MWD	16,002	2,173	0	0	**18,175**
Ventura County FCD	1,850	0	0	0	**1,850**
Totals	**2,308,166**	**21,432**	**62,544**	**0**	**2,392,142**
Total South of Delta	**2,306,745**	**21,432**	**62,544**	**0**	**2,390,721**

Table D.2 Historical State Water Project Deliveries: 1998

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	527	0	0	0	**527**
City of Yuba City	1,054	0	0	0	**1,054**
Napa County FC&WCD	5,359	0	0	0	**5,359**
Solano County WA	21,377	9,982	0	407	**31,766**
Alameda County FC&WCD, Zone 7	17,941	0	0	0	**17,941**
Alameda County WD	19,075	0	0	0	**19,075**
Santa Clara Valley WD	62,526	0	0	884	**63,410**
Oak Flat WD	4,401	0	0	0	**4,401**
County of Kings	3	12	0	0	**15**
Dudley Ridge WD	52,919	984	0	1,747	**55,650**
Empire West Side ID	0	0	0	542	**542**
Kern County WA	856,906	0	0	1,684	**858,590**
Tulare Lake Basin WSD	11,367	9,310	0	0	**20,677**
San Luis Obispo County FC&WCD	3,592	0	0	0	**3,592**
Santa Barbara County FC&WCD	18,618	0	0	0	**18,618**
Antelope Valley-East Kern WA	52,926	0	0	0	**52,926**
Castaic Lake WA (+Rch 31A, 5 & 7)	20,093	0	0	0	**20,093**
Coachella Valley WD	23,100	0	55,000	0	**78,100**
Crestline-Lake Arrowhead WA	187	0	0	0	**187**
Desert WA	38,100	0	20,000	0	**58,100**
Littlerock Creek ID	404	0	0	0	**404**
Mojave WA	3,925	0	0	0	**3,925**
Metropolitan WDSC	359,213	0	0	33,672	**392,885**
Palmdale WD	8,752	0	0	0	**8,752**
San Bernardino Valley MWD	1,878	0	0	0	**1,878**
San Gabriel Valley MWD	9,310	0	0	0	**9,310**
Ventura County FCD	1,850	0	0	0	**1,850**
Totals	**1,595,403**	**20,288**	**75,000**	**38,936**	**1,729,627**
Total South of Delta	**1,593,822**	**20,288**	**75,000**	**38,936**	**1,728,046**

Table D.3 Historical State Water Project Deliveries: 1999

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	286	0	0	0	**286**
City of Yuba City	1,096	0	0	0	**1,096**
Napa County FC&WCD	4,550	754	0	0	**5,304**
Solano County WA	37,753	0	0	0	**37,753**
Alameda County FC&WCD, Zone 7	46,000	2,910	0	0	**48,910**
Alameda County WD	34,871	2,781	0	0	**37,652**
Santa Clara Valley WD	67,465	15,480	0	0	**82,945**
Oak Flat WD	4,871	0	0	0	**4,871**
County of Kings	4,000	0	0	0	**4,000**
Dudley Ridge WD	51,870	4,990	6,566	0	**63,426**
Empire West Side ID	3,000	176	0	0	**3,176**
Kern County WA	1,077,755	58,241	42,154	0	**1,178,150**
Tulare Lake Basin WSD	118,500	49,898	121,337	0	**289,735**
San Luis Obispo County FC&WCD	3,743	0	0	0	**3,743**
Santa Barbara County FC&WCD	20,137	0	0	0	**20,137**
Antelope Valley-East Kern WA	69,073	0	0	0	**69,073**
Castaic Lake WA (+Rch 31A, 5 & 7)	32,899	0	0	0	**32,899**
Coachella Valley WD	23,100	0	27,380	0	**50,480**
Crestline-Lake Arrowhead WA	1,132	0	0	0	**1,132**
Desert WA	38,100	0	20,000	0	**58,100**
Littlerock Creek ID	342	0	0	0	**342**
Mojave WA	5,144	0	0	0	**5,144**
Metropolitan WDSC	829,777	22,840	0	0	**852,617**
Palmdale WD	13,278	0	0	0	**13,278**
San Bernardino Valley MWD	12,874	0	0	0	**12,874**
San Gabriel Valley MWD	18,000	0	0	0	**18,000**
Ventura County FCD	1,850	0	0	0	**1,850**
Totals	**2,521,466**	**158,070**	**217,437**	**0**	**2,896,973**
Total South of Delta	**2,520,084**	**158,070**	**217,437**	**0**	**2,895,591**

Table D.4 Historical State Water Project Deliveries: 2000

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	586	0	0	0	**586**
City of Yuba City	901	0	0	0	**901**
Napa County FC&WCD	3,136	297	0	1,525	**4,958**
Solano County WA	32,882	1,040	0	1,417	**35,339**
Alameda County FC&WCD, Zone 7	53,877	3,740	0	0	**57,617**
Alameda County WD	33,598	2,380	0	0	**35,978**
Santa Clara Valley WD	70,433	18,381	0	13,174	**101,988**
Oak Flat WD	4,494	0	0	14	**4,508**
County of Kings	3,600	0	0	0	**3,600**
Dudley Ridge WD	38,673	7,454	12,193	2,884	**61,204**
Empire West Side ID	1,271	528	0	0	**1,799**
Kern County WA	825,856	78,908	233,202	13,193	**1,151,159**
Tulare Lake Basin WSD	98,595	56,818	27,073	15,827	**198,313**
San Luis Obispo County FC&WCD	3,962	0	0	0	**3,962**
Santa Barbara County FC&WCD	22,741	0	0	0	**22,741**
Antelope Valley-East Kern WA	83,577	0	0	0	**83,577**
Castaic Lake WA (+Rch 31A, 5 & 7)	40,680	0	0	0	**40,680**
Coachella Valley WD	20,790	17,820	3,713	0	**42,323**
Crestline-Lake Arrowhead WA	1,194	0	0	0	**1,194**
Desert WA	34,290	17,820	6,124	0	**58,234**
Mojave WA	9,135	0	0	0	**9,135**
Metropolitan WDSC	1,273,729	103,124	0	169,529	**1,546,382**
Palmdale WD	8,221	0	0	839	**9,060**
San Bernardino Valley MWD	18,399	0	0	0	**18,399**
San Gabriel Valley MWD	14,000	475	0	0	**14,475**
Ventura County FCD	4,050	0	0	0	**4,050**
Totals	**2,702,670**	**308,785**	**282,305**	**218,402**	**3,512,162**
Total South of Delta	**2,701,183**	**308,785**	**282,305**	**218,402**	**3,510,675**

Table D.5 Historical State Water Project Deliveries: 2001

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	513	0	0	0	**513**
City of Yuba City	1,065	0	0	0	**1,065**
Napa County FC&WCD	4,293	996	82	1,723	**7,094**
Solano County WA	17,756	2,304	0	1,021	**21,081**
Alameda County FC&WCD, Zone 7	22,307	0	308	5,990	**28,605**
Alameda County WD	13,695	10	107	4,192	**18,004**
Santa Clara Valley WD	35,689	0	0	12,233	**47,922**
Oak Flat WD	2,089	0	22	101	**2,212**
County of Kings	1,560	0	0	0	**1,560**
Dudley Ridge WD	18,467	933	347	6,815	**26,562**
Empire West Side ID	0	253	0	1,107	**1,360**
Kern County WA	363,204	23,233	6,502	92,052	**484,991**
Tulare Lake Basin WSD	40,830	8,755	769	7,889	**58,243**
San Luis Obispo County FC&WCD	4,184	0	99	0	**4,283**
Santa Barbara County FC&WCD	14,285	396	296	0	**14,977**
Antelope Valley-East Kern WA	45,071	0	899	0	**45,970**
Castaic Lake WA (+Rch 31A, 5 & 7)	30,471	850	618	0	**31,939**
Coachella Valley WD	9,009	0	91	0	**9,100**
Crestline-Lake Arrowhead WA	1,057	0	0	0	**1,057**
Desert WA	14,859	0	151	0	**15,010**
Mojave WA	4,433	0	0	0	**4,433**
Metropolitan WDSC	686,545	10,415	7,949	200,000	**904,909**
Palmdale WD	8,170	0	0	2,257	**10,427**
San Bernardino Valley MWD	26,488	0	0	0	**26,488**
San Gabriel Valley MWD	6,534	0	0	0	**6,534**
Ventura County FCD	1,850	0	0	0	**1,850**
Totals	**1,374,424**	**48,145**	**18,240**	**335,380**	**1,776,189**
Total South of the Delta	**1,372,846**	**48,145**	**18,240**	**335,380**	**1,774,611**

Table D.6 Historical State Water Project Deliveries: 2002

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	419	0	0	0	**419**
City of Yuba City	1,181	0	0	0	**1,181**
Napa County FC&WCD	2,022	827	283	3,743	**6,875**
Solano County WA	28,223	2,242	0	0	**30,465**
Alameda County FC&WCD, Zone 7	40,707	1,484	556	8,113	**50,860**
Alameda County WD	24,250	83	862	2,331	**27,526**
Santa Clara Valley WD	55,896	202	2,053	3,311	**61,462**
Oak Flat WD	3,841	50	76	134	**4,101**
County of Kings	2,800	0	54	0	**2,854**
Dudley Ridge WD	38,688	1,861	1,177	1,994	**43,720**
Empire West Side ID	1,278	26	0	101	**1,405**
Kern County WA	670,884	21,951	20,543	15,680	**729,058**
Tulare Lake Basin WSD	73,785	3,749	2,289	5,385	**85,208**
San Luis Obispo County FC&WCD	4,355	0	0	0	**4,355**
Santa Barbara County FC&WCD	24,166	436	324	3,455	**28,381**
Antelope Valley-East Kern WA	53,907	0	1,008	3,256	**58,171**
Castaic Lake WA (+Rch 31A, 5 & 7)	61,880	280	0	6,657	**68,817**
Coachella Valley WD	16,170	111	474	0	**16,755**
Crestline-Lake Arrowhead WA	2,189	0	0	0	**2,189**
Desert WA	26,670	189	781	0	**27,640**
Mojave WA	4,346	0	0	0	**4,346**
Metropolitan WDSC	1,273,205	9,624	14,335	97,940	**1,395,104**
Palmdale WD	8,359	0	437	0	**8,796**
San Bernardino Valley MWD	68,268	0	0	3,801	**72,069**
San Gabriel Valley MWD	18,353	0	0	4,698	**23,051**
Ventura County FCD	4,998	0	0	0	**4,998**
Totals	**2,510,840**	**43,115**	**45,252**	**160,599**	**2,759,806**
Total South of the Delta	**2,509,240**	**43,115**	**45,252**	**160,599**	**2,758,206**

Table D.7 Historical State Water Project Deliveries: 2003

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	551	0	0	0	**551**
City of Yuba City	1,324	0	0	0	**1,324**
Napa County FC&WCD	6,026	376	180	1,055	**7,637**
Solano County WA	25,135	2,280	0	1,918	**29,333**
Alameda County FC&WCD, Zone 7	30,695	0	656	13,099	**44,450**
Alameda County WD	31,086	0	354	5,150	**36,590**
Santa Clara Valley WD	90,620	936	841	14,104	**106,501**
Oak Flat WD	4,059	19	48	140	**4,266**
County of Kings	3,600	58	34	0	**3,692**
Dudley Ridge WD	49,723	1,928	482	1,452	**53,585**
Empire West Side ID	1,074	175	0	187	**1,436**
Kern County WA	841,697	27,891	8,419	22,380	**900,387**
Tulare Lake Basin WSD	94,376	6,243	938	4,284	**105,841**
San Luis Obispo County FC&WCD	4,417	36	0	0	**4,453**
Santa Barbara County FC&WCD	24,312	339	43	2,274	**26,968**
Antelope Valley-East Kern WA	52,730	0	250	7,049	**60,029**
Castaic Lake WA (+Rch 31A, 5 & 7)	49,895	991	90	4,760	**55,736**
Coachella Valley WD	14,045	204	194	0	**14,443**
Crestline-Lake Arrowhead WA	1,563	0	0	0	**1,563**
Desert WA	23,168	330	321	0	**23,819**
Mojave WA	10,907	0	0	3,528	**14,435**
Metropolitan WDSC	1,550,356	17,622	16,920	134,845	**1,719,743**
Palmdale WD	9,701	0	0	1,846	**11,547**
San Bernardino Valley MWD	25,371	200	0	1,844	**27,415**
San Gabriel Valley MWD	13,034	200	0	0	**13,234**
San Gorgonio Pass WA	116	0	0	0	**116**
Ventura County FCD	5,000	0	0	0	**5,000**
Totals	**2,964,581**	**59,828**	**29,770**	**219,915**	**3,274,094**
Total South of the Delta	**2,962,706**	**59,828**	**29,770**	**219,915**	**3,272,219**

Table D.8 Historical State Water Project Deliveries: 2004

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	1,440	0	0	0	**1,440**
City of Yuba City	1,434	0	0	0	**1,434**
Napa County FC&WCD	5,030	1,450	52	1,602	**8,134**
Solano County WA	17,991	7,787	0	47	**25,825**
Alameda County FC&WCD, Zone 7	39,898	0	0	11,466	**51,364**
Alameda County WD	20,956	0	214	6,714	**27,884**
Santa Clara Valley WD	52,867	2,983	508	0	**56,358**
Oak Flat WD	4,324	0	29	276	**4,629**
County of Kings	5,850	3,157	46	0	**9,053**
Dudley Ridge WD	36,377	7,393	291	2,185	**46,246**
Empire West Side ID	1,310	626	0	1,626	**3,562**
Kern County WA	640,190	86,513	5,075	40,120	**771,898**
Tulare Lake Basin WSD	58,575	15,299	489	5,638	**80,001**
San Luis Obispo County FC&WCD	4,096	69	0	0	**4,165**
Santa Barbara County FC&WCD	29,566	0	122	0	**29,688**
Antelope Valley-East Kern WA	50,532	0	0	9,199	**59,731**
Castaic Lake WA (+Rch 31A, 5 & 7)	46,358	1,618	0	35,785	**83,761**
Coachella Valley WD	8,631	0	89	6,745	**15,465**
Crestline-Lake Arrowhead WA	2,006	0	0	0	**2,006**
Desert WA	9,966	0	102	11,122	**21,190**
Mojave WA	11,176	0	0	0	**11,176**
Metropolitan WDSC	1,195,807	91,601	10,223	215,000	**1,512,631**
Palmdale WD	10,549	0	0	1,613	**12,162**
San Bernardino Valley MWD	35,522	0	0	20,631	**56,153**
San Gabriel Valley MWD	15,600	0	0	0	**15,600**
San Gorgonio Pass WA	841	0	0	0	**841**
Ventura County FCD	5,250	0	0	0	**5,250**
Totals	**2,312,142**	**218,496**	**17,240**	**369,769**	**2,917,647**
Total South of the Delta	**2,309,268**	**218,496**	**17,240**	**369,769**	**2,914,773**

Table D.9 Historical State Water Project Deliveries: 2005

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	527	0	0	0	**527**
City of Yuba City	1,894	0	0	0	**1,894**
Napa County FC&WCD	5,322	606	0	1,741	**7,669**
Solano County WA	24,515	10,421	0	83	**35,019**
Alameda County FC&WCD, Zone 7	38,388	0	275	7,849	**46,512**
Alameda County WD	36,469	846	943	6,341	**44,599**
Santa Clara Valley WD	89,476	6,298	342	11,899	**108,015**
Oak Flat WD	4,067	0	127	0	**4,194**
County of Kings	8,100	11,504	202	0	**19,806**
Dudley Ridge WD	51,609	28,197	1,286	821	**81,913**
Empire West Side ID	1,448	1,799	0	587	**3,834**
Kern County WA	893,439	453,078	22,397	9,851	**1,378,765**
Tulare Lake Basin WSD	86,604	47,267	2,158	3,973	**140,002**
San Luis Obispo County FC&WCD	4,006	245	0	0	**4,251**
Santa Barbara County FC&WCD	22,981	0	155	0	**23,136**
Antelope Valley-East Kern WA	57,205	0	0	2,626	**59,831**
Castaic Lake WA (+Rch 31A, 5 & 7)	54,303	2,451	0	2,702	**59,456**
Coachella Valley WD	26,984	0	2,716	12,819	**42,519**
Crestline-Lake Arrowhead WA	807	0	0	0	**807**
Desert WA	33,168	0	1,122	14,799	**49,089**
Mojave WA	10,360	0	0	1,201	**11,561**
Metropolitan WDSC	1,269,291	168,300	6,530	106,032	**1,550,153**
Palmdale WD	10,174	0	0	1,538	**11,712**
San Bernardino Valley MWD	31,211	56	0	283	**31,550**
San Gabriel Valley MWD	10,500	0	0	0	**10,500**
San Gorgonio Pass WA	677	15	0	0	**692**
Ventura County FCD	1,665	0	0	0	**1,665**
Totals	**2,775,190**	**731,083**	**38,253**	**185,145**	**3,729,671**
Total South of the Delta	**2,772,769**	**731,083**	**38,253**	**185,145**	**3,727,250**

Table D.10 Historical State Water Project Deliveries: 2006

	SWP Table A	Article 21	Turnback	Carryover	Total
County of Butte	468	0	0	0	**468**
City of Yuba City	4,148	1,194	0	0	**5,342**
Napa County FC&WCD	7,312	300	0	172	**7,784**
Solano County WA	12,070	18,195	0	390	**30,655**
Alameda County FC&WCD, Zone 7	50,785	0	491	2,252	**53,528**
Alameda County WD	0	2,375	39,373	1,331	**43,079**
Santa Clara Valley WD	47,344	26,769	0	524	**74,637**
Oak Flat WD	4,118	0	107	17	**4,242**
County of Kings	8,991	366	173	0	**9,530**
Dudley Ridge WD	55,343	18,515	1,068	0	**74,926**
Empire West Side ID	1,500	1,124	0	658	**3,282**
Kern County WA	961,882	256,634	18,610	5,418	**1,242,544**
Tulare Lake Basin WSD	48,361	59,424	1,787	0	**109,572**
San Luis Obispo County FC&WCD	3,382	827	0	0	**4,209**
Santa Barbara County FC&WCD	19,255	4,020	0	0	**23,275**
Antelope Valley-East Kern WA	76,623	0	0	3,761	**80,384**
Castaic Lake WA (+Rch 31A, 5 & 7)	56,758	2,089	0	3,905	**62,752**
Coachella Valley WD	121,100	0	0	0	**121,100**
Crestline-Lake Arrowhead WA	257	0	0	0	**257**
Desert WA	50,000	0	0	0	**50,000**
Mojave WA	32,496	0	0	1,518	**34,014**
Metropolitan WDSC	1,103,538	238,478	11,638	136,424	**1,490,078**
Palmdale WD	10,374	1,653	130	335	**12,492**
San Bernardino Valley MWD	31,902	0	0	3,427	**35,329**
San Gabriel Valley MWD	13,524	0	0	0	**13,524**
San Gorgonio Pass WA	4,262	0	0	0	**4,262**
Ventura County FCD	1,850	0	0	0	**1,850**
Totals	**2,727,643**	**631,963**	**73,377**	**160,132**	**3,593,115**
Total South of the Delta	**2,723,027**	**630,769**	**73,377**	**160,132**	**3,587,305**

Appendix E. Comment Letters on the Draft Report and the Department's Responses

Written comments from the public on the *Draft State Water Project Delivery Reliability Report* (December 2007) were accepted through March 13, 2008. These letters and the responses to them are contained in this appendix.

Index

california water impact network

March 11, 2008

California Department of Water Resources
SWP Delivery Reliability Report-Attn: Cynthia Pierson
PO Box 942836
Sacramento, CA 94236-0001

RE: Accuracy of SWP Delivery Reliability Report

Dear Sirs,

The California Water Impact Network (C-WIN) appreciates this opportunity to comment on the 2007 draft SWP Delivery Reliability Report. We believe the conclusion reached about the average reliability of the SWP at 66% is seriously misleading. Water agencies and planners will be relying on this number and could cause serious harm if this is not accurate.

How is the 66% reliability estimate in the draft Reliability Report, which purportedly takes the Wanger decision into consideration, consistent with assertions made in the most recent allocation estimate, which was issued just after snow surveys reported an above average snowpack.

The most recent estimates from DWR place the reliability of the SWP, even in this year's high snow pack scenario, at **35%**. In the DWR press release giving the 35% reliability figure for 2008, DWR also notes that without the Wanger decision, the figure from DWR would have been 50% delivery of Table A amounts.

C-WIN urges you to make sure that the final SWP Delivery Reliability Report accurately reflects the ability of the SWP to deliver water to the 29 SWP contractors who depend on it. The draft Reliability Report does not appear to be accurate.

Sincerely,

Carolee Krieger

Carolee Krieger, President

STATE OF CALIFORNIA -- THE RESOURCES AGENCY **ARNOLD SCHWARZENEGGER,** *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Ms. Carolee Krieger, President
California Water Impact Network
808 Romero Canyon Road
Santa Barbara, CA 93108

Dear Ms. Krieger:

This letter responds to your letter dated March 11, 2008 providing comments of the California Water Impact Network on the draft of the State Water Project Delivery Reliability Report—2007 (DRR2007).

In your letter, you express concern for the accuracy of the reliability of SWP deliveries presented in the DRR 2007. You state that the report concludes that the average reliability of the SWP under interim export restrictions to protect Delta smelt is 66 percent. You contrast this value with an estimate done in February 2008 by the Department of Water Resources that, despite above normal snowpack in 2008, SWP deliveries in 2008 would be 35 percent of SWP Contractors' 2008 Table A amounts and would be 50 percent if the federal court-ordered 2008 Delta export restrictions to protect Delta smelt were not in-place.

I believe the average SWP delivery reliability of 66 percent you refer to in your letter is actually listed as 63 percent in Tables 6-4, 6-5, 6-6, 6-20, 6-21, 6-22, and 7-1. This value is the average annual SWP Table A delivery under current conditions over the 82-year simulation period, expressed in terms of percent of maximum Table A amounts. The value of 63 percent is the mathematical average of 82 values which range from 6 percent to 90 percent (Table 6-4). As shown in Table 6-5, average SWP deliveries over several multiple-year dry periods range from 34 to 35 percent of maximum Table A amounts. Thus, there is considerable variability in the annual SWP Table A deliveries presented in the draft report under current conditions. Year-to-year variability in simulated deliveries is attributed to several factors including varying precipitation and the amount of water stored in SWP conservation reservoirs.

DWR estimates of actual SWP contractors deliveries depend in part upon existing storage in SWP reservoirs, SWP operational constraints, and contractor demands. The SWP started the 2008 water year (October 1, 2007) with storage amounts in its reservoirs that were well below normal. Thus, while the February 28, 2008 DWR news release, which estimated SWP contractor deliveries at 35 percent of full Table A amounts, pointed to a normal or above-normal Sierra snowpack, that same news release quoted a DWR manager in its Hydrology Branch as cautioning that “additional precipitation is still needed to alleviate the deficits to water supply conditions that existed at the start of the [water supply] season.”

Thus, an estimate of SWP contractor deliveries for an individual water year with under near-normal snowpack conditions is not comparable to a long-term average of simulated deliveries, which incorporates a wide range of precipitation and reservoir storage conditions.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department’s responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

March 13, 2008

California Department of Water Resources
PO Box 942836
Sacramento, California 94236-0001

Attn: Cynthia Pierson

Subject: State Water Project (SWP) Delivery Reliability Project

The Draft SWP Delivery Reliability Report 2007 (Report) updates the Department of Water Resources (DWR) estimate of current (2007) and future (2027) SWP delivery reliability and expands the conditions under which reliability is quantified. The report is produced every two years. 2027 potential deliveries are based on the assumption that no changes will be made in either the way water is conveyed across the Delta or in the interim operating rules to protect Delta smelt. It shows a continued eroding of SWP water delivery reliability under the current method of moving water through the Delta.

The staff of the Delta Protection Commission (Commission) has reviewed the subject document dated January 2008. From the information provided, staff has determined that the proposed project is located within the Primary Zone of the Legal Delta and a apportion of the Secondary Zone , and is therefore subject to consistency with the Land Use and Resource Management Plan for the Primary Zone (Management Plan) and appeal to the commission.

The Delta Protection Act (Act) was enacted in 1992 in recognition of the increasing threats to the resources of the Primary Zone of the Delta from urban and suburban encroachment having the potential to impact agriculture, wildlife habitat, and recreation uses. Pursuant to the Act, a Management Plan was completed and adopted by the Commission in 1995.

The Management Plan sets out findings, policies, and recommendations resulting from background studies in the areas of environment, utilities and infrastructure, land use, agriculture, water, recreation and access, levees, and marine patrol/boater education/safety programs.

The policy from the Management Plan that is relevant to this project includes, but is not limited to the following:

Water

- Policy 3: "Water agencies at local, State, and federal levels shall work together to ensure that adequate Delta water quality standards are set and met and that beneficial uses of State waters are protected consistent with the CALFED (see Water code Section 12310(f) Record of Decision dated August 8, 2000."

The Recommendations in the Management Plan which are intended to help achieve the Policies , which are relevant to this project are as follows:

- ."Recommendation 1: "The Delta waterways should continue to serve as a primary transportation system moving water to the State's natural and developed water systems."
- Recommendation 2:"Delta water rights should be respected and protected."
- Recommendation 3: " Programs to enhance the natural values of the State's aquatic habitats and water quality will benefit the Delta and should be supported."

A copy of the Management Plan and the Act are available at the Commission's web site www.delta.ca.gov for your reference. Please contact me at (916) 776-2292 or lindadpc@citlink.net if you have any questions regarding the Commission or the comments provided herein.

Sincerely,

Linda Fiack
Executive Director

Cc: Kathy Kelly,
Chief, Bay-Delta Office, DWR

STATE OF CALIFORNIA -- THE RESOURCES AGENCY **ARNOLD SCHWARZENEGGER,** *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Ms. Linda Fiack, Executive Director
Delta Protection Commission
14215 River Road
PO Box 530
Walnut Grove, CA 95690

Dear Ms. Fiack:

This letter responds to your letter dated March 13, 2008 providing comments of the Delta Protection Commission on the draft of the State Water Project Delivery Reliability Report—2007 (DRR(2007)).

In your letter, you state that the DRR (2007) is subject to consistency with the Delta Protection Commission's 1995 comprehensive long-term resource management plan, *Land Use and Resource Management Plan for the Primary Zone of the Delta.* As such, the DRR (2007) is subject to the Management Plan's Policy 3 which states that local,

State and federal water agencies "shall work together to ensure that adequate Delta water quality standards are set and met and that beneficial uses of State waters are protected consistent with CALFED." You also site three recommendations in the Management Plan for achieving its policies which you find to be relevant to the DRR (2007): Recommendation 1, which states that Delta waterways should continue to serve as a primary transportation system moving water to the State's natural and developed water systems; Recommendation 2, which states that Delta water rights should be respected and protected; and Recommendation 3, which states that programs to enhance the natural values of the State's aquatic habitats and water quality will benefit the Delta and should be supported.

The DRR (2007) is consistent with Policy 3 and Recommendations 1, 2, and 3 in the *1995 Land Use and Resource Management Plan for the Primary Zone of the Delta.* The SWP delivery reliability estimates in the DDR (2007) are based upon CalSim II simulations of both SWP and CVP operations. These simulations under both current and future conditions assume several factors including: existing Delta water quality standards protecting beneficial use of Delta water are met; existing Delta water rights continue; the 2007 federal court-ordered interim flow standards to protect delta smelt are in place; and Delta waterways and the means of conveying water to Banks and Jones Pumping Plants remain unchanged.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

Comments of the California Department of Water Resources'
Transmission Planning Branch
On the California Department of Water Resources'
"State Water Project Delivery Reliability Report 2007"
March 13, 2008

The Transmission Planning Branch of the California Department of Water Resources' Power Planning and Risk Management Office submits the following comments regarding the "State Water Project Delivery Reliability Report 2007":

The biennial report identifies factors that may impact water availability along with changes that can be made to improve future water supply reliability. The report updates DWR's estimate of the ability to maintain current (2007) and future (2027) State Water Project (SWP) delivery reliability.

The report identifies various factors that affect the SWP's ability to convey source water to the desired point of delivery. Among the factors identified as affecting Delta pumping operations were water quality constraints, fish and wildlife constraints, future sea level rise impacts associated with climate change, and levee failure impacts. However, the report did not, but should, address another important factor – potential restrictions on Banks Pumping Plant operation due to curtailment of energy transmission service to operate the pumps.

The SWP pumping plants in the Delta receive transmission service under the Comprehensive Agreement between DWR and Pacific Gas and Electric (PG&E). Under this agreement, which terminates on December 31, 2014, DWR has contractual rights for up to 275 megawatts (MW) of transmission service at the Banks Pumping Plant switchyard. However, only 157 MW is firm service; the remaining 118 MW is subject to curtailment by the California Independent System Operator (CAISO). Investor-owned utilities, such as PG&E, own most of the California high voltage transmission grid and, as a result of the electricity deregulation, has turned over the operation of these transmission facilities to the CAISO.

In June 2007, Banks Pumping Plant operation was severely restricted for much of the month to protect the Delta smelt. When the Delta smelt constraints were lifted in July 2007, DWR had intended to operate the plant continuously at full capacity to make up for June's pumping restriction. However, Banks Pumping Plant operation was curtailed due to curtailment of transmission service.

A recent operations study by DWR indicates that to make up for lost pumping opportunities and maximize water delivery reliability, Banks Pumping Plant and the expanded South Bay Pumping Plant will require a combined 305 MW of firm transmission service. To that end, DWR's Transmission Planning Branch is working with PG&E, CAISO, and the Western Area Power Administration to identify reinforcements needed to provide 305 MW of firm transmission service for these Delta pumping facilities. It is anticipated that this level of service will occur no earlier than 2011 and could occur as late as 2015.

If you have any questions regarding the comments, please call Linda Quok, Chief of DWR's Transmission Planning Branch, at (916) 574-0617.

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Ms. Linda Quok, Chief
Transmission Planning Branch
California Department of Water Resources
Joint Operations Center
3310 El Camino Avenue, Room LL90
Sacramento, CA 95821-9000

Dear Ms. Quok:

This letter responds to your letter dated March 13, 2008 providing comments on the draft of the State Water Project Delivery Reliability Report—2007.

In your email, you state that the draft report should address potential restrictions on Banks Pumping Plant operations due to the energy transmission service to operate the pumps being subject to curtailment by the California Independent System Operator (CAISO).

As you point out in your letter, SWP pumping at Banks Pumping Plant may at times be in effect curtailed by CAISO, a situation that may persist until sometime between 2011 and 2015. While this may be true, this level of detail of concern exceeds the level of analysis in the report. The analysis is based upon results from CalSim II studies which assume a monthly time step. Watershed runoff, reservoir storage, reservoir releases, Delta inflow, Delta consumptive use, Delta exports, Delta outflow, and SWP Table A and Article 21 deliveries are all calculated on a monthly average basis over the 82-year simulation period. Banks Pumping Plant restrictions due to water quality and flow standards are also based upon monthly average data. For presentation of CalSim II results in the report, monthly average SWP Table A and Article 21 deliveries are summed for each year to generate 82 values of total annual deliveries. Considering the level of detail inherent in the report, temporary curtailments of the energy transmission service needed to operate the pumps at Banks Pumping Plant is not viewed as significant.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Executive Office

March 12, 2008

Ms. Cynthia Pierson
California Department of Water Resources
SWP Delivery Reliability Report- Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

Dear Ms. Pierson:

State Water Project Delivery Reliability Report 2007—December 2007 Draft

The Metropolitan Water District of Southern California (Metropolitan) has reviewed the Department's December 2007 draft of the State Water Project Delivery Reliability Report. The report updates estimates of the current (2007) and future (2027) State Water Project delivery reliability and incorporates (i) the December 2007 Federal Court ruling for Delta exports and (ii) potential impacts of future climate change. The utility of the draft Reliability Report could be enhanced if it is amended to include a second future conditions analysis that omits the projected effects of climate change.

The draft Reliability Report presumes that the restrictions on exports from the Delta put in place by the Federal Court for water year 2008 to protect the delta smelt are similar to the operational requirements that will result from the adoption of new federal biological opinions. While the Court ruling is only applicable until September 2008, when the new biological opinion is due to be issued, Metropolitan believes this to be a prudent assumption at this time. The forthcoming incidental take permit will incorporate operational requirements that may or may not be more stringent than the Wanger interim operations rules. Regardless, the present decrease in supply reliability underscores the need to provide improvements to the conveyance of Project water across the Delta.

The incorporation of projected effects due to climate change introduces a level of uncertainty in the assessment of the reliability of the State Water Project through 2027. While the draft Reliability Report states that, "Potential changes in climate patterns are becoming better defined..." (second paragraph, page 7), it also states that the potential effects of climate change in the future are "evolving" and that, "Incorporating climate change into future projections is difficult because of the many ways the patterns of rain, snow and temperature could shift" (second full paragraph, page 10). The analysis made use of the results of a 2006 report from the Department in which "broad-brush estimates are made of the potential impact upon the SWP around the year 2050...". The analysis converted the year 2050 conclusions contained in the

700 N. Alameda Street, Los Angeles, California 90012 • Mailing Address: Box 54153, Los Angeles, California 90054-0153 • Telephone (213) 217-6000

2006 report to year 2027 through interpolation. Given the high degree of uncertainty, it is unclear how the results should be used.

Recently, Metropolitan has joined with other major water agencies within the United States to form the Water Utility Climate Alliance (WUCA). Top among WUCA's list of research needs is to reduce the uncertainty in projections related to how climate may change by improving and refining global climate models and applying them at the regional or local level. To facilitate incorporation of continued research and refinements of the projected effects of climate change, Metropolitan requests that the final version of the Reliability Report include a second analysis of future conditions without the climate change assumptions. This would provide a baseline analysis for future conditions to which refined projections of the effects of climate change could be applied.

Very truly yours,

Stephen N. Arakawa
Manager, Water Resource Management

JLS:tw
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STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES

1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Mr. Steve Arakawa, Manager
Water Resource Management
The Metropolitan Water District of Southern California
700 N. Alameda Street
Los Angeles, CA 90012

Dear Mr. Arakawa:

This letter responds to your letter dated March 12, 2008 providing comments of the Metropolitan Water District of Southern California on the draft of the State Water Project Delivery Reliability Report—2007 (DRR 2007).

In your letter, you refer to the relative uncertainty in the assessment of the future reliability of State Water Project deliveries under climate change assumptions, and request that the DRR

The relative uncertainty of the effects of climate change on SWP delivery reliability are appreciated. However, Governor Schwarzenegger's Executive Order S-3-05, signed on June 1, 2005, directs the Secretary of the California Environmental Protection Agency to coordinate with State agencies to report every two years on the impacts to California of global warming, including impacts to water supply. The Department of Water Resources identifies climate change in the 2005 update of the California Water Plan (Bulletin 160-05) as a key consideration in planning for the State's future water management. This is because analysis has shown that climate change may in the future seriously affect the State's water resources, particularly SWP's ability to deliver water. The DRR (2007) recognizes the uncertainty of climate change projections by evaluating future State Water Project deliveries under four scenarios of climate change: weak temperature warming and weak precipitation increase in California under model PCM; modest warming and modest drying under model PCM; modest warming and modest drying under model GFDL v. 2.0; and weak temperature warming and weak precipitation increase in California under model GFDL v. 2.0. Simulated deliveries under these scenarios of climate change were then interpolated to estimate deliveries in the year 2027.

The estimated future (2027) SWP Table A and Article 21 deliveries under the climate change scenarios in the DRR (2007) are based upon interpolations of SWP deliveries under future conditions without climate change and climate change at the 2050 level. The annual SWP deliveries under future conditions with and without climate change are presented in Appendix B (tables B-4 through B-11) and are available electronically via the DRR (2007) website if any reader wishes to perform further analysis.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

NATURAL RESOURCES DEFENSE COUNCIL

March 13, 2008

Ms. Cynthia Pierson
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001
email: **comments-on-2007drr@water.ca.gov**

Re: Comments on the Draft State Water Project Delivery Reliability Report 2007 and OCAP Consultation

Dear Ms. Pierson:

We are writing on behalf of the Natural Resources Defense Council and its over 120,000 members and activists in California. We appreciate the opportunity to comment on the draft State Water Project Delivery Reliability Report 2007 ("Reliability Report" or "Report") and look forward to working cooperatively with the Department of Water Resources ("DWR") to address many of the issues raised by the Reliability Report, including improving conditions in the Delta to protect the ecosystem and water supply reliability for 25 million Californians. We also request that these comments and attachments be considered in the ongoing consultation regarding the Operating Criteria and Plan ("OCAP") for future joint operations of the State Water Project ("SWP") and Central Valley Project ("CVP").

We identify below some recommended changes to the final Report. Primary among these is the need for more discussion and analysis of demand management as a tool to improve reliability. Because reliability is a function of both water supply and water demand, reductions in demand can effectively improve reliability, as well as reduce the stresses on the Delta ecosystem caused by excessive water diversions. Governor Schwarzenegger recently released a new water plan, which includes a 20 percent reduction in per capita water use statewide by 2020. *See* Letter from Governor Schwarzenegger to Senators Perata, Steinberg, and Machado (February 28, 2008), appended as Attachment 1. This reduction in demand far exceeds the five percent reduction in average SWP Table A supplies that the Report projects for 2027. Report at 30. In fact, aggressive demand reduction measures could allow for far more significant reductions in SWP (and CVP) deliveries without adversely impacting reliability. We urge DWR to revise its modeling and analysis to address demand-side management for the final Report and in the ongoing OCAP consultations.

I. THE REPORT SHOULD INCLUDE A DISCUSSION OF DEMAND MANAGEMENT

The draft Reliability Report recognizes that the concept of "reliability" measures "a system's ability to match water supplies with *demand*." Report at 6 (emphasis added). The Report asserts that reliability in the context of the SWP depends on three general factors: "the availability of water at the source, the ability to convey water from the source to the desired point of delivery, *and the magnitude of demand for the water*." *Id.* (emphasis added). Despite this recognition of the importance of water demand in the reliability equation, the draft Report omits any discussion of demand management, or the ability of SWP contractors to improve reliability by reducing their own demand, both overall and at different times of the year. Instead, the draft Report bases its analysis of reliability on demand values from previous years, which values are derived from historical data and information received from the SWP contractors. *Id.* at 9. This omission should be corrected in the final Report.

As explained in DWR's most recent State Water Plan update, and in the attached NRDC analysis and water district testimony, SWP contractors have considerable untapped capacity to improve the efficiency of their water use, to reduce their demand through improved groundwater management, and to reduce their demand through water recycling, stormwater capture, and other methods. Realizing this untapped capacity would reduce SWP contractor demand, reduce the need for diversions from the Delta, and improve SWP delivery reliability. *See* NRDC, *Effective Solutions to Meet California's Water Supply Reliability Needs* (February 25, 2008), appended as Attachment 2; Testimony of Jeffrey Kightlinger, General Manager, Metropolitan Water District of Southern California before the House Committee on Natural Resources, Subcommittee on Water and Power (January 29, 2008), appended as Attachment 3; Testimony of Richard W. Atwater, General Manager, Inland Empire Utilities Agency before the House Committee on Natural Resources, Subcommittee on Water and Power (January 29, 2008), appended as Attachment 4. The Report should be modified to include an analysis of the impact of these demand reduction measures on SWP reliability, as well as the impact of the Governor's call for a 20 percent reduction in per capita water use by 2020.

II. THERE IS NO EVIDENCE THAT NEW CONVEYANCE NORTH OF THE DELTA PROVIDES ECOSYSTEM BENEFITS

The draft Reliability Report picks up a refrain from the Bay Delta Conservation Plan ("BDCP") process that "a new North of Delta diversion(s) from the Sacramento River, which would divert water for export around the Delta, offers the greatest potential for meeting ecosystem restoration objectives." Report at 12. We are not aware of any specific proposal for a new North of Delta diversion(s), addressing such issues as proposed size, operational rules, total proposed diversions, governance and assurance mechanisms and mitigation plan. Nor are we aware of any analysis of the potential impacts of such a proposal. *See* Letter from NRDC to the Resources Agency Re: Comments on BDCP Points of Agreement (December 21, 2007), appended as

Attachment 5. In fact, there are myriad ways in which a new North of Delta diversion could cause greater harm to the Delta ecosystem than the management of the existing SWP and CVP conveyance facilities, including by increasing the amount of exports (either overall or seasonally), reducing downstream water quality, increasing migrating fish mortality (especially salmonids), increasing the relative concentration of toxic contaminants, increasing adverse Delta food web impacts, increasing the threat and growth of invasive species, reducing Delta agricultural productivity and more. If DWR has analyzed these potential impacts, we urge the agency to make that information publicly available. Otherwise, the statement that a theoretical North of Delta diversion(s) "offers the greatest potential for meeting ecosystem restoration objectives" (which objectives also remain undefined in the Report and the BDCP process) lacks any foundation and is premature.

III. THE ENVIRONMENTAL WATER ACCOUNT BENEFITS CONTRACTORS, NOT THE ENVIRONMENT

The draft Report incorrectly states that "decline in the abundance of juvenile delta smelt led to a voluntary modification in 2007 in SWP and CVP operations to reduce the reversed flows in Middle and Old Rivers – a modification made possible through the Environmental Water Account." Report at 15. In fact, the Environmental Water Account ("EWA") did not make this action "possible." Rather, DWR, the Bureau of Reclamation and the fisheries agencies are compelled to modify pumping operations when those operations adversely impact the survival, recovery and critical habitat of fish protected under the Endangered Species Act, such as the delta smelt. Indeed, a federal judge recently held, at DWR's urging, that "regardless of whether [EWA and similar 'environmental water'] programs are fully funded and/or remain functional mechanisms to provide water to the Delta, 'the burden … falls on the Projects, not the smelt.'" *NRDC v. Kempthorne*, case no. 05-CV-01207, Order on Summary Judgment, at 61 (May 25, 2007). If the fisheries agencies require the Projects to reduce pumping to protect listed fish, DWR and the Bureau must do so, whether or not EWA assets are available.

The history of the EWA demonstrates that, rather than aiding ecosystem recovery, the EWA has primarily functioned as an impediment to fish protection and recovery, by acting as an artificial constraint on the amount of water available for ecosystem needs. *See* Letter from NRDC to the Bureau of Reclamation Re: Comments on the Draft Supplemental EIS/EIR for Extending the Environmental Water Account and OCAP Consultations (December 10, 2007), appended as Attachment 6. The studies in the draft Report correctly assume that no EWA will be in place in the future. The text of the Report should be modified to correct the misconception that this outcome is bad for fish or constrains DWR's and the Bureau's ability and obligation to make sufficient water available for ecosystem protection.

IV. THE REPORT SHOULD CONFORM ITS SEA LEVEL RISE ASSUMPTIONS TO THE RECOMMENDATIONS OF THE CALFED INDEPENDENT SCIENCE BOARD

The draft Report estimates the effects of climate change on SWP delivery reliability by analyzing four different climate change scenarios developed in DWR's 2006 report entitled "Progress on Incorporating Climate Change into Management of California's Water Resources." Report at 18. However, the estimates of the impacts of climate change on California, and sea level rise in particular, have changed considerably since those four scenarios were developed. In particular, as the Report notes, the CALFED Independent Science Board has recommended that for planning purposes incorporating sea level rise, DWR should use the full range of variability of 50-140 cm (20-55 inches). Report at 22; *see also* Memorandum from Jeffrey Mount to Michael Healey re: Sea Level Rise and Delta Planning (Sep. 6, 2007), appended as Attachment 7. This range is considerably higher than DWR previously assumed in its 2006 report (a one-foot sea level rise), and will likely have considerably more significant water supply and ecosystem impacts. It is likely that other estimates of the impacts of climate change need to be updated as well, including projections of reduced Sierra snowpack and increased evaporation rates in watersheds and surface storage reservoirs. *See, e.g.,* NRDC, *In Hot Water, Water Management Strategies to Weather the Effects of Global Warming* (July, 2007), http://www.nrdc.org/globalWarming/hotwater/hotwater.pdf. The analysis should be redone incorporating the most recent sea level rise and other climate change analysis.

V. ARTICLE 21 WATER SHOULD BE OFFERED TO FISHERIES AGENCIES BEFORE BEING PROVIDED AS SURPLUS WATER TO CONTRACTORS

The Report assumes that DWR will continue to provide considerable amounts of Article 21 water to contractors in the future. It is within DWR's discretion whether or not to make Article 21 water available in any given year for delivery to SWP contractors. As we have urged DWR in the past, we request again that DWR implement a policy of foregoing Article 21 declarations and deliveries if state and federal fisheries agencies recommend that the water remain instream or available for ecosystem protection purposes. This small step to improve the Delta's ailing ecosystem would improve reliability for all water users by reducing the need for unplanned, emergency pumping restrictions to protect an ecosystem poised on the brink of collapse.

VI. REDUCED EXPORTS MEANS GREATER UPSTREAM RESERVOIR STORAGE

We note that one effect of reducing pumping from the historically high levels of recent years is that higher amounts of storage will be available in upstream reservoirs at the end of the year. Report at 30. Increased upstream reservoir storage should allow for improved coldwater management for salmon and steelhead below the dams. We urge DWR and the fisheries agencies to utilize the increase in carryover storage to increase the protections for imperiled salmonids from the lessened protections in the most recent OCAP salmonid biological opinion, including the reduced Shasta carryover storage requirement and the more restrictive downstream temperature control point.

VII. REDUCED EXPORTS MEANS REDUCED YEILD FROM POTENTIAL SOUTH OF DELTA STORAGE

The current levels of Delta diversions, which are lower than those in the past, will also reduce the potential yield of proposed South of Delta storage facilities. This effect is due to the fact that there will be fewer times in the future when existing South of Delta storage is full. These reduced levels of diversion are likely to remain in place for the foreseeable future. The report should discuss the relationship between lower levels of diversions and proposed expansions in storage South of the Delta that would be dependant on Delta pumping as a water source.

Thank you again for the opportunity to comment. Please contact us with any questions.

Sincerely,

Katherine S. Poole
Senior Attorney

Barry Nelson
Senior Policy Analyst

Enc.

Cc: Cay Goude, USFWS
Maria Rea, NMFS

ATTACHMENT 1

Office of the Governor

ARNOLD SCHWARZENEGGER
THE PEOPLE'S GOVERNOR

PRESS RELEASE

02/29/2008 GAAS:112:08 FOR IMMEDIATE RELEASE

Governor Schwarzenegger Outlines Comprehensive Actions Needed to Fix Ailing Delta

Governor Schwarzenegger sent the following letter to Senators Perata, Steinberg, and Machado in response to their unfounded concerns that his administration is "unilaterally" beginning work on a so-called "peripheral canal." Consistent with the extensive work done by his administration over the last two years to gain consensus on a bipartisan legislative solution for a comprehensive plan to upgrade California's water infrastructure, Governor Schwarzenegger detailed his agenda in the following letter:

February 28, 2008

The Honorable Don Perata The Honorable Darrell Steinberg
President pro Tempore California State Senate
California State Senate State Capitol
State Capitol Room 4035
Room 205 Sacramento, California 95814
Sacramento, California 95814

The Honorable Mike Machado
California State Senate
State Capitol
Room 5066
Sacramento, California 95814

Dear Don, Mike and Darrell,

My administration has been working on solutions for addressing California's water supply and the environmental crisis in the Sacramento-San Joaquin Delta for more than two years. As you all have acknowledged during our negotiations on a comprehensive water infrastructure package over the last year, the heart of California's vital water supply system is in jeopardy of collapse without both immediate action and long term solutions to restore the ecosystem and protect water supplies.

I created the bipartisan Delta Vision Blue Ribbon Task Force by administrative action in 2006. The Task Force has issued its Vision and will develop a Strategic Plan to implement the Vision by the end of this year. In its recommendations, the Task Force identified a series of near-term actions that should be taken to protect the estuary, including studying the options for improving water transfer in the Delta. Far from acting unilaterally, my administration has been transparent in working with stakeholders and legislators on identifying both administrative and legislative actions that will be necessary to address the recommendations of the Task Force. As part of that effort, I will continue to negotiate in good faith with legislators on a comprehensive water infrastructure package.

To clarify the administrative actions we are considering as part of a comprehensive solution in the Delta, let me outline some of the key elements under development:

1. **A plan to achieve a 20 percent reduction in per capita water use statewide by 2020.** Conservation is one of the key ways to provide water for Californians and protect and improve the Delta ecosystem. A number of efforts are already underway to expand conservation programs, but I plan to direct state agencies to develop this more aggressive plan and implement it to the extent permitted by current law. I would welcome legislation to incorporate this goal into statute.
2. **Protection of floodplain in the Delta.** The Department of Water Resources (DWR) and other appropriate state agencies will expedite the evaluation and protection of critical floodplains. This action protects people and property, the existing water export system and the Delta ecosystem.
    - **Policy guidance on Delta land use.** The Blue Ribbon Task Force made it clear that changing land use patterns may limit our ability to address critical issues with the existing water export system and the Delta ecosystem. Accordingly, I will ask the Delta Protection Commission to update their Land Use and Resource Management Plan and direct the Governor's Office of Planning & Research and the State Architect to develop model Delta land use guidelines for distribution to local governments.
    - **Levee protection and standards.** DWR is actively involved in efforts to improve our flood protection and levee systems and, as part of this effort, should establish recommended standards for Delta levees.
3. **Multi-agency Delta disaster planning.** DWR, in coordination with the Office of Emergency Services, and other appropriate state agencies will develop and implement an emergency response plan and conduct a multi-agency disaster planning exercise in the Delta.
    - **Contract for emergency response equipment and services.** I will authorize DWR to continue its efforts to obtain equipment and services including barge services, sheet piling and other flood fighting materials to respond to disasters in the Delta. In addition to my previous orders, we must expedite the placement of materials and supplies in and near the Delta, to improve our emergency response capabilities.
4. **Expedite interim Delta actions.** The Resources Agency, DWR, Department of Fish and Game and the State Water Resources Control Board have already begun efforts to help protect and restore Delta habitat and help water users cope with supply interruptions.

I will direct the Resources Agency to expedite the completion of the Bay Delta Conservation Plan (BDCP), including the environmental review and permitting activities. Ongoing Delta actions, in conjunction with these efforts, will provide a foundation to help conserve at-risk species and improve water supply reliability.

5. **Water quality.** While additional storage and improved conveyance can allow greater control

of water flows that improve drinking water quality, more must be done. I will direct the State Water Resources Control Board to develop and implement a comprehensive program in the Delta to protect water quality.

6. **Improvements to Delta water conveyance.** DWR and other appropriate state agencies will soon begin the public process to study the alternatives available for improving the Delta water conveyance system. As part of this study, DWR must coordinate with BDCP efforts to recover at-risk species. DWR must also incorporate the issues of water supply reliability; seismic and flood durability; ecosystem health and resilience; water quality; and projected schedule, cost and funding in their options review, as suggested by the Task Force.

The Task Force recommended that we study a "dual conveyance facility" as a starting point. However I believe we must look at a full range of options for improving conveyance in the Delta.

Accordingly, I intend to direct DWR to proceed with the NEPA/CEQA analysis on at least four alternatives for Delta conveyance. They shall consider the following:

- The possibility of no new Delta conveyance facility;
- The possibility of a dual conveyance facility, as suggested by the Task Force;
- The possibility of an isolated facility;
- The possibility of substantial improvements and protections of the existing water export system, most often referred to as ‘armoring the Delta' or a "through-Delta" solution.

7. **Water storage.** DWR will complete the feasibility studies for the CALFED storage projects including Temperance Flat, Sites Reservoir, and the Los Vaqueros expansion. Each of these projects, depending on how they are built and operated, can provide substantial public benefits. Unlike in the past, when local entities built storage facilities for their own benefit and with little state investment, the current deteriorating condition of the Delta and the statewide water system demand public investment in exchange for the public benefit the entire state will realize.

In addition, I will direct DWR to expedite funding for groundwater storage projects throughout the state that will improve water supply reliability.

Please know that I will continue to work with the Legislature and all stakeholders to develop a comprehensive solution to the crisis in the Delta, and I will act on administrative measures in a transparent manner at the appropriate time.

California's history is filled with innovators and problem solvers. In 2006, with Democrats and Republicans working together for a common cause, we added to that legacy by building up our infrastructure. We showed leadership, not for the benefit of our own ambitions, but for the future of the state. That's something that Californians weren't used to, and they responded forcefully, approving all of the bonds. It's time for us to put the state first and add another chapter to the history books. It's time to secure a safe, clean and reliable water supply for the next generation of Californians. We have a great opportunity, and the people are counting on us. Let's not let it pass.

Sincerely,

Arnold Schwarzenegger

ATTACHMENT 2

NATURAL RESOURCES DEFENSE COUNCIL

EFFECTIVE SOLUTIONS TO MEET CALIFORNIA'S WATER SUPPLY RELIABILITY NEEDS

The Bay-Delta Estuary is facing a crisis. Numerous species are listed as threatened or endangered, or proposed for listing. The Delta smelt is on the verge of extinction. The status quo is not sustainable for any of the Delta's users, including farmers, commercial and sport fishermen, Delta residents and the 23 million Californians who rely on the Delta for a portion of their water supply. Investments to improve water supply reliability must also improve conditions in the Delta. By directing state funds to alternative water supplies, Delta flood protection and restoring a healthy ecosystem, the State will help improve water supply reliability, meet the needs of a growing population and protect imperiled fish species.

There is a broad consensus regarding the most effective tools to meet California's future water supply needs. The 2005 California Water Plan update contains extensive, detailed estimates of the water supply potential of a range of proven water supply tools. The bar chart below presents many of those totals, ranging from low to high yield estimates. We believe that the more ambitious estimates are realistic, and that aggressive targets and ambitious programs are required to assure Californians a reliable water future. DWR estimates that the three tools with the greatest potential – urban water conservation, wastewater recycling and improved groundwater management – could, together, produce more than six million acre-feet of new water. This represents approximately as much water as the CVP and SWP have diverted from the Delta in recent years, and more than enough to reduce Delta diversions and meet future growth needs.

NRDC believes that total Delta diversions must be reduced from the unsustainable record levels in recent years. We are working with other members of the environmental community to develop a science-based target for that reduction, which we will provide to the Task Force in the near future. Urban water use efficiency and other tools discussed below can provide the State with near-term and cost-effective supplies to offset any impacts from a reduction in Delta supplies.

Proven "Cornerstone" Water Supply Reliability Tools

Urban Water Use Efficiency: Currently, urban areas use over eight million acre-feet of water during a typical year. One-third or more of this water is used to irrigate urban landscapes. Urban water use efficiency could yield up to **3,500,000 acre-feet** of water per year according to the Pacific Institute's most recent projections. (This estimate is close to DWR's estimate of 3.1 million acre-foot high estimate of the potential of urban conservation at $230-522 per acre-foot.) Significant reductions in water use can be achieved through design, installation and maintenance of water efficient landscapes, along with indoor conservation measures in the commercial, industrial and residential sectors. These savings can be realized by investing in current, off-the-shelf technologies, reducing lost and unaccounted for water through system water audits, and increasing implementation of conservation pricing. New water efficient technologies will undoubtedly continue to emerge and contribute additional savings in the future.

Recycled Water: Recycling urban wastewater (also known as reclamation or re-use) is an important strategy to increase water supply. Recycled water is most frequently used for agricultural or landscape irrigation or groundwater recharge. DWR estimates water recycling can generate up to **1,500,000 acre-feet a year** by 2030 at average cost of $600 per acre-foot.

www.nrdc.org 111 Sutter Street
20th Floor
San Francisco, CA 94104
TEL 415 875-6100 FAX 415 875-6161

Improved Groundwater Management: The Department of Water Resources estimates that improved groundwater management, such as the conjunctive use of surface and underground storage, has the potential to provide between 500,000 and 2 million acre-feet at costs ranging from $10-600. The average cost in a recent round of applications received by DWR for conjunctive use projects was $110 per acre-foot. The appropriate target for conjunctive use will be determined in part by decisions on water management in the Delta, which will influence potential yield from groundwater storage. Such investments are likely to yield greater benefits south of the Delta, where projects may be less constrained by Delta operations and provide greater independence from the Delta. This effort could also be coordinated with floodplain and habitat restoration efforts in the Central Valley.

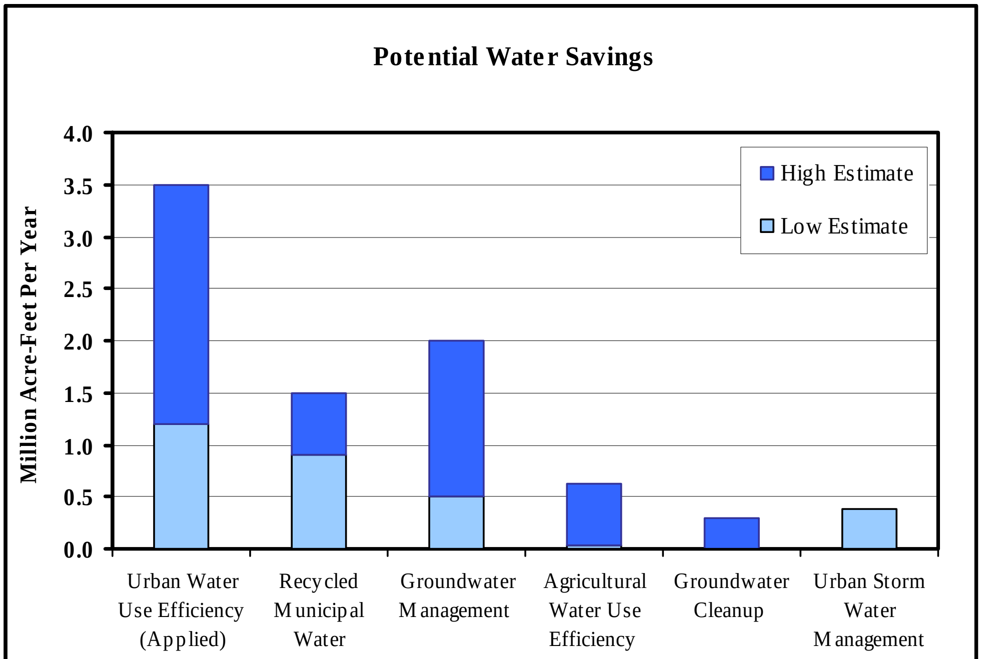
Additional Effective Strategies

In addition to the key tools discussed above, a number of additional water management tools can generate significant additional supplies.

Agricultural Water Use Efficiency: Eighty percent of California's annual water use goes to agriculture. Although in some areas considerable strides have been made in water use efficiency, farming methods are not as water-efficient as they can be. The California Bay-Delta Authority's Year Four report estimates up to **620,000 acre-feet** of water can be saved through agricultural water use efficiency, which includes installing micro-irrigation technology or other water management improvements, at a cost of $242 per acre-foot. We believe that these estimates understate the true potential of this tool.

Additionally, agricultural water is often highly subsidized. Pricing reform that sends clear, meaningful signals to agricultural water users can be very effective in encouraging increased water use efficiency.

Groundwater Clean-up: Removing salts, including nitrates, from groundwater can be a cost-effective means of producing clean water supplies, recharging stressed and contaminated aquifers, and increasing groundwater storage capacity without the need to build expensive surface storage projects. DWR estimates brackish groundwater desalination costs $250-500 per acre-foot, with a potential of yielding up to **290,000 acre-feet per year**.



Sources:
California Department of Water Resources, *California Water Plan Update 2005*.
Pacific Institute, *California Water 2030: An Efficient Future,* September 2005, p. 33.
DWR Taskforce, *Water Desalination – Findings and Recommendations,* October 2003, p. 3.

Urban Storm Water Management: Urban water agencies, particularly in Southern California, are increasingly recognizing the potential to provide multiple benefits by capturing, treating (where necessary), storing and using urban storm water. Use of low impact development techniques (LID) results in the diversion and capture of storm water and dry-weather runoff before it flows into surface waters. This water can then be used on- or off-site as an alternative water source for irrigation of parklands, sporting fields, cluster housing groups, or for fire-fighting. Such projects can provide water supply and flood management benefits, while reducing coastal pollution from urban runoff.

Nationally, research has repeatedly shown that LID has the potential to deliver vast quantities of useable water through recharge and infiltration, and that it is the most effective and cost-efficient means of managing storm water and abating water pollution. Further, LID uses common sense and simple technology – strategically placed beds of native plants, rain barrels, "green roofs," porous surfaces for parking lots and roads, and other tools – to retain rainfall on site or help rainfall soak into the ground, rather than polluting the nearest water body.

The Los Angeles Integrated Regional Water Management Plan indicates that proposed urban storm water management projects can generate **100,000 acre-feet** from urban storm water capture, and that the maximum potential is at least twice that amount. NRDC's preliminary estimate of the water savings from implementation of LID practices suggests that if LID were used in just 50% of all residential and commercial properties in Los Angeles, Riverside, and San Diego Counties, **377,000 acre-feet** annually could be infiltrated or otherwise reused. By offsetting energy-intensive imported water in like amounts, and after accounting for average energy requirements associated with pumping groundwater in these areas, LID could result in the reduction of up to 45,000 metric tons of CO_2 annually in Los Angeles County and an additional 55,000 metric tons of CO_2 in San Diego and Riverside Counties combined.

Transfers and Land Retirement. These tools must be carefully designed in order to avoid impacts to third parties. However, significant land retirement on the west side of the San Joaquin Valley is very likely and can generate significant water savings. For example, the Westlands Water District has advocated a land retirement program of up to 200,000 acres. Farming this land has historically required as much as 700,000 acre-feet of water.

Benefits of Alternative Water Management Strategies

A Healthier Bay-Delta and Other Ecosystems: Investments in surface storage could harm the Bay-Delta ecosystem by reducing flows to the Delta or increasing diversions from the Delta. In contrast, alternative water management tools would decrease our reliance on the Delta.

Energy Savings and Reduced Greenhouse Gas Emissions: Almost 20% of California's electricity use, and over 30% of its non-power plant natural gas use, is associated with the use of water. Water use efficiency and recycling can generate substantial energy savings and reductions in greenhouse gas emissions, and help the State meet AB 32 implementation targets.

Water Quality Benefits: Investing in water efficiency and groundwater cleanup will improve water quality by reducing urban runoff from lawns and gardens. In addition, investments in these tools will also help stretch limited state and federal funds available for water and wastewater treatment facility expansions and upgrades, by delaying or reducing the size of water system expansions. These investments will also improve drinking water quality, particularly for poorer communities in the Central Valley that rely on groundwater.

Reducing the Economic Risk from Delta Levee Failures: A massive levee failure in the Delta could jeopardize a critical water supply for 23 million Californians. Investments in alternative water management tools will reduce reliance on Delta diversions, thereby decreasing the risk to California's economy from potential Delta levee failures.

Strategies to Achieve Maximum Water Savings

This memo focuses on potential targets for a range of water management tools. The bullets below briefly outline key strategies that can maximize the water savings from these tools. We will present more details regarding these and other strategies in the future.

A Clear Conclusion Regarding Delta Diversion Totals: The single most effective thing the Delta Vision Task Force could do to encourage the development of alternative water supplies would be to make a clear, forceful recommendation regarding the need to reduce Delta diversions by a specified amount. Reducing Delta diversions will be a significant change from the trend over the last four decades. The likelihood that we will succeed in this transition will be greatly increased if the state has a clear goal to guide planning efforts and investments.

Learning from California's Energy Efficiency Success: California has emerged as a global leader in energy efficiency. We believe that the policy tools, such as a loading order and public benefits charges that have made this progress possible in the energy arena, can produce similar progress in encouraging water use efficiency. (See NRDC's white paper entitled: *Transforming Water Use: A California Water Efficiency Agenda for the 21st Century*.)

AB 32 Implementation: Reducing Delta diversions and investing in alternatives, such as water conservation, has the potential to significantly reduce energy use and greenhouse gas emissions. By integrating water planning with energy and climate change efforts, the state can take advantage of the synergies among these issues, including potential additional funding sources for less energy intensive alternatives to Delta diversions.

Integrated Regional Water Management: In recent years, IRWM has emerged as a key strategy to design water management solutions tailored to local needs, by considering local conditions, a full range of water management tools and a broad spectrum of potential benefits.

Credible Economics and Financing: Delta Vision should recommend that state and federal agencies carefully analyze the cost of alternative water supply strategies. Individual water agencies do this as a matter of course. However, state and federal agencies often fail to incorporate adequately basic economic analysis. For example, public funds dedicated to improving water supply reliability should be focused on the most cost-effective environmentally sound tools. The Delta Vision Task Force should develop recommendations to reduce water subsidies (e.g. by reforming renewed CVP contracts) and move toward real "beneficiary pays" financing.

ATTACHMENT 3

Testimony

Provided By

Jeffrey Kightlinger, General Manager
Metropolitan Water District of Southern California

On

The Immediate Federal and State Role in Addressing Uncertain Water Deliveries for California and Impacts on California Communities

Before the

Committee on Natural Resources
Subcommittee on Water and Power
United States House of Representatives

January 29, 2008

House Subcommittee on Water and Power
"The Immediate Federal and State Role in Addressing Uncertain Water Deliveries for California and Impacts on California Communities"

Oral Testimony by Jeffrey Kightlinger, General Manager
Metropolitan Water District of Southern California

Thank you Chairwoman Napolitano. I am pleased to give you and the subcommittee a brief survey of the impacts being felt throughout Southern California from the evolving water situation and Metropolitan's response. We face a new reality and new roles for Metropolitan and the state and federal governments to bringing more certainty to our water future.

At the moment we are roughly on track for an average rainfall year in both Southern California and Northern California. Traditionally this was good news. Traditionally this would mean that Metropolitan would likely receive enough water from the Sacramento-San Joaquin Delta to meet local demands and make modest additions to our storage reserves.

But not this year. Because of ongoing environmental problems in the Delta, there are court-ordered curtailments in water deliveries that started late last year and are expected to last into June. At the moment, the State Water Project has committed to delivering 25 percent of water supplies to its contractors throughout California. This percentage may increase, but Metropolitan is making preparations for a significant cutback in supplies. Metropolitan is responding by seeking to purchase additional supplies on the open market and funding a $6 million dollar water use efficiency outreach campaign to encourage conservation throughout our service area. In addition, Metropolitan's board of directors has approved over $30 million to aggressively implement water conservation and recycled hook-ups for public agencies and the commercial and industrial sectors.

Our tracking polls suggest that nearly half of the 18 million people in our service area have gotten the message and are taking steps to lower water use. This is helpful. Along with our efforts to creatively manage our resources, Metropolitan also invested in efforts to increase our storage capacity. In fact, today we have 10 times the amount of water in storage than we did during the last drought in the late 1980s and early 1990s. This includes a $2 billion capital investment in the building of Diamond Valley Lake, which alone nearly doubled the region's surface water storage capacity. Those reserves provide a cushion and give us some time. But, with the new restrictions in the Delta, we are now living on that borrowed time. That realization, and the uncertainties in the Delta, are beginning to create water supply impacts throughout the region.

Metropolitan, working with its member agencies, is developing a plan to equitably allocate our available State Water Project supplies from the Delta, the Colorado River Aqueduct and water stored in reserves. The primary objective of the plan is to minimize the impact on the overall regional economy. We are also striving to strike a balance recognizing needs from MWD, accounting for local supply and rewarding local districts that lower demands and increase supplies. A sterling example is Orange County. Last week it celebrated the opening of one of the largest water recycling facilities in the world. This facility will turn wastewater that used to drain into the Pacific Ocean into a reliable high-quality drinking water supply that will help replenish the local groundwater basin. Metropolitan provided incentive funds to help make this project a reality. This is precisely the kind of strategic regional partnership that Metropolitan is working to replicate throughout our service area.

In the coming weeks and months, Metropolitan will review existing and new programs to lower demand and increase local supplies. We will be doing this despite rapidly rising costs from the State Water Project and other investments, which will likely require double-digit rate increases into the future. We continue to identify and implement new ways to lower demand and increase local supplies because we have seen the dramatic results of past efforts. And we are re-evaluating and updating our long-term water strategy, our Integrated Resources Plan, to determine if our conservation and local water supply targets should be even more ambitious.

To ensure our long-term plans are taking into account the impacts of climate change, Metropolitan has entered into a partnership with the RAND Corporation to develop appropriate planning models and protocols that would take into account long-term impacts on water supplies. The state has taken a leadership role with its energy policy, which is focused on landmark efforts to reduce greenhouse gases and working to ensure a better linkage between water and energy. Conserving water helps reduce the need to transport and treat water, which are energy-consumptive activities. Metropolitan is evaluating its carbon footprint in tandem with our water supply and planning efforts.

While there is much still to be done when it comes to water conservation, it is important to recognize how far Southern California has come. As an example, in the past 15 years Metropolitan has invested more than $200 million in water-conserving devices. These conservation investments, combined with plumbing code reforms, reduce our potential demands by about a million acre-feet per year. Had we not been this successful in lowering demand and simply expected the State Water Project to solve the region's problems, our demand on the Delta would be about 50 percent larger now. Given the multiple changing conditions due to climate change, endangered species rulings and other impacts in the Delta, Metropolitan has embarked upon a comprehensive update of its long-term Integrated Resources Plan. A renewed focus on the development of local resource projects will help decrease our dependency on the Delta. But we do need a more reliable supply from the Delta than the current system is providing. And we embrace the notion that restoring the health of this ecosystem is an essential ingredient to creating a more reliable water system.

How can the federal government help? We urge the federal agencies to remain active and engaged participants in the Delta. We need a new biological opinion from the U.S. Fish and Wildlife Service that will guide the operations of the State Water Project and the Central Valley Project. Metropolitan is actively seeking operational strategies that can help reduce conflicts between pumping operations and fish migration patterns. We also need the active participation of the federal wildlife agencies in coming up with a new Bay Delta Conservation Plan, which is exploring new and better ways to separate the movement of water supplies from the natural flows in the estuary. Yes, that may mean some form of a canal as one piece of a much larger solution. We need the feasibility studies and better science to understand new ways of moving water supplies. The deliberations ahead should be based on new facts and not old fears. Metropolitan has made a commitment to seek reliability from Delta supplies, and to find the water for new growth from within our service area, a historic difference between the emerging Delta discussion and debates of the past. Metropolitan urges the federal government – our elected officials, federal agencies and staff – to support our local resource projects including recycling and other conservation programs.

As for assistance from the state, while we recognize the challenging fiscal situation, there are ways that the state can help. Metropolitan seeks to sponsor or support state legislation that would create a standard approach for regional water boards to authorize water recycling projects that seek to store supplies in groundwater basins. There are hundreds of millions of dollars from bonds that voters have already approved that are available to address parts of the Delta problem and to help regions become more self-sufficient.

Metropolitan remains a constructive and realistic participant to bring about dramatic and historic change in the Delta. We are very pleased to have the interest and involvement of both the state and federal governments to solve our problems and a collective recognition that the Delta as we know and manage it today is a broken ecosystem that needs fixing.

Thank you Chairwoman for today's hearing and I would be happy to respond to any questions.

Attachment 4

COMMITTEE ON RESOURCES
Subcommittee on Water and Power

"The Immediate Federal and State Role in Addressing Waste Deliveries for California and the Impacts in California Communities"
January 29, 2008

Testimony by
Richard W. Atwater
General Manager
Inland Empire Utilities Agency

I. Introduction

Thank you Chairwoman Grace Napolitano and members of the Subcommittee for Water and Power for the opportunity to testify before today regarding the water problems facing California. I am the General Manager of the Inland Empire Utilities Agency. The Subommittee has asked four important questions related to how address the critical water problems from Judge Wanger's court decision and how we develop regional and statewide strategies with the federal government to meet the challenges of having less water available from the Delta and the related issues with developing a sustainable ecosystem. The Inland Empire Utilities Agency in partnership with many other agencies in southern California and with financial assistance from the State of California and the Bureau of Reclamation is implementing a "Drought Proofing Strategy" that is a key element of a Delta Plan. We have recognized the challenges for a long time of meeting the statewide water needs in an environmentally responsible manner have committed over $500 million over the past seven years to implement projects that will develop new local supplies in southern California and reduce our need for Delta exports.

A. Inland Empire Utilities Agency/Chino Groundwater Basin

The Inland Empire Utilities Agency, a municipal water district under California law, was formed in 1950 by a popular vote of its residents. The service area of the Agency is entirely in San Bernardino County and has a current population of approximately 800,000. The IEUA service area is rapidly growing and will probably increase by 50 percent to 1.2 million within the next 20 years. The Chino Groundwater Basin was adjudicated in 1978 and is governed by a 9 member Watermaster Board. Overall water use is about 350,000 acre-feet annually, 70 percent of the supplies are from local sources within the Santa Ana Watershed. With the rapid growth, demand from MWD could increase from 70,000 acre-feet per year currently to 150,000 acre-feet in 2020 if we did business as usual! However IEUA, Chino

Basin Watermaster and in cooperation with many other agencies have developed a "Drought Proof Plan" that will develop over 100,000 acre-feet of new local supplies to minimize the need for additional imported water from MWD, thereby reduce our need for more Delta (SWP) water supplies.

B. History, Background and Interagency Relationships with CALFED Bay-Delta Program

The Agency has been a member agency of the Metropolitan Water District since 1950 and distributes about 70,000 acre-feet of imported water to the cities of Chino, Chino Hills, Fontana (through the Fontana Water Company), Ontario, Upland, Montclair, Rancho Cucamonga (through the Cucamonga County Water District), and the Monte Vista Water District. The Agency also provides wastewater treatment service (four regional water recycling plants that produce about 60 million gallons per day or 67,000 acre-feet per year). Excess recycled water flows downstream into the Santa Ana River where the Orange County Water District recharges that water into the Orange County groundwater basin for drinking water.

The Agency is also a member of the Santa Ana Watershed Project Authority (SAWPA) and is an active member of the Santa Ana River Watershed Group and the Chino Basin Watermaster. As a member agency of SAWPA, the Agency's water projects are closely coordinated with the SAWPA watershed wide planning and the funding of priority projects through the Water Bond Proposition 13 and Proposition 50 grants.

Public and Private Partnerships to Improve the Santa Ana Watershed

- Santa Ana Watershed Project Authority (SAWPA) has maintained an inclusive dialogue with all interested parties and is leading the update of the Santa Ana integrated regional watershed management plan through the "One Water-One Watershed" (OWOW) process;
- All local governments within the three counties (San Bernardino, Riverside and Orange) are working cooperatively together to manage growth and plan for the water/wastewater infrastructure needed to meet the needs of this rapidly urbanizing watershed;
- Partnerships with industry including dairies, manufacturing, and developers have resulted in creative solutions to local water quality problems (e.g. the Santa Ana brine sewer to the ocean) as well as producing new sources of renewable, cost effective energy;
- Industrial customers throughout the area are planning on using recycled water to reduce costs, ensure reliability, and to be excellent environmental stewards.

The Chino groundwater basin is one of the largest in Southern California. The Chino Basin Watermaster adopted an Optimum Basin Management Plan (OBMP) to protect the water quality of the basin and to manage the local supplies effectively to the maximum benefit of the local ratepayers. A key element is the expansion of the conjunctive use operation of the Chino Basin to expand the storage and recovery by approximately 300,000 to 500,000 acre feet.

Other key components are the Inland Empire Utilities Agency regional water recycling project to develop new local supply of 100,000 acre-feet per year and the Chino Basin desalters that would develop an additional new local supply of 40,000 acre-feet per year.

The key benefits of the Chino Basin regional "OBMP" water plan are as follows:

Benefits

- *Provide a more dependable local water supply and reduce the likelihood of water rationing during future droughts and the impacts of climate change;*
- *Economic benefits of reliable water supply to industry and provide incentives to attract new industry and jobs in the Inland Empire region;*
- *Environmental protection – reduce wastewater discharges into Santa Ana River by 50 percent through local water recycling and protect Orange County drinking water supplies through implementation of comprehensive lower Chino Dairy area manure management strategy;*
- *Reduce imported water use in the rapidly growing Inland Empire region (upper Santa Ana River Watershed) and thereby contribute in a significant manner to the statewide CALFED Bay-Delta and Colorado River solutions through more efficient use of existing local supplies;*
- *Assist in solving multiple Endangered Species Act problems within the Santa Ana Watershed, the CALFED Bay-Delta program, and the Colorado River/Salton Sea;*
- *Implement a sustainable long-term water resources management program that maintains the salt balance of the Santa Ana River watershed;*
- *Reduce the energy intensity of the region's water supplies, helping to conserve energy and reduce greenhouse gas emissions that are contributing to climate change.*

II Chino Basin "Drought Proofing Strategy"

The IEUA Urban Water Management Plan, adopted in December 2005 and the Chino Basin Watermaster Optimum Basin Management Plan, document the overall strategy for improving the water supply reliability in the Chino Basin area.

- ✓ Water Conservation – 10% savings 35,000 AF
- ✓ Water Recycling – 100,000 AF
- ✓ Local Groundwater Storage and Conjunctive Use – 500,000 AF of new storage
- ✓ Chino Desalter 40,000 AF

- ✓ Stormwater – 25,000 acre-feet of new supplies
- ✓ Renewable Energy and Organics Recycling – Clean energy through biodigesters (using biosolids, dairy manure and food waste), solar power and wind power (goal of 15 megawatts)
- ✓ Water Quality Management – Establishment of Chino Creek Wetlands and Educational Park at IEUA and a continued partnership with Orange County Water District on Prado Wetlands implementation of the Chino Creek Integrated Watershed Plan.

A. Water Conservation- (35,000 acre-feet per year, 10 percent of overall use)

IEUA and its retail utilities are committed to implementing the Memorandum of Understanding (MOU) regarding Urban Water Conservation in California. IEUA is an active member of the California Urban Water Conservation Council (CUWCC). Currently, the Agency is expanding its conservation efforts to promote both water and *energy* conservation programs to our customers. IEUA's goal is to reduce water demands by 10 percent (35,000 acre-feet per year) through aggressive implementation of customer conservation programs. Innovative programs initiated by IEUA include the Inland Empire Landscape Alliance, in which elected officials from cities and water agencies within IEUA's service area are working to promote outdoor conservation including turf reduction rebates, use of California-friendly native plans and new regional model landscape ordinances that will promote water savings. Other programs include conservation rebates which are offered in partnership with the Metropolitan Water District of Southern California (ultra-low-flow toilets, weather-based irrigation controllers, synthetic turf, efficient sprinklers, water brooms X-Ray recirculation units and other water saving devices), landscape audits, and school education programs including the award-winning Garden In Every School program.

B. Water Recycling (50,000 acre-feet by 2010)

IEUA owns and operates four water recycling plants that produce high quality water that meets all state and federal requirements for non-potable landscape irrigation, industrial uses, and groundwater replenishment. Since 2000 the Agency has spent over $60 million expanding its recycled water distribution system and currently recycles about 15,000 acre-feet annually. Recently the IEUA Board approved an accelerated implementation plan to increase annual recycled water use to approximately 50,000 acre-feet within the next 3 years by constructing "purple" recycled water pipeline system to hookup existing large customers (schools, golf courses, city parks, groundwater recharge). IEUA's Board has approved a $140 million budget to expedite the construction of recycled water pipeline distribution system. The accelerated implementation plan was developed through a collaborative process with local cities, water districts, Chino Basin Watermaster and other stakeholders and represents a comprehensive evaluation of the infrastructure needed to maximize recycled water use in the region. In addition, IEUA and local cities have coordinated with developers to incorporate dual "purple" piping into new urban developments to maximize recycled water use for non-potable purposes.

The energy demands to produce and deliver recycled water are less than one third of the energy required to deliver water through the State Water Project. Additional energy savings are included in the plan by building new smaller water recycling plants in the northern part of our service area to provide recycled water to communities (Upland, Fontana, and Rancho Cucamonga) without the need to pump the water to them. The Cucamonga County Water District (CCWD) proposed satellite plant authorized by HR 2919 would be the prototype water recycling plant to reduce energy use of pumping recycled water to the higher elevations along the San Gabriel Mountains.

Approximately 25% of the recycled water will be used for groundwater replenishment within the Chino Groundwater basin to augment the potable water supply. IEUA and Chino Basin Watermaster recently got court approval to expand the artificial recharge of the Chino Basin Groundwater Basin. The plan is to blend recycled water with stormwater and imported water in a coordinated fashion with flood control district to ensure that all water sources are conserved in an optimal manner (targeted goal is an additional recharge of 80,000 acre-feet per year).

C. Local Groundwater Storage and Conjunctive Use (500,000 acre-feet of new storage)

The Chino Basin Watermaster is implementing an Optimum Basin Management Plan to enhance the conjunctive use storage of the Chino Basin. Today MWD has stored over 80,000 AF in the Basin and has funded $1.5 million in engineer feasibility studies to expand the storage to 150,000 AF. The Optimum Basin Management Program developed over the past two years by the Chino Basin Watermaster would implement a comprehensive water resources management strategy to drought proof the area and enhance the yield of the groundwater basin. The Chino Basin Watermaster has developed a conjunctive use program to store 300,000 – 500,000 acre-feet of imported water in wet years for drought year withdrawal for local, regional and statewide availability. In June, 2003 IEUA, Chino Basin Watermaster, Three Valleys MWD, Western MWD and the Metropolitan Water District executed an agreement for the initial 100,000 acre-feet of storage and recovery projects ($27.5 million funding from MWD and Calif. DWR). In June 2007 MWD agreed to fund studies to evaluate expanding this storage program.

D. Chino Desalination Projects (40,000 acre-feet annually by 2020)

Historically, Colorado River water (relatively high salinity) and “Route 66” agricultural practices have caused areas of the Chino Basin to have high salts that make the water unfit for domestic uses. To correct this problem and to recover this poor quality water, the Chino Basin Optimum Management Plan recommends implementation of groundwater cleanup projects to pump and treat poor quality groundwater to meet drinking water standards.
Additionally, the desalination projects of the lower Chino Basin area will protect and enhance the water quality of the Santa Ana River and the downstream use by Orange County. HR 813 (passed the House on October 22, 2007) would provide authorization under the Bureau of Reclamation’s Title XVI program to provide funding for the third Chino desalter and brine line improvements with the SAWPA SARI brine system

recommended in the Southern California Comprehensive Water Reclamation and Reuse Study (USBR, 2003) and the joint MWD/USBR Salinity Management Study (1999). The third phase expansion is projected to cost $110 million and increase to approximately 40,000 AF.

E. Stormwater (25,000 acre-feet annual average of new stormwater capture percolation)

A critical issue facing the coastal plain of Southern California as the region continues to urbanize and hardscape our landscapes will be how to implement both small scale and larger scale projects for stormwater capture to allow percolation into our groundwater basins. IEUA in coordination with the Chino Basin Watermaster, the San Bernardino County Flood Control District and the Chino Basin Water Conservation District has developed an integrated recharge master plan to optimize the capture of stormwater with replenishment of imported water from MWD and our local recycled water to enhance the storage and recovery of water from the Chino Basin. During the past five years, IEUA has funded construction of over $50 million in improvements on the Groundwater Recharge Basin.

IEUA is also sponsoring innovative small scale, on-site (neighborhood development) storm water management projects to enhance percolation of rainfall to minimize runoff, reduce contamination of rainwater before it percolates into the ground and to cost effectively reduce flood control requirements while helping the cities and county meet regulatory requirements. This innovative program is being funded in partnership with the CALFED Bay-Delta Program, Metropolitan Water District of southern California, and the Southern California Concrete Association.

III. Climate Change Impacts on California Water Supplies

In the fall of 2006 IEUA collaborated with RAND on a study of the potential affects of Climate Change on the IEUA and Chino Basin area. This work has been recently completed and a Congressional briefing will held on January 31, 2008 to explain the findings of this report. Climate change will affect water supplies in California, but few water-management agencies in the state have formally included climate change in their water-management plans. RAND researchers have worked with Southern California's Inland Empire Utilities Agency to help it identify vulnerabilities related to climate change in its long-term water plans and to evaluate its most effective options for managing those risks. But in summary the RAND research project highlights the critical need to develop more local supplies in California (e.g., water recycling, local groundwater storage and stormwater replenishment programs, implement excellent water use efficiency/conservation programs) to avoid significant water shortages and economic impacts.

IV. Future Issues and Need for Federal Assistance

Southern California does have enormous water problems when you consider the following trends:

- ✓ *The current population is about 18.5 million and will likely double over the 50 years;*
- ✓ *The imported water infrastructure from MWD can optimistically only deliver 2.4 million acre-feet, assuming resolution State Water Project Delta issues and the Colorado River problems are successfully resolved;*
- ✓ *Climate change is expected to impact both amount and timing of future water supplies, increasing the likelihood of shortages during critical times;*
- ✓ *Importing water to southern California requires a large amount of electrical energy, substantially more than the alternative local supplies (recycled water, capturing stormwater, and groundwater recovery of poor quality water);*
- ✓ *The region faces significant shortages unless we develop a local supply strategy.*

The issue for the region as articulated in the MWD Integrated Water Resources Plan adopted in 2004, is to develop a balanced approach to multiple sources of supplies with a clear priority to local resources management and emphasis on less energy intensive uses of water that protect water quality and the wildlife habitats of the region.

Addressing the four questions asked in the letter inviting me to testify.? My response to these questions and suggestions are as follows:

The Committee should continue to examine the opportunities for State and Federal agency partnerships to promote water use efficiency programs recommended in the CALFED Bay-Delta Record of Decision (increase water conservation, water recycling and new local groundwater storage programs to reduce the need for Delta exports consistent with the California Water Plan.

The Committee has developed Views and Estimates in the past few years that strongly supports increased funding for the Bureau of Reclamation's Title XVI Program. For FY 2009 I recommend the Committee support an increase of $100 million increase in the funding of Title XVI Program expenditures.

A *coordinated approach to regional infrastructure planning for water supply, groundwater management, stormwater, wastewater reuse and recycling needs to be integrated on a watershed and regional scale. Regional leadership in the planning of flood control, wastewater and water facilities is an opportunity that can save billions over the next 5 decades as well as help address the serious challenge facing this nation through climate change. The federal government should be a partner in this process helping both to facilitate redirection of federal programs to support local planning and providing funding for projects that contribute to the nation's goals for water security and reduction of climate* *change impacts. EPA, Army Corps, US Bureau of Reclamation, the USDA Natural Resources and Conservation Service all have significant activities within the region.*

A historic example of a state/federal partnership was the leadership of this committee in 1996 in drafting the CALEED Bay-Delta legislation that provided the authorization.

I would recommend that your Committee hold additional hearings on these opportunities to develop new regional, state and federal partnerships that address comprehensively watershed divide problems

In closing, thank you for the opportunity to testify. If I can provide any additional information on the current and future water problems facing California, please don't hesitate to contact me.

ATTACHMENT 5

December 21, 2007

Ms. Karen Scarborough
Resources Agency
1416 Ninth Street
Sacramento, CA 94814

Re: Comments on BDCP Points of Agreement

Dear Ms. Scarborough:

We are writing on behalf of the Natural Resources Defense Council ("NRDC") and its more than 120,000 members in California to express our concerns regarding the recent planning document approved by the Bay Delta Conservation Plan ("BDCP") Steering Committee: Points of Agreement for Continuing into the Planning Process (November 16, 2007) ("Points of Agreement"). These comments are supplementary to our previous comments. Unfortunately, with the one exception noted below, this document does not address the serious concerns we raised a year ago. *See* Letter from Barry Nelson and Katherine Poole to Scott Cantrell re Proposed Planning Agreement for the Bay Delta Conservation Plan (Oct. 2, 2006) (attached). In fact, in some areas, this document appears to be moving farther away from a balanced, legally sufficient and effective program.

I. PREMATURE DECISION REGARDING CONVEYANCE ISSUES

The Points of Agreement concludes that "the most promising approach for achieving the BDCP conservation and water supply goals involves a conveyance system with new points of diversion" including "the construction and operation of a new point (or points) of diversion in the north Delta on the Sacramento River and an isolated conveyance facility around the Delta" as well as "[m]odifications to existing south Delta facilities." *Id.* at 3. The document reaches this conclusion *before* the BDCP process has conducted the in-depth environmental review and comparison of alternatives under CEQA, NEPA, the ESA and the NCCPA that is necessary to support any scientifically-supportable and legally-defensible conservation plan. The BDCP has no basis for eliminating all other water conveyance and operations alternatives from serious consideration. This decision is premature, and should be revisited.

The Points of Agreement acknowledges that the Steering Committee has not yet begun the planning process for the development of the BDCP. Points of Agreement at 6. In fact, the BDCP has not yet defined the "preliminary biological goals and objectives to guide initial plan development." *Id.* at 7. If the goal of the BDCP process is truly to "develop a conservation plan for the Bay Delta pursuant to the Endangered Species Act (ESA) and the Natural Community Conservation Planning Act (NCCPA)", as the Points of Agreement asserts, then the biological goals and objectives should be driving the content of the plan, not water supply considerations. *Id.* at 1. For example, as in the case of the Planning Agreement, this document does not commit to the recovery of listed species, and thus fails to meet the requirements of the NCCPA. That commitment should be one of the first and most fundamental commitments for a legitimate conservation plan.

Water conveyance facilities and their operations are one of the primary stressors on the Delta's ecosystem and aquatic species, and are ostensibly the focus of the BDCP. It stands to reason that the BDCP should consider the impacts of a wide array of alternative water conveyance facilities and operations on aquatic habitat, and consider alternative ways to revamp that water supply system to be compatible with fisheries conservation and recovery. The BDCP initially appeared to be pursuing this approach, identifying four "conservation strategy" options that would have allowed the agencies to analyze and compare the environmental impacts of a range of alternative water supply scenarios. Those options included:

- Option 1: use of existing facilities
- Option 2: improved through-Delta conveyance
- Option 3: dual conveyance
- Option 4: a new diversion on the Sacramento River

Points of Agreement at 5. By analyzing the benefits, costs and impacts of these alternative conveyance points, in combination with changes in operation that included various different diversion amounts, including significant reductions in total diversions, the BDCP could have garnered a great deal of useful data to inform a conservation plan.

Instead, the BDCP has prematurely narrowed its focus to Option 3, eliminating all other diversion and conveyance alternatives from consideration before fully analyzing the impacts of those alternatives. As explained in the Options Evaluation Report, this dual conveyance option will now "serve as the nucleus for the larger conservation plan and other major elements of the strategy will be formulated around it." BDCP Options Evaluations Report at ES-1 (Sept. 2007). As a result, any subsequent analysis will fail to provide decision makers with a meaningful comparison of critical policy alternatives, such as how the environmental impacts of reducing diversions from existing facilities would compare to the impacts of building a highly expensive new diversion facility on the Sacramento River.

Moreover, the BDCP's own Options Evaluation Report identified conveyance alternatives that it concluded were biologically preferable to the dual conveyance option, e.g. Option 4, but which the BDCP nevertheless rejected. While we do not endorse the analysis or conclusions of the Options Evaluation Report, it is telling that the BDCP stakeholders have already rejected an option that the federal fish agencies and their own internal analysis suggested was the biologically preferable option.

Simply put, we do not believe that it is justifiable to select a "plumbing" alternative without making any meaningful decisions regarding other key issues, such as endangered species recovery, ecosystem recovery goals, total diversions, annual operations, water quality impacts, impacts to Sacramento River fisheries, cost, financing, governance, and other issues central to the question of restoring the Delta. Some of these considerations could fundamentally affect decisions regarding conveyance strategies.

II. INCONSISTENCY WITH THE DELTA VISION BLUE RIBBON TASK FORCE VISION DOCUMENT

The imbalance in the Points of Agreement is particularly striking in comparison with the recently released Delta Vision document from the Delta Vision Blue Ribbon Task Force. The Delta Vision process was created through SB 1574 and Executive Order, representing an agreement between the legislature and the Governor. It is charged with developing a long term plan for the Delta that addresses more issues than are addressed by the BDCP process. Through the Stakeholder Coordination Group, this process also provides for the involvement of a broader range of stakeholders than the BDCP. Thus, the task force has broader support, broader involvement and a broader focus than the BDCP. Therefore, the BDCP should take care to ensure that its methodology, recommendations and timing are adapted to the Delta Vision process. Unfortunately, in the following respects, the Points of Agreement document is inconsistent with the Delta Vision document.

The Delta Vision document contradicts the conclusion of the BDCP regarding conveyance by recognizing that "not enough information is available at this point" to reach conclusions regarding conveyance. Instead, the Delta Vision document calls for an approach "recognizing the interdependence of all elements of a sustainable Delta vision and making decisions about conveyance and storage within that larger perspective." Delta Vision at 13. Unfortunately, the BDCP document has turned the sound approach of the Delta Vision document on its head, reaching a conclusion regarding the one issue for which the Task Force has most clearly recommended a cautious, comprehensive approach, and failing to reach conclusions regarding many other issues on which strong conclusions are clearly justified. The common thread among these decisions is an excessive focus on water supply issues, at the expense of other considerations.

The Delta Vision document is also far more direct in discussing the need for reductions in diversions, as well as the need for water in California to be managed "with significantly higher efficiency." Delta Vision at 2. This conclusion is supported by the CALFED Science Program, which recently stated that "opportunities for increasing supply to satisfy growing demand are becoming limited, and environmental problems are creating a growing need to reallocate water to the ecosystem. As California's population grows, increasing urban water needs will have to be met mainly by improving water management instead of by developing new supplies within the Sacramento-San Joaquin system." CALFED Science Program, State of the Science for the Bay-Delta System: Draft Summary for Policymakers and the Public at 9 *(*November 2007.) A reduction in diversions has also been mandated by the December 14 federal district court ruling regarding the protection of Delta smelt. The Points of Agreement should recognize this pressing need, which the Delta Vision document addresses more directly.

We recommend that the approach of the BDCP be modified to reflect the recommendations and approach of the Delta Vision Task Force.

III. LACK OF CONSIDERATION OF THE FAILURE OF THE ENVIRONMENTAL WATER ACCOUNT

The primary focus of this document appears to be to provide regulatory assurances for the CVP and SWP Delta facilities. Unfortunately, the Points of Agreement and the previous planning agreement do not clearly call for the analysis of the dramatic and fundamental failure of the previous assurances mechanism – the Environmental Water Account. We have described these failures in some detail. *See* Letter from Katherine Poole and Barry Nelson to Sammie Cervantes re the draft supplemental EIS/EIR for extending the EWA (Dec. 10, 2007) (attached). Indeed, the EWA has contributed to the collapse of the Bay-Delta ecosystem and its fisheries. Clearly, this is a highly questionable tool for inclusion in a conservation plan for the Bay-Delta. It appears, however, based on the current proposal to extend the EWA, that state and federal agencies are attempting to extend temporarily this failed strategy until it can be made permanent by the BDCP. The BDCP can only avoid a full and fundamental evaluation of the EWA if this tool is permanently abandoned. The recovery of the Delta and listed species will require far more effective tools, including clear regulatory requirements and robust adaptive management measures that are not dependant on annual purchases and public funding, or on self-defeating increases in Delta pumping.

IV. ELIMINATION OF 8,500 AS AN INTERIM PROJECT

We are pleased that BDCP has responded to one of the recommendations in our previous letter – specifically by eliminating as an interim action the proposal to increase to 8,500 cfs the pumping limit for the SWP Delta pumps. Unfortunately however, other than this decision, the Points of Agreement document has not addressed the many fundamental concerns raised in that letter.

V. CONCLUSION

As you know, NRDC has reluctantly chosen not to participate in the BDCP process. We made this decision after raising concerns that the BDCP Planning Agreement failed to ensure that the final plan would conserve and recover affected listed species, while guaranteeing assurances to regulated entities "that neither the USFWS nor NMFS will require the commitment of additional land, water, or financial compensation or additional restrictions on the use of land, water, or other natural resources beyond the level otherwise agreed upon for Covered Species, without the consent of the affected Potential Regulated Entities." Planning Agreement, pp. 10-11. Our concerns have not been addressed. Indeed, the recently-issued Points of Agreement heightens our previous concerns regarding this effort, which is not yet a credible "conservation plan."

We urge you to reconsider this approach, make the BDCP consistent with the Delta Vision process and refocus it on conservation as its first priority. Thank you in advance for considering our comments.

Sincerely,

Barry Nelson
Senior Policy Analyst

Katherine Poole
Senior Attorney

Cc: Senator Dianne Feinstein
Senator Barbara Boxer
Congresswoman Grace Napolitano
Congressman George Miller
Senate President pro tem Don Perata
Senator Mike Machado
Assemblywoman Lois Wolk
Assemblyman Jared Huffman
Lester Snow, DWR
John Davis, BOR
Steve Thompson, FWS
Maria Rea, NMFS
John McCamman, DFG

ATTACHMENT 6

NATURAL RESOURCES DEFENSE COUNCIL

December 10, 2007

Ms. Sammie Cervantes
Bureau of Reclamation
2800 Cottage Way, MP-140
Sacramento, CA 95825
scervantes@mp.usbr.gov

VIA ELECTRONIC AND U.S. MAIL

Re: Comments on the Draft Supplemental EIS/EIR for Extending the Environmental Water Account and OCAP Consultations

Dear Ms. Cervantes:

We are writing on behalf of the Natural Resources Defense Council ("NRDC") and its more than 120,000 members in California with regard to the draft supplemental EIS/EIR ("DSEIS/EIR") for the Environmental Water Account ("EWA"). The DSEIS/EIR proposes to extend the existing EWA program, which is currently set to expire at the end of 2007, for another four years, through 2011. The U.S. Bureau of Reclamation and the California Department of Water Resources, the co-lead agencies for the DSEIS/EIR, propose to take this action without providing any analysis of how the EWA has functioned since its inception in 2001 or whether the EWA has succeeded in achieving its stated fish protection purposes. In fact, the EWA has *not* functioned as envisioned and, by placing artificial restraints on the amount of water ostensibly available for fish protection, has contributed to the *decline* of imperiled fish in the Delta, most of which are in worse condition today than they were in 2001. For these reasons, we urge the agencies to discontinue the failed experiment of the EWA, and to devote the taxpayer resources currently dedicated to the EWA to actions that could provide a real benefit to imperiled fish.

In previous biological opinions on the joint operations of the Central Valley Project and State Water Project (i.e., the "Operating Criteria and Plan" or "OCAP"), the agencies have considered the EWA a central feature to mitigate the harmful impacts of the projects on listed fish. The Bureau has reinitiated consultation on those OCAP biological opinions, and those reconsultations are ongoing. Apparently, the agencies have not yet defined the "project" for this reconsultation and it is unclear whether the agencies are contemplating including the EWA in the new project description. Because the EWA has failed to function as a fish protective measure and should not be considered an effective mitigation or conservation tool in the new biological opinions, we seek consideration of these comments in those ongoing consultations as well. Likewise, we request that this information be incorporated, by DWR and DFG, into efforts to comply with the requirements of CESA.

I. THE EWA HAS NOT FUNCTIONED AS ENVISIONED

www.nrdc.org
111 Sutter Street
20th Floor
San Francisco, CA 94104
TEL 415 875-6100 FAX 415 875-6161
NEW YORK · WASHINGTON, DC · LOS ANGELES · CHICAGO · BEIJING

There is no doubt that in past years the water promised for fish protection through both the Environmental Water Account and the CVPIA (b)(2) account has been significantly less than what was promised in the CALFED ROD. *Finding the Water: New Water Supply Opportunities to Revive the San Francisco Bay-Delta*, Environmental Defense, 2005 (appended as Exhibit 1). From 2001-2004, the EWA provided only 29% on average of the expected 195,000 acre-feet of operational assets. *Id.* at 12-13. Collectively, the EWA and b(2) have contributed as much as 500,000 acre-feet *less* water per year towards fish protection and restoration than anticipated in the CALFED ROD. These shortfalls have occurred while exports from the Delta have reached record high levels and the ecosystem has continued spiraling downward. Clearly, the EWA experiment has not performed as planned.

The failure of the EWA to function as envisioned is epitomized in the failure of the agencies to invoke Tier 3 this year – the intended backstop for any shortfall in EWA assets. EWA Tier 3 was supposed to ensure that if EWA was underfunded or failed to perform as anticipated (both of which have happened), sufficient water would be provided to ensure no jeopardy to listed fish. As explained in the Tier 3 Protocol, a copy of which is appended hereto as Exhibit 2:

> As part of the MSCS Conservation Agreement and the FWS and NMFS biological opinions, the CALFED agencies have provided a commitment, *subject to specified conditions and legal requirements*, that for the first four years of Stage 1, there will be no reductions, beyond existing regulatory levels, in CVP or SWP Delta exports resulting from measures to protect fish under FESA and CESA. *This commitment is based on the availability of three tiers of assets:*
> …
> Tier 3 is based upon the commitment and ability of the CALFED Agencies to make additional water available should it be needed.
> …
> Tier 3 is a fail-safe device, intended to be used only when Tier 1 and Tier 2 are insufficient to avoid jeopardy to the continued existence of an endangered or threatened species.
> …
> The State and Federal Projects will be responsible for making preparations for the activation of Tier 3.

(Emphasis added). This language makes clear that the assurances provided under CALFED, and the ESA and CESA compliance of the EWA, were dependent upon the existence and availability of these Tier 3 assets.

Unfortunately, when the time came to call upon this Tier 3 "fail-safe", the agencies failed to trigger it, ensuring that listed species rather than water users would suffer the consequences of the failure of the EWA to live up to its stated purpose. There can be no question that Tier 1 and Tier 2 have been and are insufficient to avoid jeopardy to the threatened delta smelt. A federal court held in May of this year that the "delta smelt is indisputably in jeopardy as to its survival and recovery." *NRDC v. Kempthorne*, Order on Summary Judgment at 119 (May 25, 2007). This finding echoes the findings of several expert fisheries biologists, including staff of many state and federal agencies. *See, e.g.*, DSWG Briefing Statement (May 15, 2007) ("the species has become critically imperiled and an emergency response is warranted") (attached hereto as Exhibit 3); Statement Presented by Ryan Broddrick, Director, CDFG, to House Subcommittee on Water and Power (July 2, 2007) ("it is DFG's position that actions must be taken to protect as many individual smelt as can be through manipulation of the water projects. Each reproducing organism is important to the survival of the species.") (appended hereto as Exhibit 4). Despite these findings and the continued take of large numbers of delta smelt at the Project pumps this past summer, *see* delta smelt May, June and July take tables (appended hereto as Exhibit 5), the Project agencies obstinately refused to invoke Tier 3.

Inexplicably, the DSEIS/EIR makes no mention of this breakdown of the EWA's "fail-safe", nor does it describe or analyze the historical shortfalls of the EWA or the program's failure to function as envisioned. These shortcomings are far more relevant to the foreseeable impacts of extending the program than any of the purely hypothetical modeled impacts contained in the DSEIS/EIR. The DSEIS/EIR must be revised to address these issues. Further, these historical realities belie the statement in DSEIS/EIR that "[i]f pumping would be likely to put at risk the continued existence of a species listed as endangered or threatened under the Endangered Species Act (ESA), the Project Agencies would curtail pumping even if purchases already totaled 600,000 acre-feet and all assets were used." DSEIS/EIR at ES-5. This is precisely the situation that presented itself to the Project Agencies this summer, and the agencies failed to curtail pumping once EWA assets were depleted even though continued pumping threatened the continued existence of the delta smelt.

Moreover, the DSEIS/EIR seeks to utilize the ESA/CESA process for coverage of the EWA initially established in the CALFED ROD, without addressing any of these fundamental failures of the process to operate as envisioned and which were essential to the CALFED analysis. *See generally* DSEIS/EIR Appendix C.[1] For example, Tier 3 no longer exists as a viable "fail-safe device." Yet, the CALFED assurances were explicitly "based on the availability of three tiers of assets." Tier 3 Protocol. The DSEIS/EIR makes passing reference to this change, obliquely noting that "[b]ased on current circumstances, these three tiers are no longer an accurate way to describe EWA assets." DSEIS/EIR at 2-4. But the document fails to acknowledge the implications of omitting this critical "fail-safe device" or to describe the replacement structure of the EWA going forward.

In short, the DSEIS/EIR fails to adequately describe the project to decisionmakers and the public or to disclose the environmental impacts associated with the policy choice of extending the EWA. The document should be revised to correct these shortcomings. We believe that an accurate description and assessment of the EWA will demonstrate that the program should not be extended.

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[1] The DSEIS/EIR also fails entirely to discuss the state court decision finding that DWR lacks the necessary CESA coverage for operation of the SWP, which also likely impacts the CESA analysis in Appendix C. It is unclear, for example, how EWA assets pumped through the SWP facilities at Clifton Court forebay and Banks pumping plant have CESA take authority when the court found that the SWP lacked any take authority for its pumping operations. The DSEIS/EIR must be revised to address this issue.

II. THE EWA HAS LIMITED, RATHER THAN EXPANDED, THE AMOUNT OF WATER AVAILABLE FOR IMPERILED FISH

Since shortly after the first EWA ROD was signed in 2004, the program has been used as an excuse by the agencies to deny needed water to imperiled fish rather than to help protect and recover imperiled fish. For example, in February 2005, when delta smelt populations were at then-record low levels, fishery biologists recommended that exports be curtailed to reduce entrainment. However, because EWA supplies were scarce, project managers did not curtail exports as much or as long as was requested. *Compare* "Data Assessment Team" call notes (Feb. 1, 2005) (recommending combined exports be reduced to 1500 cfs for one week) (appended hereto as Exhibit 6, without attachments) *with* CVO smelt report (February 2005) (showing much higher combined export levels) (appended as Exhibit 7). Hundreds of delta smelt were taken at the pumps as a result. *Id.* The lawful and proper course of action would have been for the agencies to fully implement the recommended action, and then use non-EWA project water to meet fish needs later in the year if EWA supplies ran short. Instead, the program has been implemented to turn this requirement on its head, and to short fish without any consideration given to imposing uncompensated reductions on project contractors and other water users.

Unfortunately, the agencies have continued this pattern of using limited EWA assets to deny needed fish protection actions. In 2006, as the delta smelt continued its unparalleled decline in abundance, the Delta Smelt Working Group ("DSWG") evaluated a range of protective actions that could be taken to lessen the impacts of water project operations. One action that was evaluated was to address fall (September-December) Delta salinity levels by making releases from upstream reservoirs to increase Delta outflows. The discussions and analyses of this proposed action are reported in DSWG notes for July 10 (see also the notes from August 21, and Sept 26 (appended hereto as Exhibits 8). The DSWG determined that the fall action had a high likelihood of being successfully implemented and that the scientific basis for the action was supported by statistically significant correlations.

Ultimately, the fall action was not taken because it was determined that "the amounts of water needed to demonstrably improve fall habitat quantity/quality [were] unavailable". Based on analyses provided by DWR, the amount of water necessary for maintaining net Delta outflows at 7000 cfs for the September-December period would range from only 170-433 TAF. DSWG notes (Aug. 21, 2006). As a result of not taking this action, Delta outflows steadily declined, falling below 6000 cfs in October, and salinity levels shifted upstream of 80 km, the critical threshold identified by the DSWG for delta smelt habitat quality and subsequent abundance. Delta smelt abundance plummeted to a new record low the following year, indicating that the fisheries agencies were not sufficiently addressing adverse habitat conditions in the Delta and other stressors to ensure the delta smelt's survival and recovery.

Perceived unavailability of water assets was also the reason behind the DSWG rejecting a protective action in winter 2006 intended to set net flows in Old and Middle Rivers to zero cfs to better protect pre-spawning adults. Low San Joaquin River inflows and negative flows on Old and Middle Rivers, concurrent with high export rates, are likely creating hydrodynamic conditions that draw greater numbers of fish to the pumps and correspond to significantly higher salvage rates. Protection of these biologically valuable spawning adult fish is essential for recovery and sustainability of this at-risk species. Despite the expected benefit of taking this action, it was rejected because "DWR staff have derived estimates of the water costs of the potential actions in the Resources Agency POD Action Matrix and found that the proposed winter action could consume all available environmental water, leaving no assets for spring actions for larvae or juveniles." DSWG notes (Dec. 11, 2006) (appended as Exhibit 9); *see also* DSWG notes (Oct. 10, 2006) ("The Working Group notes that some of the weaknesses of the DFG plan included the potential to exhaust all EWA and B2 assets in winter, leaving nothing in reserve for spring actions") (appended as Exhibit 10).

More recently, NMFS' biologists testified against taking actions to protect delta smelt based on a similar misperception that the total amount of water available to protect imperiled salmonids was limited to a pot of "environmental water" defined by EWA and b(2) assets, and that water used to protect smelt would necessarily deplete the amount of water available to protect salmon. *See* Declaration of Bruce Oppenheim in *NRDC v. Kempthorne* ((June 15, 2007) (appended as Exhibit 11). For example, Mr. Oppenheim explained that "the use of environmental water after VAMP on the San Joaquin River may have consequences later in the year on the Sacramento River." *Id.* at 3. This statement is only true if there is a limited pot of "environmental water" available to meet all fisheries needs – a position that is contrary to numerous requirements of state and federal law.

All of these decisions are based on the incorrect assumption that the amount of water available to protect listed fish species is limited to the assets of the EWA, CVPIA b(2), and other sources of water "dedicated" to the environment. The Bureau has perpetuated this fallacy, asserting that it must meet the needs of CVP contractors before meeting the needs of listed fish species. *See* Declaration of Ronald Milligan in *NRDC v. Kempthorne* (June 21, 2007) ("Reclamation operates New Melones to meet … project needs of the East Side Division CVP contractors" which leaves "no additional water available for out of basin releases from New Melones Reservoir" even if needed to prevent jeopardy to listed delta smelt) (appended as Exhibit 12); *see also see also* Transcript of Hearing re Interim Remedies Day 7, *NRDC v. Kempthorne*, Testimony of Ronald Milligan at 1553-54 (Aug. 31, 2007) (explaining that the WOMT rejected some recommendations of the DSWG because of concerns regarding "the ability for the EWA to function in a manner that it could, in essence, pay back the projects for curtailments without impacting operations in the long term sense or allocations to contractors") (appended as Exhibit 13). Similarly, DWR has asserted that it has no additional water available for fish protection, while simultaneously making hundreds of thousands of acre-feet of surplus "Article 21" and "turnback pool" water available to water users and contractors.

This presumed EWA limitation on the amount of water available to protect fish is simply not correct. Numerous courts have made it abundantly clear that the Bureau and DWR must provide sufficient water to protect and recover listed fish species, whether it exceeds the amount of the water the agencies may have earmarked for that purpose or not. *See, e.g., NRDC v. Kempthorne*, Order on Summary Judgment at 61 (May 25, 2007) ("The EWA is simply a means by which the SWP and CVP can obtain water by purchasing it from willing sellers. …If money is unavailable to fund the EWA, Defendants are nonetheless required to prevent smelt take from exceeding permissible take limits. … [I]f all else fails, [additional] assets may be brought to bear, which include 'additional purchased or operational assets, funding to secure additional assets if needed, or project water if funding or assets are unavailable.'") (emphasis in original).

The agencies have turned the EWA on its head and, instead of using it to supplement the resources needed *and required* for fish protection, have used it as an excuse to short the environment and avoid committing those mandatory resources. Unless the agencies make very clear that limited EWA assets cannot be used as a reason not to take an action that would help protect or restore imperiled fish, it should be discontinued.

III. THE ANALYSIS FAILS TO DEMONSTRATE THAT THE EWA HELPS PROTECT AT-RISK FISH SPECIES AND CONTRIBUTE TO THEIR RECOVERY

In addition to the problems discussed above, the DSEIS/EIR fails to provide adequate support for its conclusion that extending the EWA would benefit fish protection and restoration.

First, the document recognizes in several places that a pumping "window" during which EWA assets may be pumped out of the Delta without increasing adverse impacts to listed fish no longer exists. The document explains that "[t]he EWA protects fish at the pumps by reducing pumping when it would help at-risk fish species, then transferring EWA assets across the Delta at other times to repay CVP and SWP users for water lost during pump reductions." DSEIS/EIR at 2-15. The DSEIS/EIR asserts that EWA assets should be used to reduce export pumping to protect fish from the months of December through July. DSEIS/EIR at 2-10 to 2-11. This proposal allows exports to increase to allow delivery of EWA water during the months of August through November. But several imperiled species are vulnerable to take at the pumps during this late summer/fall period. *See id.* at 2-13, 4-15. Moreover, the document notes that the alarming and continuing decline in four pelagic organisms in the Delta have corresponded to a period of "increased exports during June through December." DSEIS/EIR at 4-11. In addition, recent studies have indicated that decreased Delta inflows in late fall and winter may result in reductions in fall habitat quality and eastward movement of X2, which may result in adverse impacts to fish. DSEIS/EIR at 4-13. Thus, it is unclear when a safe pumping window exists for EWA to increase Delta exports. Instead, it is likely that an extended EWA would simply help sustain the current record high levels of exports pumped out of the Delta – export levels that have corresponded to many of the declining fish populations in the Delta. *See, e.g., id.* at B-3 to B-4 (Banks pumping would increase in July, August, and September to convey EWA assets).

Second, the DSEIS/EIR assumes with no support that "[w]hile the fish actions in … revised biological opinions [that are currently being developed for project operations] are unknown, they would likely be less than with the EWA program." DSEIS/EIR at ES-4. This statement reflects a fundamental misunderstanding of the nature of ESA and CESA requirements, which *mandate* that project operations cause no jeopardy to the existence *or recovery* of listed species, cause no adverse modification of critical habitat for survival *or recovery* of listed species, and that the impacts of project take be minimized and fully mitigated. In addition, Section 7 also imposes an affirmative obligation on federal agencies to "utilize their authorities in furtherance of the purposes of this chapter by carrying out programs for the conservation of endangered species and threatened species listed" under the Act. 16 U.S.C. § 1536(a)(1). A program of "conservation" is one that brings the species to the point of recovery and delisting. *Id*. § 1532(3). In short, the project agencies are obligated to protect, recover and conserve listed species, whether or not the EWA is in place.

Third, the DSEIS/EIR explicitly bases its analysis of fish actions on the invalidated, reinitiated, and discredited OCAP biological opinions, claiming that it "would be speculative to assume that the fish actions in the BO will be the same as those described by Judge Wanger because the BO will be based on a comprehensive review of all available information and science." DSEIS/EIR at 1-6. In reality, Judge Wanger's decision is based on a more comprehensive and current review of the science regarding the delta smelt than the invalidated BO, which failed even to acknowledge the precipitous decline of the delta smelt in recent years. In addition, the OCAP BO on listed salmonids has been discredited by more than three independent science reviews, including a CALFED review panel, which concluded that the BO was not based on the best available science. The DSEIS/EIR's reliance on the fish actions encompassed in these discredited BOs for the basis of its analysis lacks a reasonable basis.

Fourth, the Bureau has reinitiated consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service on the OCAP. That consultation is ongoing. Until the Bureau meets the requirements of ESA §7 and, among other things, obtains a valid biological opinion at the conclusion of consultation, the ESA § 7(d) prohibition on making any irreversible and irretrievable commitment of resources applies to the Bureau's actions. Regional Director Kirk Rodgers has correctly recognized that reauthorization of the EWA during the pendency of the OCAP consultations would be a violation of §7(d), and has (twice) sworn to a federal court that such authorization would not occur before completion of the new BOs. *See* Declaration of Kirk Rodgers (Oct. 18, 2006), Declaration of Kirk Rodgers (July 9, 2007) (appended hereto as Exhibit 14). Reauthorization of the EWA as proposed in the DSEIS/EIR runs afoul of the 7(d) prohibition and contradicts Mr. Rodgers sworn statements in the pending OCAP lawsuits.

Finally, the DSEIS/EIR concludes that continuation of the EWA "would have a less than significant impact on X2 location during June through December." DSEIS/EIR at ES-9. However, as the document recognizes, emerging science indicates that moving X2 westward of its recent historic location in the fall could have a significant beneficial impact on listed species and their habitat. By reducing outflow in the fall, EWA could have a significantly detrimental impact on the ability of agencies to meet this new threshold.

IV. THE ANALYSIS FAILS TO EVALUATE THE EWA'S FAILURE TO ASSIST IN ECOSYTEM RESTORATION BEYOND ESA/CESA COMPLIANCE

To date, as discussed above, the EWA has primarily, even exclusively, been operated to limit protective ESA/CESA actions. However, the failure of the EWA extends even farther. The EWA was intended to "provide water for the protection and recovery of fish." CALFED Programmatic ROD at 54. Note that these benefits are not restricted to listed species. The ROD also states that the EWA will "acquire water for ecosystem and species recovery needs." CALFED ROD NCCP Determination at 21. Thus, the EWA was intended as a tool to provide restoration benefits beyond the requirements of ESA/CESA for listed species. These benefits were an important part of the Ecosystem Restoration Program and were the justification for public funding for the EWA. The document does not analyze the failure of the EWA to provide these anticipated benefits.

Indeed, far from facilitating improved ecosystem health, by limiting ESA/CESA actions and by increasing diversions during the August to November period, the EWA has damaged ecosystem health. This failure is indicated by the fact that non-listed species, such as threadfin shad, are showing the same decline affecting listed species such as the delta smelt and that the Pelagic Organism Decline process has identified "water project operations" as a potential cause of the decline of Delta fishes. *See* Interagency Ecological Program 2006-2007 Work Plan to Evaluate the Decline of Pelagic Species in the Upper San Francisco Estuary (January 12, 2007) at 4 (appended hereto as Exhibit 15). The document does include one, inadequate mention of these impacts, by concluding that "(t)he entrainment indices for threadfin shad and American shad would be increase." DEIS/EIR at 4-36. Clearly, the EWA has undermined, rather than facilitated, the CALFED ecosystem restoration goal.

The document must be revised to fully and adequately evaluate the failure of the EWA to contribute to fisheries and ecosystem restoration beyond the requirements of ESA/CESA.

V. THE ANALYSIS FAILS TO EVALUATE THE EWA'S FUTURE USEFULNESS TO FACILITATE "REAL TIME" MANAGEMENT

The EWA was also intended to provide "real time diversion management" of Delta flows and the CVP and SWP Delta pumps. CALFED ROD NCCP Determination at 29. Such real time management assumes that the EWA has enough flexibility to modify Delta flows and the management of the projects beyond the relatively fixed prescriptive requirements of ESA/CESA compliance. The document fails to analyze the extent to which the EWA will provide such flexibility to achieve additional ecosystem or protective measures. Unless the management priorities or assets of the EWA are changed dramatically (a change that this document does not anticipate) it appears unlikely that the EWA will have much, if any, flexibility to provide additional protective measures. To the contrary, to the extent that the EWA provides real time management, this flexibility is designed to increase pumping, potentially causing additional impacts to the ecosystem, and designed solely to provide additional water supplies for South of Delta CVP and SWP contractors.

VI. THE FAILURE TO ANALYZE PAST PERFORMACE UNDERMINES A FUNDAMENTAL PURPOSE OF THE EWA -- TO FAILITATE ADAPTIVE MANAGEMENT

The CALFED ROD was designed with science-based adaptive management as a "central feature." CALFED Programmatic ROD at 4. This document repeats this assertion that "(a)daptive management is a key component of the EWA," and that "(a)daptive management provides a process to change fish actions or asset acquisitions." DSEIS/EIR at page 2-24. The careful evaluation of the past performance of management tools is the defining feature of adaptive management, in order to allow improved, adaptive future management. Indeed, the ROD explicitly commits CALFED agencies to "assess the success of EWA operations." CALFED ROD EWA Operating Principles Agreement at 4. Without such analysis, agencies cannot "adapt" the management of the program in a manner that builds on past successes and responds to failures. The analysis of past performance of the EWA as an adaptive management tool is critical to the central purpose of this document – extending the EWA into the future. Such analysis is also important to agencies, such as the Delta Vision Task Force, the Bay-Delta Conservation Plan process, the Department of Fish and Game, NOAA Fisheries and the Fish and Wildlife Service, which may consider the merits of incorporating the EWA into future management for the Delta. Finally, such analysis is essential to the legislature and the Administration as they consider the justification for public funding for the EWA. An analysis of the past performance of the EWA will reveal that there is no justification for such continued public funding. As discussed above, the document fails to analyze past performance, a failure that cuts to the core of the purpose of the EWA as an adaptive management tool. The document must be revised to fully and accurately analyze the effectiveness of the EWA as an adaptive management tool.

VII. THE DOCUMENT FAILS TO DESCRIBE ACCURATELY THE PROJECT PURPOSE

As discussed above, the document does not adequately analyze the EWA's failure to engage in real time management and adaptive management, to ensure ESA/CESA compliance and to contribute to broader ecosystem restoration. The document also does not include any meaningful provisions to address these failures. The document, however, largely maintains the old, inaccurate description of the purpose of the EWA. DSEIS/EIR at page 2-3. Thus, the document fails to adequately describe the purpose of the project. At the moment, the actual purpose of the EWA appears to be to limit protective actions under ESA and CESA, and to provide additional water supplies to south of Delta water contractors. The document should be revised to include an accurate description of the project.

VIII. CONCLUSION

In light of these many shortcomings in the operation of the EWA and the analysis of the DSEIS/EIR, we urge you to reject the proposal to extend the program beyond the end of 2007. In the alternative, we urge you to withdraw this document and issue a new, adequate draft that addresses the concerns outlined above.

Sincerely,

Katherine S. Poole
Senior Attorney

Barry Nelson
Senior Policy Analyst

Cc: Cay Goude, USFWS
Maria Rea, NMFS
John McCammon, DFG
Lester Snow, DWR

ATTACHMENT 7

September 6, 2007

TO: Michael Healey, Lead Scientist
CALFED Bay-Delta Program

FROM: Jeffrey Mount, Chair
CALFED Independent Science Board

RE: Sea Level Rise and Delta Planning

In July of this year, you asked that the Independent Science Board (ISB) examine the array of sea level rise projections available in published reports and, based on current scientific understanding, advise the Science Program about which projections are most appropriate for incorporating into on-going planning for the Delta. The ISB discussed this issue at their August, 2007 meeting and have developed recommendations detailed in this memo. It is important to note that this is not an assessment of the state of sea level rise science, but is intended to highlight the large uncertainty in sea level rise projections and recommend ways to incorporate this uncertainty into planning.

Background

Sea level plays a dominant role in the San Francisco Bay-Delta. Water surface elevations and associated fluctuations due to tides, meteorological conditions and freshwater inflows drive Bay-Delta hydrodynamics. Hydrodynamics, in turn, dictate the location and nature of physical habitat, the quantity and quality of water available for export, and the design of the flood control/water supply infrastructure. Change in sea level has the potential to substantially alter Bay-Delta conditions and to constrain future management options.

Global sea level rise is a well-documented phenomenon, both in the paleoclimatic record as well as the historical record. Tidal gage records indicate that sea level during the 20th century has risen an average of 2mm/yr (.08 in) during a period of 0.7^{o}C warming. Recent studies suggest that since 1990, global sea level has been rising at a rate of approximately 3.5 mm/yr (.14 in/yr)[1]. The cause of sea level rise stems from two processes: 1) thermal expansion of sea water as the surface layer warms, and 2) increase in mass of sea water associated with melting of land-based glaciers, snowfields and ice sheets.

Recent research supported by the California Energy Commission[2] (CEC) and continued under the CALFED-sponsored CaSCADE program, shows that sea level

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[1] Church, J.A and N.J. White 2006 *A 20th Century Acceleration in Global Sea-Level Rise* Geophysical Research Letters, v. 33, article no. L01602

[2] Cayan, D. *et al*. 2006 *Projecting Future Sea Level* California Climate change Center White Paper CEC-500-2005-202-SF Accessed at http://www.climatechange.ca.gov/research/climate/projecting.html

rise will impact the Delta principally by increasing the frequency, duration and magnitude of water level extremes. These extreme events occur at various periodicities and are associated with high astronomical tides and Pacific climate disturbances, such as El Niño. The CEC study showed that under moderate climate warming and a sea level rise of 3 mm/year (12 in./century), extreme high water events in the Delta--those that exceed 99.99% of historical high water levels and severely impact levees--increases from exceptionally rare today to an average of around 600 hours/year by 2100. This work also showed that roughly 100 of these hours would coincide with very high runoff conditions, further amplifying the impacts of sea level rise. In sum, even under modest sea level rise and climate warming projections, extreme high water levels that are considered rare today will likely be very common by the end of this century.

Sea Level Rise Projections

Early in 2007, the Intergovernmental Panel on Climate Change (IPCC) released its latest assessment of the scientific basis for projections of future climate conditions, including global average sea level rise[3]. As noted in the press, in comparison with the IPCC's 2001 assessment, the latest sea level rise projections appear to have narrowed the range of potential sea level rise and lowered the magnitude of projected sea level rise. This was viewed by some outside of the IPCC as indication that: 1) uncertainty regarding sea level rise had decreased and 2) the problem of sea level rise itself appeared to be less than originally stated. However, both the methods used to derive the IPCC 2007 sea level projections, along with extensive new published research in 2007 suggest that this more optimistic view of future sea level rise may be unwarranted.

The IPCC projections are based on physical models that attempt to account for thermal expansion of the oceans and storage changes in land-based glaciers and ice fields. These models, by necessity, simplify the complex processes of ocean circulation and ice melting. The IPCC midrange projection for sea level rise this century is 20-43 cm (8-17 inches), with a full range of variability of 18-59 cm (7-23 inches). The range of variability reflects model differences and uncertainties as well as differences in greenhouse gas emission scenarios. The IPCC model effort is consensus-based, reflecting the agreement of numerous international scientists.

During the past year, there have been major advances in the science of sea level rise. Paradoxically, these advances have increased the uncertainty of projections in sea level rise, at least temporarily. These advances have also led to strong criticism of the approach that the IPCC used in establishing its projections[4]. One criticism is that the models used to project sea level rise tend to under-predict historical sea level rises, most notably failing to capture recent increases. Indeed, models that use empirical historical relationships between global temperatures and sea level rise perform better

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[3] IPCC 2007 *Climate Change 2007: The Physical Basis—Summary for Policymakers* Accessed at http://www.ipcc.ch/SPM2feb07.pdf

[4] summary in Kerr 2007 *Science NOW* Accessed at http://Sciencenow.sciencemag.org/cgi/content/full/2007/215/2

than the IPCC 2007 models[5]. When applied to the range of emission scenarios used by IPCC 2007, empirical models project a mid-range rise this century of 70-100 cm (28-39 in.) with a full range of variability of 50-140 cm (20-55 in.), substantially higher than IPCC 2007 projections. However, foremost among the criticisms is the failure of the IPCC to include dynamical instability of ice sheets on Greenland and Antarctica in their projections for sea level rise.

Melting of the ice sheets of Greenland and Antarctica has the potential to raise sea level 70 m. For most of the 20th century, the ice sheets have remained relatively stable, with melting contributing a minor fraction to sea level rise. However, during the past year numerous studies have demonstrated that the mass balance (input from snowfall versus losses due to melting or detachment) of these ice sheets is shifting toward more rapid loss, most likely in response to warming of the atmosphere and oceans[6]. The recent rate of mass loss in these ice sheets exceeds current physical model predictions. As many authors have pointed out, increased rates of ice sheet flow involving meltwater lubrication of the ice sheet bed or the removal of buttressing ice shelves, may be accelerating the rate of ice loss on Antarctica and Greenland. The IPCC 2007 report explicitly chose not to incorporate the uncertainty associated with this process into their sea level projections. Recent publications that have examined this issue suggest that, under business as usual emissions scenarios, dynamical instability of ice sheets may add as much as 1 m (39.4 in) to sea level rise by 2100[7].

<u>Recommendations</u>

The ability of current physical models to project sea level rise are limited. This stems in part from our poor understanding of and current inability to model the response of Greenland and Antarctic ice sheets to atmospheric and oceanic warming. Given the costs associated with levee failure in the Delta, the ISB feels it would be a mistake for the various planning processes now underway (BDCP, Delta Vision, DRMS) to base their planning on the conservative 2007 IPCC estimates of sea level rise. Although there is some disagreement about mechanisms of ice sheet disintegration, current advances in understanding coupled with new physical measurements all point toward the same conclusion: dynamical instability of ice sheets will likely contribute significantly to future sea level rise, with the potential for very rapid increases of up to a meter (39.4 in.) by 2100 from ice sheets alone. For this reason, the range of sea level projections based on greenhouse gas emission scenarios contained in the IPCC 2007 report should be viewed, at best, as minima for planning purposes.

The board recommends that planning efforts use three approaches to incorporate sea level rise uncertainty. First, given the inability of current physical models to accurately simulate historic and future sea level rise, until future model refinements

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[5] Rahmstorf, S 2007 *A Semi-Empirical Approach to Projecting Sea-Level Rise* Science v. 315, pp. 368-370.
[6] Shepherd, A. and D. Wingham 2007 *Recent Sea-Level Contributions of the Antarctic and Greenland Ice Sheets* Science, v. 315, pp. 1529-1532.
[7] Hansen J *et al* 2007 *Dangerous human-made interference with climate: a GISS modelE study* Atmospheric Chemistry and Physics, v. 7, pp.2287-2312.

are available, it is prudent to use existing empirically-based models for short to medium term planning purposes. The most recent empirical models project a mid-range rise this century of 70-100 cm (28-39 in.) with a full range of variability of 50-140 cm (20-55 in.). It is important to acknowledge that these empirical models also do not include dynamical instability of ice sheets and likely underestimate long term sea level rise. Second, we recommend adopting a concept that the scientific and engineering community has been advocating for flood management for some time. This involves developing a system that can not only withstand a design sea level rise, but also minimizes damages and loss of life for low-probability events or unforeseen circumstances that exceed design standards. Finally, the board recommends the specific incorporation of the potential for higher-than-expected sea level rise rates into long term infrastructure planning and design. In this way, options that can be efficiently adapted to the potential for significantly higher sea level rise over the next century will be favored over those that use "fixed" targets for design. After all, the current debates over uncertainty in sea level rise are less about how much rise is going to occur and more about when it is going to occur.

STATE OF CALIFORNIA -- THE RESOURCES AGENCY
ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 25, 2008

Ms. Katherine S. Poole, Senior Attorney
Mr. Barry Nelson, Senior Policy Analyst
Natural Resources Defense Council
111 Sutter Street
San Francisco, CA 94104

Dear Ms. Poole and Mr. Nelson:

This letter responds to your letter dated March 13, 2008 providing comments of the Natural Resources Defense Council on the draft of the State Water Project Delivery Reliability Report—2007 (DRR(2007)). Your letter addresses the water demands of the State Water Project (SWP) contractors used in the report, the characterization of modified SWP and CVP operations in 2007 to reduce reversed flows in Old and Middle Rivers, and a statement in the report concerning north-of-Delta diversions. Your letter also makes several recommendations for improving the report and urges changes in SWP operations.

You recommend that the Department include more discussion and analysis of demand management as a tool to improve reliability. The DRR (2007) estimates of SWP contractor demands are based on historical data and information received from the SWP contractors. Those demands are used in the CALSIM studies to obtain the estimates for annual water supply deliveries. The information in the report is presented as the amount of risk associated with an annual quantity of SWP supply. The information is not presented as the amount of risk associated with meeting the assumed SWP contractors' demand. This allows the results from the DRR—2007 to be directly incorporated into an SWP contractor's water management plan to estimate the overall reliability of the district's supply. The greater the ability of the district to draw upon other water supply sources and implement demand management programs, the greater the ability of the water management plan to meet the local water needs.

Providing guidance to SWP contractors on how local and overall water supply reliability could be improved is beyond the intended scope of the DRR (2007). The purpose of the report is to present the Department's current information regarding the annual water delivery reliability of the SWP for existing and future conditions. A key objective of the California Water Plan is to provide guidance to local agencies and governments and regional partnerships on ways to increase regional self sufficiency in meeting their future water demands. The Water Plan includes a diverse set of resource management strategies that can be implemented in different combinations to provide water supply reliability and to meet other water related resource management needs in different regions of the state.

You state that the DRR (2007) should also include an analysis of the impact on SWP delivery reliability of implementing the Governor's call for a 20 percent reduction in per capita water use by 2020. The Department strongly supports aggressively reducing per capita water use however it is not clear how the reduction will affect the demand for Delta exports. SWP contractors should review their current water demands and future demand scenarios to help determine the mix and amounts of water supply sources they will need (including SWP supplies) to meet their water demands and other water resource objectives. It would be advisable for them to consider a future demand scenario that assumes a 20% reduction in per capita water use because it could change how much they decide to invest in different water supply sources. These evaluations, and their implications to the demand for imported water from the SWP and other sources, is a responsibility of the SWP contractors and can be a part of their 2010 Urban Water Management Plans. Urban Water Management Plans will be updated in 2010 and will incorporate this mandate. Those plans will help to define the anticipated demand on Delta water supply. This information will be incorporated into future reports as appropriate.

You state that the conclusion presented in the draft report (page 12) about a new North of Delta diversion from the Sacramento River offering the greatest potential for meeting ecosystem restoration objectives is premature. This statement has been removed from the final report. The Department is proceeding with an evaluation under NEPA and CEQA of the impacts and benefits of implementing the Bay-Delta Conservation Plan. As part of this effort, alternatives for Delta conveyance will be evaluated and the most promising conveyance alternative identified. At least four configurations will be considered: 1) no new Delta conveyance facilities; 2) dual Delta conveyance facilities; 3) an isolated conveyance facility; and 4) an improved through-Delta conveyance system.

You state that the draft report on page 15 incorrectly states that "decline in the abundance of juvenile delta smelt led to a voluntary modification in 2007 in SWP and CVP operations to reduce the reversed flows in Middle and Old Rivers—a modification made possible through the Environmental Water Account." You also make the point that DWR, the U. S. Bureau of Reclamation, and the fisheries agencies are compelled to modify pumping operations when those operations adversely impact the survival, recovery and critical habitat of fish such as delta smelt which are protected under the Endangered Species Act. The Department agrees that it is required to follow a directive by a fish regulatory agency to reduce exports if that agency has determined the action is needed to protect an endangered fish. In this circumstance, the Department had not been directed to reduce exports and chose to reduce them to protect delta smelt.

You state that the DRR (2007) should be redone in order to incorporate the full range of variability of sea level rise recommended by the CALFED Independent Science Board and incorporate updated projections of reduced Sierra snowpack and increased evaporation rates in watersheds and surface storage reservoirs. The Department is a leader in applying climate change factors to projections for water supply and we will continue to take a leadership role in this endeavor. The DRR is published every two years and we will use the best information and analytical methods available to develop the latest projections for delivery capability under potential climate change scenarios.

The remaining comments in your letter go beyond the scope of the DRR (2007). They include requesting DWR to implement a policy of foregoing Article 21 declarations and deliveries if state and federal agencies recommend that the water remain instream or available for ecosystem protection purposes; that DWR use increased carryover storage resulting from reduced pumping to increase the protection for imperiled salmonids; and that a discussion be included in the report of the relationship between lower levels of diversions and proposed expansions in storage south of the Delta that would be dependent on Delta pumping as a water source.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

cc: Cay Goude
U. S. Fish & Wildlife Service
3310 El Camino Avenue Suite 130
Sacramento, California 95821-6340

Maria Rea
Sacramento Area Office Supervisor
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, California 95814-4706

From: Pennington, Bill
Sent: Tuesday, January 29, 2008 4:18 PM
To: 2007DRRComments
Cc: Fong, Frank C.; Waggoner, Michael G.; Wright, Jon
Subject: Reliability of Clifton Court Forebay

The reliability of the Forebay embankments and radial gates, etc., should be considered in the same manner as the reliability of the delta levees. Loss of control at the Forebay may be as likely as the expected levee failures over a 100-year period. Although the risk to individuals and real property might be small due to an embankment or gate failure at the Forebay, such failures may have a big, and long lasting, impact to delivery operations. Bill Pennington

STATE OF CALIFORNIA -- THE RESOURCES AGENCY **ARNOLD SCHWARZENEGGER,** *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Mr. Bill Pennington
California Energy Commission
1516 Ninth Street, MS28
Sacramento, California 95814

Dear Mr. Pennington:

This letter responds to your email of January 29, 2008 providing comments on the draft of the State Water Project Delivery Reliability Report—2007.

In your email, you state that the reliability of Clifton Court Forebay features, such as the intake gates and forebay embankment, should be considered in the same manner as the reliability of Delta levees. You express concern that the risk of the loss of control at the Forebay may be as likely as the risk of levee failure over a 100-year period and would significantly impact water deliveries.

While a failure of one or more of Clifton Court Forebay's intake gates or a portion of its embankment would potentially disrupt pumping at Banks Pumping Plant, the Department of Water Resources doesn't view this risk to State Water Project deliveries as comparable to the risk posed by the extensive levee system in the Delta. One of the strategic planning goals of the Department is to plan, design, construct, operate, and maintain the State Water Project to achieve maximum flexibility, safety, and reliability. In order to meet this goal, the Department is committed to the maintenance and effective operation of Clifton Court Forebay.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

PLANNING AND CONSERVATION LEAGUE

March 16, 2008

Katherine Kelly, Chief
Bay-Delta Office
California Department of Water Resources
1416 9th Street, Room 215-37
Sacramento, CA 95814

California Department of Water Resources
SWP Delivery Reliability Report – Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

via facsimile to: (916) 653-6077
via email to: comments-on-2007drr@water.ca.gov

Re: Comments on the *Draft State Water Project Delivery Reliability Report 2007*

Ms. Kelly:

The Planning and Conservation League (PCL) submits the following comments on DWR's Draft State Water Project Delivery Reliability Report 2007 (2007 DRR). As an organization that advocates for wise investment in and sustainable use of the state's water resources, as well as a party to the settlement agreement that calls for preparation of these biennial reliability reports, PCL urges DWR to substantively address the comments below so that the final report fully meets the rigorous reporting requirements specified in that agreement, and that local planning decisions can be made based on a clear and complete analysis of water delivery reliability.

1. The 2007 DRR must be sufficiently clear and accurate for use in the 2010 Urban Water Management Plans (UWMPS).

As recognized in the 2007 DRR, the Delivery Reliability Report is an important planning document used by many of the SWP contractors, and in turn local water districts as the basis for Urban Water Management Plans (UWMPs), water supply assessment and verifications.

Despite the importance of the DRR, DWR has tended to release the Delivery Reliability Report past the deadlines outlined in the settlement agreement. Per the settlement agreement the DRR is due to be updated biennially, beginning in 2003. The previous DRR was due in 2005; however the final was not issued until June 2006. As a result, all water agencies depending on the DRR were forced to rely on a May 2005 draft document for preparation of their 2005 UWMP. The 2007 Draft DRR was not released to the public until December of 2007, and the final will not be issued until sometime in 2008. The late release of the report is a disservice to the many water agencies which receive water from the State Water Project, as well as the many cities and counties that need the information contained in the report to assess the adequacy of water supply assessments and verifications. Indeed, by releasing these reports in such a manner, local water agencies and local planning entities are forced to rely on draft materials or significantly dated materials as the basis for legally challengeable decisions. Such situations expose these entities to significant risk.

Should DWR continue the trend of late releases of the DRR, the next report, the 2009 DRR, will be issued too late to be useful to urban water agencies for the preparation of the 2010 urban water management plans. Therefore, the accuracy and clarity of the 2007 DRR is even more crucial to water managers and planner entities. PCL respectfully recommends that DWR revise the 2007 DRR to ensure it provides the level of reliable information necessary for the purposes in which it will be used. PCL further respectfully requests that DWR commit to releasing the Draft 2009 DRR in June 2008, and the Final 2009 DRR by February 2009 in order to ensure local water agencies will have sufficient time to incorporate DWR's information into the 2010 UWMPs.

2. The 2007 DRR should provide additional explanation and clarification of data and results to ensure information is presented in a readily understandable manner.

In referring to the Delivery Reliability Report, the settlement agreement specifically states that "The information presented in each report shall be presented in a manner readily understandable by the public." While we recognize that information about the reliability of the SWP is complex, clearer explanations and specific guidance from DWR on particular points are necessary to meet the intent of the settlement agreement and assist readers in deciphering this complex information. PCL proposes the following specific recommendations to develop a more reality understandable document.

A. The DRR must fully disclose the reliability associated with water supplied from the SWP and disclose the implications associated with various levels of reliability.

While the Draft DRR includes the results of many model runs, it fails to provide a significant discussion regarding the implications of the level of *reliability* associated with SWP deliveries. In particular, the Draft DRR fails to articulate how reliability should be factored into water planning, and the DRR fails to disclose the implications of reliance on water that cannot be reliably delivered.

For instance, the DRR includes a very cursory explanation of Article 21. Through out Chapter 7 of the Draft DRR, DWR has listed an "Article 21" category within the water supply source table examples. The Draft DRR does include a footnote stating that, "Annual Article 21 amounts vary significantly from year to year. Without the ability to store Article 21 supply, it is not likely to contribute to local water supply." This statement is woefully inadequate and dangerously misleading. Indeed, a study of the actual model outputs reveals that in one case, for example in table B-20 no Article 21 could be delivered for a period of over 20 consecutive years. Article 21 is reported to be available in only 3 years between 1922 and 1966 in Table B-20. Even when Article 21 is available, in this case 22 thousand acre-feet in a year like 1925, it is not in a quantity that would result in a significant additional local supply even if storage where available.

Even in outputs for more recent conditions, such as in Table B-16, there are long periods of 8 and 10 years when no Article 21 water would be available. Most storage facilities in the state are not designed or operated to store water for a period or 8 to 20 years.

Yet, readers would have to study the many tables in the appendices of the DRR in order to find this information. Readers would then have to interpret those tables further to understand the significance of the listed numbers.

Because Article 21 cannot be delivered in quantities sufficient enough to enhance storage or annual water supply on a consistent basis, it is not reliable and is not an appropriate water supply for those that uses that require a high degree of reliability. In fact, relying on Article 21 for permanent supply is part of the “paper water” problem that was at the heart of the original Monterey Amendments litigation. By masking the dismal reliability of Article 21 with an understated and misleading footnote, DWR facilitates use inappropriate use of Article 21 for purposes that require a higher degree of reliability.

Beyond Article 21, the DRR fails to clearly disclose the reliability of all deliveries from SWP in a substantive manner. While the DRR does include modeling runs reporting the estimated delivery of water to SWP contractors, those runs omit important information, including risk factors in the Delta, and the need to respond to environmental, water quality and area of origin legal requirements. The DRR fails to inform readers that the model runs very likely overestimate the reliability of the SWP. Further, the DRR fails to provide guidance to SWP contractors on how local and overall water supply reliability could be improved.

To remedy this, PCL recommends that DWR include a full discussion regarding the reliability of all types of water delivered from the SWP. That discussion should include a full discussion of the implications of mismatching various levels of water supply reliability with the various intended uses (i.e. urban and agricultural use, or permanent and annual crops). In addition, the Final DRR should omit Article 21 from the list of Water Supply Sources in all tables. The final DRR may include Article 21 is a separate table of “interruptible and unreliable water sources.” Such tables should include a footnote that reads, “Article 21 should not be used to support a permanent economy.”

B. The DRR should include Water Supply Source tables for each SWP contractor.

DWR should include a clear and understandable forecast of how much water (both Table A and Article 21) the SWP can delivered under current and future conditions for each SWP contractors. Although some of this information is in the draft DRR, it is split up and scattered in many tables, figures, and graphs, and in some cases must be derived from information in the DRR by means of additional calculations. Inclusion of separate tables for each contractor would allow readers to clearly find information affecting the specific area of interest.

C. The DRR should provide estimates of SWP delivery reliability for the period required by the next UWMP.

As noted in the 2007 Draft DRR, the primary use of the DRR is by SWP contractors and their customers for use within the regional and local UWMPs. California law requires the UWMPs, and also water supply assessments and verifications to assess water supplies for 20 years into the future. In order to be useful to those water planners, DWR should extend the analysis included in the DRR to the period required by the following UWMPs, which in this case would be 2030. While this seems to be a technical detail, failing to extend the range of the DRR could result in significant legal vulnerability for water and land use planners who rely on the DRR to make legally challengeable decisions.

3. The 2007 DRR should clearly disclose the limitations of modeling outputs and the implications of the modeling assumptions in CALSIM II, and provide recommendations to water agencies for appropriate use of modeling outputs.

CALSIM II is the primary analytic tool used in estimating current and future water delivery reliability, yet it has known weaknesses that are not disclosed or discussed in the 2007 DRR. Of particular concern to PCL is the fact that, although local agencies will be using this document as a basis for developing local UWMPs there is no acknowledgement of the potential for CALSIM II to *over*estimate delivery reliability. This is a critical flaw in the document that must be addressed.

As participants in the Monterey Plus EIR Committee process, PCL has previously submitted comments to DWR expressing our concerns regarding the adequacy of CALSIM II for use in water management planning and deliveries assessment. Rather than resubmit those comments, we incorporate them by reference here, and highlight some particular issues below.

The Draft DRR reports water availability to the SWP and SWP deliveries through 2027 based on CALSIM II runs. While CALSIM II may be a sophisticated and useful modeling tool for certain purposes, it is inappropriate for determining absolute numbers for export and deliveries. It has been criticized by a panel of expert reviewers for several weaknesses, including its lack of amenability to proper calibration. (*See* A. Close, *et al.*, *A Strategic Review of CALSIM II and its Use for Water Planning, Management and Operations in Central California* submitted to California Bay Delta Authority Science Program, December 4, 2003.

One flaw with CALSIM II is that it fails to reflect the bimodal distribution of water years in California. Currently, the DRR reports CALSIM II runs for average years, a critical dry year, a period of dry years and wet years. Given the presentation in the DRR, it would be reasonable for a reader to assume that average years are the most likely occurrences, and therefore average deliveries are the most reliable. However, based on California's fluctuating hydrology, average years are the least likely to occur, and periods of dry years and wet years are much for likely.

CALSIM II is ill-suited to address bimodal distribution of water years because the model produces an exceedence chart that hides this reality. Arve Sjovold has commented extensively on this point. Mr. Sjovold's most recent comments are incorporated by reference and attached to this letter.

Throughout the 2007 Draft DRR, modeled predictions are presented as though certain, and discussion of possible error or of ranges of possible outcomes is almost entirely absent. The models used cannot possibly produce such certainty. CALSIM II includes hundreds of assumptions. There is a reasonable likelihood that one or more of the assumptions incorporated into CALSIM II will be incorrect.. However, DWR does not disclose these limitations in a clear and understandable manner, and the Draft DRR fails to provide a reasonable strategy for addressing this issue.

Rather than the near certain results presented in the DRR, at best, the model runs can predict, given a certain set of data and assumptions, a range of possible outcomes, with some outcomes potentially more probable than others, and with all predictions limited by both known and unknown sources of error. An accurate discussion of the DRR's modeling results therefore cannot provide certain predictions, and instead should show the range of possible outcomes. By omitting both possible sources of error and potential outcome ranges, the DRR projects a false certainty that reported deliveries are likely.

Because CALSIM II is an optimization model that does not necessarily reflect options available to water operators, or options that water managers *would* choose, it may overestimates SWP deliveries. Despite the optimistic CALSIM II outputs, federal and state water quality and endangered species laws and regulations probably prohibit such high export levels due endangered species requirements, water quality requirements and other regulatory requirements. Indeed, at a recent Bay Delta Conservation Plan meeting on Delta conveyance options, DWR Deputy Director Jerry Johns, noted that CALSIM II and CALSIM Lite tend to deliver "optimistic" outputs, indicating that CALSIM II may maximize potential deliveries when such deliveries would be difficult or impossible to produce in the real world.

Based on CALSIM II outputs, the DRR assumes that future water exports from the Delta will be much higher than the historic average. This DRR prediction fails to recognize that DWR has chronically failed to meet water quality standards in the Delta under historic operations, and significant environmental degradation has taken place under such operations, resulting in new regulatory actions.

In light of the recent pelagic organism declines in the Bay Delta Estuary, and resulting rulings invalidating the biological opinion for Delta smelt, it is prudent to ensure that the Final 2007 DRR modeling assumptions and predictions are conservative, rather than "optimizing." Such revisions would provide a much more realistic and reliable estimate of deliveries that are more consistent with requirements of the Federal Clean Water Act, the Federal or California Endangered Species Acts, or any other environmental permit condition, regulation, standard, or law.

The DRR should also provide reasonable recommendations to water agencies for addressing these modeling faults. In order to increase the likelihood that the estimates used in planning documents will be reasonably accurate and reliable, the DRR could recommend that water agencies consider reducing the amount of deliveries predicted by CALSIM II by certain reasonable percentage, such as10 to 20 percent, when planning for water management.

4. The 2007 DRR should include a more comprehensive analysis of the impacts of climate change on water delivery reliability.

While the DRR recognizes that climate change will have very widespread impacts on the SWP. Yet, the DRR analyzes only one aspect associated with climate change, hydrology, for impact on the SWP deliveries. Climate change is anticipated to affect water quality in the Delta, consumptive use of water in both SWP watershed and the area of use, availability of hydropower and flood safety needs. None of these factors is analyzed for potential impact on SWP delivery reliability in the 2007 Draft DRR.

The Draft DRR proposes that some tools that may be necessary for broader analyses of climate change impacts are not yet available. For instance, the DRR states that current modeling cannot account for the impact on SWP deliveries that may result due to increasing salinity in Delta due to sea level rise. However, at a recent Bay Delta Conservation Plan meeting, DWR provided a summary of CALSIM Lite. During the presentation, it was indicated that the model is capable of assessing and responding to various salinity levels in the Delta. This implies that, at the very least, anticipated salinity increases should be taken into account along with hydrology impacts for all model runs and outputs included in the DRR. Beyond that, the DRR should clearly articulate the full range of impacts anticipated to occur under climate change. The DRR should further disclose which impacts are omitted from estimates of deliveries under climate change scenarios. Finally, the DRR should provide guidance to water agencies on how these omitted impacts are likely to affect deliveries (i.e. whether increased consumption is likely to increase or decrease the amount of water available to the SWP).

5. The 2007 DRR should evaluate variable levels of demand and in particular the 20% reduction in per capita consumption called for in Governor Schwarzenegger's recent letter.

The 2007 DRR assumes 2027 demand for supplies to be the very similar to those used in demand modeled in the 2005 DRR, an approach which neglects (a) the potential for changes in demand (for Article 21 supplies, in particular) due to changes to the SWP contracts that may result from DWR's upcoming decision on the Monterey Plus EIR (see also Section C-1 (p. 7) of the attached comments by PCL to DWR on the Draft Monterey Plus EIR), and (b) the potential for shifts in the amount and pattern of demand based on the ongoing Delta Vision and Bay Delta Conservation Plan processes.

In commenting on the 2006 DRR, PCL recommended that DWR incorporate various levels of demand into model runs. PCL repeats that comment for the 2007 DRR. Indeed, the 2007 Draft DRR, like the 2005 DRR identifies water demand in the delivery service area as one of three primary components that determine SWP reliability. However, like the 2005 DRR, the 2007 Draft DRR does not examine a significantly varied range of possible demand. That omission is important, for such analysis would likely show that reliability is inversely proportional to the level of demand.

Rather, the 2007 Draft DRR provides no clear disclosure of the demand assumptions included in the CALSIM II outputs. The 2007 Draft DRR, instead, states that demand assumptions are based solely on information provided by contractors. PCL requests that in addition to analysis based on information provided by SWP contractors, DWR provide analysis of SWP reliability under the three demand scenarios included in DWR"s 2005 California Water Plan. In addition, the DRR should include analysis that anticipates full implementation of the Governor's recent call for a 20% reduction in per capita water use.

6. The 2007 DRR should consider operations not only under the Wanger decision, but also under operations consistent with the operational recommendations of the state and federal fishery agencies for protection of species listed as threatened or endangered under the federal or state Endangered Species Acts.

The 2007 DRR assumes that 2027 operations will be subject to the current limitations proscribed by the Wanger Interim Remedy Order and SWRCB water quality requirements. However, the re-consultation on the 2004 OCAP, the continued decline of currently listed species (such as Delta Smelt and Winter-run Chinook Salmon), as well as the potential listing of additional species (such as the Longfin Smelt) are just some of the factors that may require significant changes in operations with effects on delivery reliability well before 2027.

The 2007 DRR notes that assumptions regarding 2027 operations are not a prediction of the future, but rather an assessment of the future with consideration only of hydrological effects of climate change and projections of future land and water use. This caveat must be carried clearly throughout the report, making it clear that modeled reliability is likely to be an *over*estimate based on incomplete knowledge of future operational constraints. Furthermore, the DRR should include a discussion of how water agencies may increase water supply reliability within their own service area in order to reduce the risks associated with uncertainty of future SWP supplies.

7. The DRR must recognize that DWR has not yet issued a final decision and EIR for the Monterey Plus project.

DWR is in the process of responding to comments in the Draft Monterey Plus EIR. In response to those comments and upon further analyses, it is foreseeable that DWR may choose to make changes to the Monterey Plus project. The DRR must acknowledge this fact and recognize that the outcome of DWR's Monterey Amendments decision-making may well cause further impacts to SWP delivery reliability.

PCL appreciates the opportunity to comment on the DRR, and we look forward to working with DWR to improve future drafts of the 2007 report as well as future Delivery Reliability reports.

Sincerely,

Mindy McIntyre
Water Program Manager
Planning and Conservation League

Attachments

Cc:
Lester Snow, Director , Department of Water Resources
Antonio Rossmann, Rossmann & Moore, LLP
Roger Moore, Rossmann & Moore, LLP
Senator Perata
Senator Steinberg
Senator Kuehl,
Senator Machado
Senator Kehoe
Senator Ducheny
Assemblymember Wolk
Assemblymember Eng
Susan Kennedy, Chief of Staff
SWP Contractors

Attachment 1

Delores Brown January 1, 2008

California Department of Water Resources
Chief, Office of Environmental compliance
901 P Street
Sacramento, CA 95814

Re: Draft Environmental Impact Report, Monterey Amendment, SCH#: 200301118

Dear Ms. Brown:

Please accept the attached comments in behalf of the Citizens Planning Association of Santa Barbara County, one of the original plaintiffs in the matter of **PCL et al v. DWR.** The comments have been prepared by Mr. Arve R. Sjovold, our representative to the plaintiffs' committee and a participant in the EIR process. Although Mr. Sjovold participated in many of the EIR committee meetings, he is distressed that virtually none of the comments and suggestions made in the long tenure of this committee were recognized or adopted in the preparation of the document. Accordingly, he regrets that his name is listed as one of the committee responsible for preparing this document. Nonetheless, he will honor his pledge to be of service to the committee and to DWR in this matter.

The comments are divided up into several distinct sections. The first deals with what Mr. Sjovold shows are critical flaws in the CALSIM II model, which was used as the primary analytic tool for the impact analyses. Based on his review of the model CPA finds this Draft EIR is seriously deficient. The CALSIM II review presents several analytic findings that are seminal with regard to this model's flaws; they should be addressed by DWR before this process continues. The CALSIM II review also points to critical failures in the application of the CALSIM II results in the analysis.

The second section addresses other areas of the impact analyses while the third section is an attachment of comments and criticisms of the DWR paper on incorporating climate change in to CALSIM II. Since DWR made this report central to their analyses of climate change impacts in the EIR, it is entirely appropriate to include such comments.

Finally, there are two appendices which support the CALSIM II analysis presented by Mr. Sjovold. They point to constructive changes that should be included in CALSIM II before it is used again.

These comments do not reach all the analyses presented in the Draft; there was not sufficient time to do so. However, because of the central importance of CALSIM II to the Draft's analyses, the flaws that have been shown by Mr. Sjovold are sufficient to render the entire Draft as inadequate.

AN ANALYSIS OF CALSIM II AS USED IN THE DRAFT EIR

By: Arve R. Sjovold

Introduction

The draft EIR uses CALSIM II as its primary methodology in analyzing the impacts of the Monterey Amendments (with Settlement additions) and therefore deserves detailed scrutiny as to its accuracy and appropriateness as a tool for environmental impact analysis. The accuracy problem is paramount given that the Appellate Court found that the original Monterey EIR had not considered the ramifications of the SWP's inability to deliver anywhere near the full entitlement values prescribed in the SWP contracts. A consequence of this finding is the acknowledgement that any entity relying on full entitlements as actual deliveries that cannot be fulfilled is dealing with "paper water". To quantify how much water the project can deliver reliably requires a model with a high degree of absolute accuracy. And the degree to which the project falls short of delivering reliably against expected full entitlements is the measure of "paper water". DWR's analyses of reliability of delivery rely totally on the use of its CALSIM II model; thus the accuracy of CALSIM II is essential.

DWR has not properly calibrated CALSIM II so its accuracy is still in question. The EIR does not reference any calibration exercise of CALSIM II and assumes that it delivers accurate estimates of delivery given the assumptions that are made in its development and use.

CALSIM II is referred to as a "simulation model" though in fact it is an optimization model, which is designed to determine the maximum amount of water that can be exported given the constraints of hydrology and SWRCB rules that govern the project's operations. There are troubling features of CALSIM II, which in all likelihood render the model as unsuitable as an estimator of project deliveries. The troubling features include:

- Its water year indices
- The lack of statistical rigor in characterizing the hydrology
- The inability to use environmental parameters as inputs to study impacts
- The lack of calibrations

Model Suitability for Environmental Impact Analyses

The fact that the model is an optimization model and not a simulation as purported, misleads the analysis of environmental impact. This is particularly true considering that **the optimization objective is maximizing export of water from the Delta and not the maximizing of environmental qualities.** Admittedly, quantifying environmental qualities for a mathematical model is an extremely difficult task. However, the model should at least allow ready testing of various proposals to improve the environmental health of the Delta. Instead, the model treats the existing set of water rights rules and regulations as hard-coded constraints within the model code such that it is very cumbersome to change them for use in environmental studies**. Furthermore, the constraints coded in the model are only those that the SWRCB has promulgated as regulations on the project that reflect the past history of the project and its observed impacts on the Delta. It is a tenuous proposition to pretend that those constraints are adequate to protect the environment as we move forward with this project.** For example, DWR admits that the model does not include within its code any sense of Endangered Species Act requirements, which given the current state of the Delta should be its primary focus. Furthermore, the last 12 months have seen several court rulings that acknowledge the inadequacy of the current operations and regulations to protect endangered species. As a result of these rulings, Delta exports have been dramatically reduced. As currently configured, CALSIM II is not well suited to help solve these problems.

The SWRCB constraints that are most limiting on exports are the salinity constraints in the Delta and these operate to control salinity mostly in the western Delta. **In fact, it is fair to say that the model assumes that as long as it meets the salinity constraints in the Delta it has met its requirement for environmental protection in the Delta.**

For example, there are no routines in the model to deal with reverse flows in the San Joaquin River and the consequent mortality of Delta Smelt in the project pumps. Yet there is sufficient data to provide a competent predictor based on flow and pumping conditions to predict when reverse flows are likely to occur. It could be used as a constraint on Delta pumping in order to protect the fish. (See Appendix A)

Even in the case of modeling the salinity, the model uses a predictive equation that relies on one position in the western Delta, is dependent only on Delta outflow, and is independent of project pumping. Yet the historical sense on this issue is the knowledge that heavy pumping in the South Delta can affect the position and variability of the salinity gradient in the Delta. With the relationship that presently exists in the model, the prediction of the salinity appears to be unaffected by export operations.

Furthermore, it is a tenuous scientific proposition that a single point for measuring the affects of the project on salinity in the Delta is sufficient given the magnitude and complexity of the Delta. For example, the Delta Smelt is a species that lives entirely within the brackish water of the Delta and its movements to and fro in the Delta are largely dependent on the salinity variations. DWR should use its modeling talents to predict salinity gradients throughout the Delta and how they vary under different hydrologic and pumping scenarios. The EIR is largely silent on this matter and yet it would seem, given the present dire state of the Delta, that analyses of this sort would be a primary focus of the EIR.

The presently used systems of modeling the Delta by DWR rely on CALSIM II in concert with DSM2, a more detailed model that is intended to calculate the flows throughout the myriad Delta channels. It depends on CALSIM II to provide the input and export flows to and from Delta using the CALSIM II calculations for the Sacramento and San Joaquin valleys; in effect CALSIM II provides the boundary conditions for the operation of DSM2. Thus, DSM2 is limited in the scope of its calculations by the CALSIM II constrained inputs. The limitations of CALSIM II as an export optimization model are visited upon the DSM2 calculations independent of the capability of DSM2 to investigate salinity variations more broadly.

It would be extremely useful to the analysis of the environmental impacts of the project if first model calculations could be obtained for a scenario without regulation of input flows and no exports to establish the conditions in the Delta for which the Delta Smelt are adapted. From this baseline it may be possible to determine the degree to which project operations affect Delta habitat and hence the species that rely on it.

The Problem With Water Year Indices in CALSIM II

CALSIM II uses as a primary input to its calculations a designation called "Water Year Type", which can take on one of five discreet values corresponding to whether the year in question is "wet", "above normal", "below normal", "dry", or "critical". These designations are used as input data to govern project operations in the model (and in practice), particularly in setting environmental constraints and are developed from the historical record spanning 73 years, 1922-1994, the basic hydrologic record used to drive CALSIM II.

Water year type is derived from a "Water Year Index" which is in turn developed from a runoff index. There are two sets of runoff indices, one for the Sacramento Basin runoff and one for the San Joaquin basin runoff. The basin runoff indices are calculated from the measured runoffs from the four major rivers in the Sacramento Basin and the four major rivers in the San Joaquin. These major rivers capture about 80% of the total runoff in the respective basins and are believed to be reliable surrogates for runoff. This runoff data is available on a monthly basis.

For each water year (October through September) a water year index is calculated as the weighted sum of 40% of the current forecast for the upcoming April to July runoff, plus 30% of the current October through March runoff, plus 30% of the previous year's water index. Thus the weighted formulation necessarily spans parts of two water years although it purports to represent the current water year. Depending on the value of the index for a given water year an assignment into one of the water year types is made. For project operations, the index is set by the first of the month forecast beginning in February and continues until the final determination based on the May forecast of runoff.

For use in CALSIM II a water-year type and a water year index are provided as fixed assignments for a given year in a "look-up table" for use in the calculations. **Because of the way in which these two attributes are derived they in effect provide the simulation with "perfect" information as to the upcoming runoff season (December through May) for a given water year, a circumstance that is not possible for making decisions for real time operations.** Also there is the fundamental question posed by the derivation of the water year index in that it combines the runoff from two successive water years. **There is no scientific merit to the notion that the previous year's runoff should affect the subsequent year's runoff, which is precisely what the 40-30-30 weighting does.** A simple serial correlation of the annual runoff record shows that there is no significant correlation, meaning that the current water year's runoff is independent of the previous water year. The water index is without any scientific merit and it should not be used, as is the case for the dependent parameter, water year type.

How the use of these indices biases the CALSIM II calculations and the actual project operations is difficult to deduce, but it is sufficiently clear to state that none of the calculations can be considered useful in the analyses of the EIR.

The additional fact that the indices as they are used are provided to the calculations in a fashion that gives the calculations "perfect information" ahead of the unfolding water year run-off is also sufficient to discredit any claim that this model is a simulation of system hydrology. In a simulation, one tries to replicate the decision structure that faces the system in real time. Knowing how the water year is going to end well before it is experienced allows CALSIM II to begin pumping early in the water year when at times little runoff has materialized. In effect, the early pumping borrows water from the Delta in the knowledge that it will be made up during the spring runoff. However, in real time the system operators do not know that spring runoff will be ample and therefore must restrict early pumping until events on the ground dictate that it is safe to pump.

Environmental Inputs

The object of environmental impact analyses is to evaluate the degree to which project operations and requirements affect what is broadly referred to as the environment. Because environmental attributes are difficult to quantify a good approach is to develop quantitative methods that at least allow ready evaluation of various alternatives intended to both achieve environmental protection and project operations. The present form of CALSIM II focuses only on project operations. It limits its treatment of the environment to what can be hard coded into the model as purported environmental constraints. Even in this regard no attempt has been made to have the model address important environmental questions such as that posed by the dangerous declines in Delta fish species.

A peer review panel of nationally recognized experts was convened to review the CALSIM II model as a tool to support water planning (See Appendix G of the EIR). However, that panel "did not specifically address the manner in which CALSIM II represents the environmental regulations and objectives established for the Central Valley water system", as stated in a study(1) by the National Heritage Foundation. That study builds on the peer review study to examine just how CALSIM II treats environmental constraints and objectives in the model.

The NHI study found that CALSIM II and actual operations are not faithful to the constraints and requirements that have been levied on the projects to protect the environment and the Delta. The study also attempts to examine what would be required in terms of additional changes and requirements that might be necessary to restore Delta health. The EIR does not address the current lack of compliance nor what additional measures might be necessary to begin to restore the Delta. Given the current state of the Delta this deficiency is deplorable and the EIR is again deficient.

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(1) Jeffrey T. Payne et al, "**An Environmental Review of CalSim-II** : Defining "Full Environmental Compliance" and "Environmentally Preferred" Formulations of the CalSim-II Model, Natural Heritage Institute, November 2005

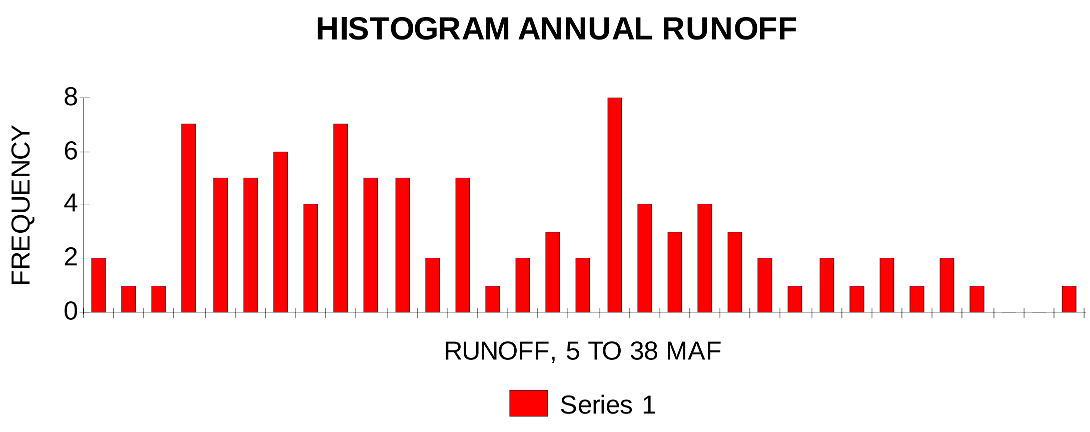
Lack of Statistical Rigor in Characterizing the Hydrology

CALSIM II uses a 73-year historical record of runoff as the primary input to the model. The variation evident in this record is assumed to be an accurate representation of the variation to be expected in the future and this assumption is relied on in characterizing the likelihood of the various output results. For the estimate of reliability of delivery, the model arranges the outputs in ascending order and ranks them in terms of the percentage of outputs exceeding a particular level of delivery. This percentage is used as an indicator of how well the project can meet its delivery requirements. Used in this way the frequency of occurrence takes on the quality of probability. But before any notion of probability can be assigned, the underlying stochastic character of the input variable, runoff, must be ascertained. In fact this information must be available to adequately design the model in the first place. This seems not to have taken place in the development of CALSIM II.

A careful examination of the statistical character of Central Valley runoff (using the 8-river runoff index--the combination of Sacramento and San Joaquin runoff) shows that runoff comprises two distinct groupings, a group that can be described as dry years and the other as wet years. Figure 1 presents a crude histogram of the 98-year runoff record for the 8-river index and it is quite clear that there are two distinct modes (central tendencies). These two tendencies

Figure 1

Runoff Distribution in the Central Valley
8-River Index
(Frequency of occurrence of annual flows-98 year record)



comprise two independent probability distributions and must be treated as such. The overall average runoff for the record (the 8-river index) is 18.04 million acre-feet, which is located in the minimum between the two central tendencies. Accordingly, the average is a relatively unlikely event, certainly not representative of what is normally referred to as “normal.” Thus to characterize individual water years as “normal”, “above normal”, or “below normal” conveys no real meaning. Another characteristic of the dry side distribution is that the only sense of a threshold that could be described as “critical” are the lowest four years in the distribution, which are all 7 MAF or less.

There are 55 years (56% of the record) that comprise the dry year distribution and 43 years (44%) that are in the wet year distribution. These characterizations are based on total annual runoff. Since project operations cannot know at the beginning of the water year in September what the eventual runoff for the year will be, and the previous year is no indicator for what may happen in the current water year, it is of interest to examine the monthly runoff variations to establish when, in a given water year, a reliable conclusion can be drawn as to the likely amount of total runoff. This is where the look-up table of water year index and water year type bias the calculations by in effect telling CALSIM II what the water year will be before it is fully experienced. (Typically, runoff in the first few months of the water year is not very high and appreciable runoff does not occur until significant rain occurs.) **This is very important to the environmental management of the Delta because it could be extremely detrimental to the fisheries if massive pumping was initiated before a reasonable forecast could be made of the amount of water to be made available.** Since in general significant runoff seldom occurs before December, prudence would dictate reduced pumping rates in the fall until runoff is sufficient to provide exports and assure a healthy Delta habitat. Of necessity the project has to be operated this way because it cannot pump water that is not really available. **However, that level of early year pumping that can both protect the Delta environment and provide for exports has not been ascertained, either for operations or for CALSIM II calculations and the EIR fails to show as much.**

Significant runoff can occur in December and generally runoff increases going into winter and peaks in the spring when snowmelt becomes the major source of runoff. However, the record shows that December and even January and February have widespread variations in runoff. Figures 2, 3, and 4 present the histograms of runoff for those months respectively based on the 98-year runoff record. What is remarkable about these histograms is that they are highly skewed to dry months, so much so that the most likely (mode) runoff is approximately 1/3 of the average runoff for either December or January. More than half the data points in December are in the first three bars of the histogram, which means that for most of the years it is very unlikely that even modest export levels should be entertained. The same is true for January and even February. Again it must be observed that the average values of monthly runoff are not very representative of anything and can be very misleading. The likelihood of an average runoff is about 1/3 that of the most likely runoff. If pumping operational decisions were to be dictated by the average level of runoff, in most years there would be insufficient water for Delta health. This may in fact be the central reason in explaining the current declines in several of the threatened and endangered species in the Delta.

Given the above characteristics for monthly runoff, it is of great interest to establish when at the earliest the overall character of the year can be discerned. To this end some illuminating regression analyses have been performed to see how well earlier monthly runoff can predict total annual runoff (See Appendix B). A fairly good predictor is obtained by taking the sum of December and January runoff as an independent variable and regressing total runoff against that variable. Figure 5 is a scatter-plot of this data and shows distinctly that the Dec-Jan variable divides the data set into wet and dry domains. (There is a gap in the scatter-plot that demarks the two domains.) All the dry year totals except one are delimited when the Dec-Jan sum is 3.9 MAF or less. That threshold also captures approximately 5 years that belong to the wet year group. The mean of the sum of December and January is 4.46 MAF so a sum of 3.9 or less signifies a dry winter as well. The average annual runoff (8-river index) is 18.04 MAF and the scatter-plot shows few data points surrounding this total, further confirmation that the average does not confer any sense of "normal."

CALSIM II needs to be revised to correctly account for the bi-modal statistical distribution of runoff. The analysis presented in Appendix B shows one possible direction. That direction would lead to a decision framework that would restrict pumping significantly in the fall and early winter until the amount of runoff that has materialized in combination with whatever snow-pack measurements indicate that more pumping can resume. And if that decision framework were put in place it would most likely eliminate the notion that there is any surplus water in January, February, and possibly March, to be used to implement Article 21, Carryover, or Turnback pool provisions in the Monterey Amendments.

Figure 2
Histogram of Dec Flow
Frequency vs. MAF

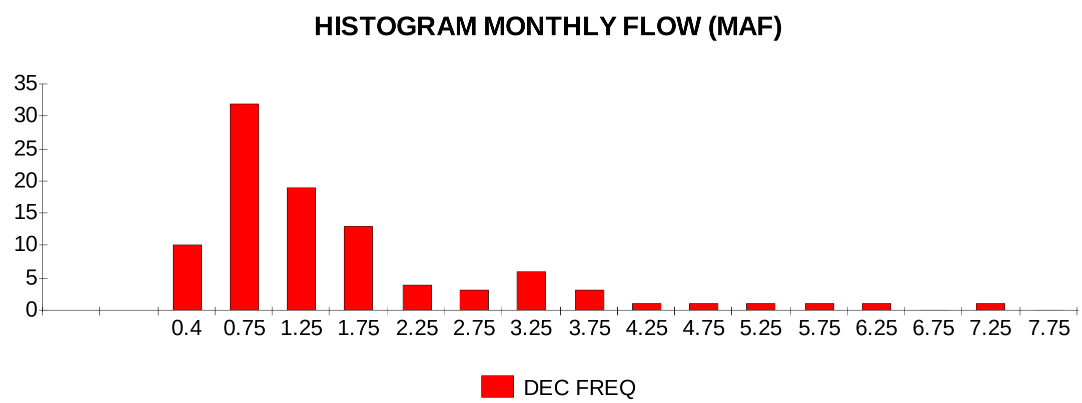


Figure 3
Histogram of Jan Flow
Frequency vs. MAF

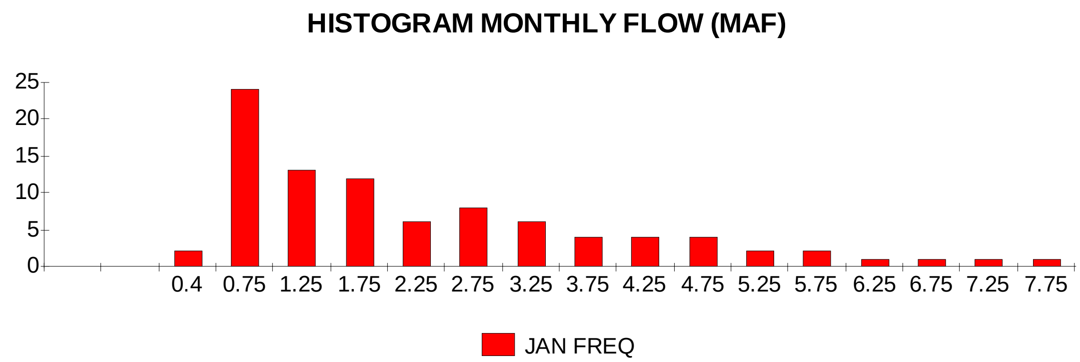


Figure 4
Histogram of Feb Flow
Frequency vs. MAF

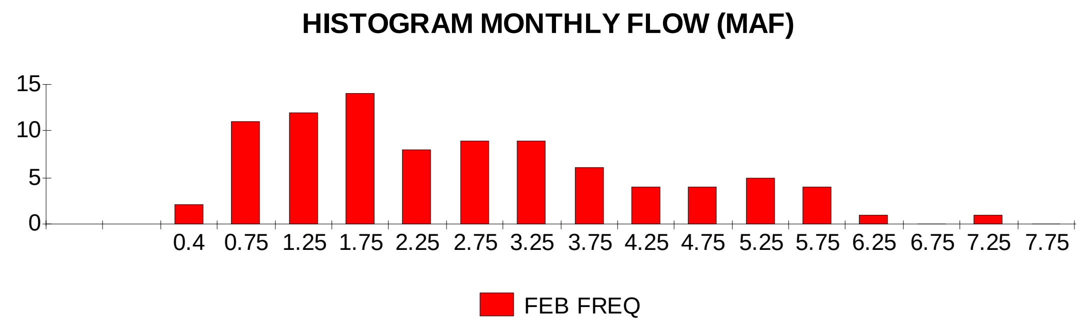
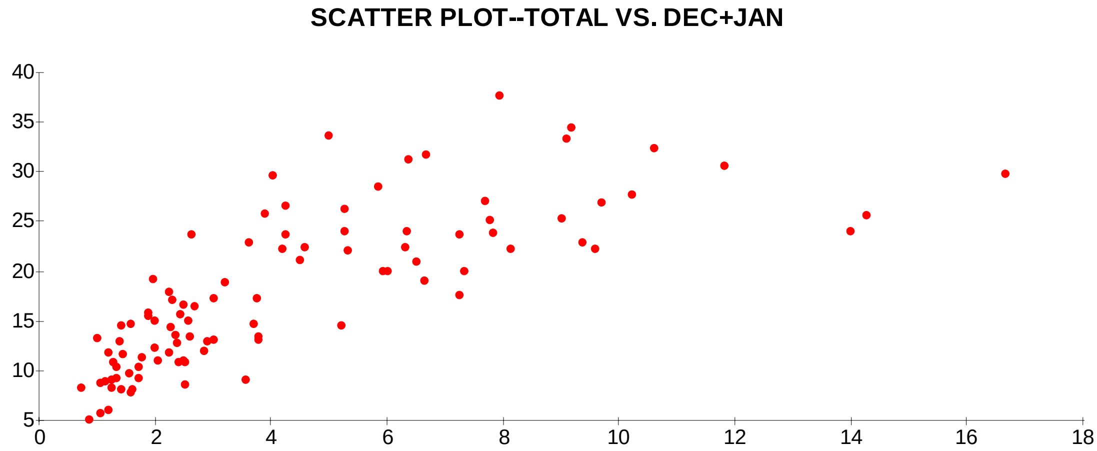


Figure 5

Total 8-River Flow vs. Dec+Jan, (MAF)



The Lack of Calibration of CALSIM II

It was stated above that it is necessary that CALSIM II be calibrated if it is to serve any useful function in environmental assessment or in assessing delivery reliability. DWR claims that its model gives reasonable answers and that it can be relied on for relative accuracy. A peer review of the model strongly recommended that the model be calibrated, especially if it is to be used where absolute accuracy is required and even if it is used for relative accuracy, as in comparisons of cases, given that it is an optimization model. **Calibrating an optimization model is essential in order to establish that whatever optima are calculated are real or possible solutions. This has not been done for CALSIM II and there can be no assurance of how well its calculated values represent reality.**

On the other hand, from the data at hand and with an understanding of how CALSIM II works it is possible to develop some estimates of its accuracy. What is required are CALSIM II estimates for a sequence of years for which there is also actual delivery data and which can be reasonably asserted are for the same conditions assumed for the CALSIM II estimates.

The EIR and the Reliability Report (Final 2005 Report) use CALSIM II estimates for a record that spans 1922-1994 and studies cases for levels of development corresponding to the years 2001, 2003, and 2021. The EIR reports in Table 6-7 the requests and subsequent actual Table A deliveries for the years 1996-2005, a period that spans the assumed level of development for year 2001 but there are no CALSIM II results for those years. The EIR also identifies the water year types associated with the actual deliveries.

Because the CALSIM II runs noted above do not include in its record the years 1996-2005 it is not possible to perform a direct comparison of estimates with deliveries. However, an examination of the CALSIM II results reported in the Reliability Report for the 73-year record shows two sequences of 10 years that are very similar to the 1996-2005 period, as judged by water year type. Those sequences are 1940-1949 and 1978-1987.

Table 1 presents the actual deliveries for the 1996-2005 period, along with the water year type and the contractor requests as reported in the EIR. Also shown are the reported actual deliveries as reported in the DWR reliability report, which show some disagreement from the EIR. Table 2 presents the water year type, assumed level of demand, and the CALSIM II deliveries for the selected 10-year sequences judged equivalent to the 1996-2005 period. The estimated deliveries are from Table B-3 of the reliability report as is the level of assumed demand, year 2001, or roughly the midpoint of the 10-year span. Water year types for these two sequences were taken from the input data file assembled for CALSIM II.

Table 1
SWP Actual Deliveries
Table A as reported (TAF)

		(From EIR)		(2005 Rel Rep)
YEAR	**YR TYPE**	**REQ**	**DEL**	**DEL**
1996	W	2676	2515	2206
1997	W	2976	2326	2308
1998	W	3335	1726	1595
1999	W	3147	2738	2521
2000	AN	3617	3201	2703
2001	D	4124	1547	1374
2002	D	3914	2573	2511
2003	AN	4126	2901	2964
2004	BN	4128	2600	2312
2005	AN	4127	2828	
	AVG	**3617**	**2495.5**	**2277.1**

It is assumed that "Requests" as reported in Table 6-7 of the EIR is a reasonable representation of the "demand" as used in the CALSIM II runs. Table 1 shows quite clearly that deliveries fall far short of requests. There is also the troubling observation that the EIR and Reliability Report do not agree; there is a little more than a 200 TAF difference in the averages. The EIR and the Reliability Report both profess to provide a detailed tabulation of actual deliveries. Since actual deliveries should be a matter of record there should be no discrepancy.

Table 2

Estimated CALSIM II Deliveries
Table A (TAF)
(From 2005 Reliability Report)

YEAR	TYPE	DEMAND	DEL	YEAR	TYPE	DEMAND	DEL
1940	AN	3713	3544	1978	AN	3126	3036
1941	W	3013	3036	1979	BN	3527	3509
1942	W	3583	3599	1980	AN	3197	3208
1943	W	3632	3545	1981	D	3834	3532
1944	D	3563	3449	1982	W	3451	3471
1945	BN	3612	3479	1983	W	3007	3036
1946	BN	3710	3724	1984	W	3692	3706
1947	D	3954	2652	1985	D	3753	3540
1948	BN	3959	2681	1986	W	3345	3023
1949	BN	3864	2568	1987	D	3905	2894
AVG		**3660**	**3227**			**3483.7**	**3295**

For both of the sequences presented in Table 2, looking at just the averages, CALSIM II estimates deliveries that are nearly equal to the assumed level of demand. For either sequence the level of demand is very nearly the same as the level of requests shown in Table 1 above. However, the level of estimated deliveries for each of these sequences is substantially higher than was shown as actual deliveries for the period 1996-2005. The estimated averages are roughly 700 TAF or 950 TAF above the actual average deliveries as reported by the EIR and the Reliability Report respectively for the period 1996-2005.

The two sequences are not perfect reproductions of the hydrologic sequence shown in Table 1 for the period 1996-2005. However, the balance of wetter than normal and drier than normal years is comparable. In fact, there are fewer drier years in the actual delivery sequence than in the two CALSIM II sequences. If there were to be any bias due to this difference it should reduce the estimated delivery level, which is already too high in comparison to the actual.

Based on these comparisons, one must conclude that either the level of demand assumed for the CALSIM II estimates is without foundation or that the model is seriously biased. In fact, until the source of this difference can be discovered and corrected the model is too inaccurate to be used for either absolute or relative accuracy in any study. It should be noted here that the list of contractor requests, which are used to drive

CALSIM II, does include some unrealistic requests. For example, a full Table A request of 25,000 acre-feet is shown for San Luis Obispo County which would be impossible to fulfill since the pipeline to San Luis Obispo County is sized to pass only 4800 acre-feet. What the model does with this excess water is a mystery.

One may conjecture that the bias is due to the difference between the operations implicit in an optimization model and the operations in actual practice. The model is given perfect information concerning the hydrology and only considers constraints that are promulgated by the SWRCB while actual operations must always be governed by the uncertainties of the hydrology ahead and environmental conditions as they materialize, of which the ESA actions are the most important. The optimization model is not really a good simulator of actual operations.

Other Comments on the Utility of CALSIM II in the EIR

Use of Averages in Reporting

Because the EIR relies so strongly on CALSIM II wherever it makes quantitative findings, it is questionable if such findings are of any merit given the deficiencies in the model. Even the methodology for reporting the model's calculations is misleading. First, because the model construction has ignored the underlying stochastic character of the input hydrology, the use of averages everywhere in the report give little insight as to the effects of project operations. For example, many lengthy tables are presented showing average flows throughout the system as calculated by CALSIM II. Table 7.1-2 of chapter 7 of the EIR presents tables that show average monthly flows for a number of stations over a fairly lengthy record. It is not certain what this table is intended to demonstrate since the record spans the period with CVP-only operations up to and including the period when both the SWP and the CVP are operating. What would be more interesting is to show the typical changes in these flows as the projects mature to maximum entitlements. **Furthermore, given the highly skewed character of the monthly flow distributions as shown above, it is more important to show what the flows are for the dry as well as wet domains. We have already shown that the average monthly flow is an uninteresting statistic and lends no meaning to the analysis.**

OTHER COMMENTS ON THE DRAFT MONTEREY + EIR

Use of Partial Hydrologic Records in Some Impact Analyses

In several instances the analysis relies on restricted hydrologic records in quantifying a particular point. The analysis of the effects of "borrowing" from lakes Castaic and Perris is a particular egregious example of distorting the impact by use of a restricted record. The analysis tries to show that the borrowing has little or no impact by comparing operations at these lakes before and after the Monterey amendments. Central to this analysis are the recorded data of operations from 1974 through 1994 for the before and the recorded data of operations from 1995 through 2003. The problem with this comparison is that the before record has an embedded 6-year drought and the after is an acknowledged wet period. Thus borrowing under Monterey occurred during a wet period while the basis for comparison has a mixed hydrologic record. Given the variations in lake parameters over ordinary operations those records are also too short to give confidence to the conclusions drawn.

If CALSIM II did not have so many flaws, this would have been a good example for its use to establish over the variation of a 98-year record the relative changes in lake levels due to borrowing. This would be standard practice for a study of this kind for which a large simulation had been developed. Unfortunately, CALSIM II is not a simulation and is not an appropriate tool. This leaves the analysis of the impact of borrowing resting on comparisons of a very restricted record.

In section 7.1, which characterizes the environmental setting in the major rivers and the Delta, data is presented which comprises significant variations in record lengths. Some data records span the period of SWP start-up but stop before full maturation of project contract entitlements. Only averages over these periods are reported so it is puzzling to discern just what the EIR is attempting to portray. Clearly, what would be much more informative would be to show the trends in stream flows as the project matures. Also, because the data represent several different sources, there are inconsistencies in the data. Inflows do not necessarily add up to Delta outflow (Table 7.1-2), as one would expect from the ensemble of rivers represented. The same can be said of the presentation of pre-project water quality data. If the environmental setting is to serve as a basis for comparison in impact analysis, the presentations leave much to be desired, especially when more informative presentations could have been prepared.

Use of frequency charts

Another reporting method is the use of the "frequency of return" charts that appear throughout the EIR. They purport to give the sense of probability of occurrence. However, because there are really two underlying probability distributions for the hydrology ("dry period" and "wet period" as we show above) the frequency charts are misleading and give an optimistic picture of the project's capabilities. They should not be used in the EIR

Article 21, Carryover, and Turn-back Pool Deliveries

These three categories of contractual water deliveries raise serious questions regarding pumping and Delta health. All are deliveries to be made in January, February, or March when certain conditions prevail. Article 21-water is termed surplus water but the only definition for it comes from the SWP contracts. There is certainly no test of whether it is surplus to the Delta. **DWR must develop a definition of surplus water that is properly constrained by considerations of Delta ecological health. This constraint must supersede the definition of surplus water in the master contract. The EIR must be considered deficient until such a requirement has been met.**

The Monterey Amendments eliminates all the conditions and constraints on delivery of surplus water that were in the original contract and substituted a new Article 21. One of the original provisions was the responsibility to determine that surplus water not be used in any manner that would constitute the development of a permanent-like economy due to its use. The new definition would seem to allow much more latitude to the use of surplus water for M&I uses that might not be allowed under the original contract. The EIR should analyze the impact of this provision in creating still more paper water.

Carryover and Turn-back Pool water are also contractual definitions and, together with Article 21 water, all three definitions have been modified by the Monterey Amendments. Carryover water is strictly a consequence of the difference between the definitions of contract year and water year. "Carryover" as used in the contract does not deal at all with reserving water in one water year to make it available in a subsequent water year, which is the normally intended meaning of the word. Instead, at the end of December when a new contract year starts, whatever Table A amounts that were scheduled but not delivered in the old year may be delivered in the new contract year even though it is in the same water year. The demand for this delivery occurs in the same months as for Article 21 water when, as we have shown, there is great uncertainty as to how the water year will turnout. The same is basically true for Turn-back Pool water. It too is a creation of the difference between contract and water years. Both "Carryover" and "Turn-back Pool" create opportunities for the contractors to "game" the system to get more Table A deliveries, all under the guise of strict adherence to the contracts. Because these categories are basically contractual creations of Monterey, invocation of them to cause deliveries in the first three months of the contract year should be carefully scrutinized in the EIR for impacts on Delta health. In fact, it would be extremely useful to examine project operations without these provisions. Furthermore, an alternative scenario for full EIR examination should be generated which requires the contract year to be coincident with the water year.

EWA operations

The EIR's discussions of the Environmental Water Account (EWA) do not help the reader understand how the EWA is supposed to work. On one hand it sounds like it is intended to reserve water to be made available for fish in the Delta when circumstances indicate that more flow into the Delta is necessary. On the other hand the EIR talks about storing EWA water in the San Luis Reservoir. If it is in the San Luis Reservoir how is it made available to the fish when needed? The obvious question is could the water be kept above the Delta so that its release for fish is direct and to the point? Why must the water be delivered to San Luis Reservoir if it is anticipated that it will be needed for the EWA? Are those who are selling their water south of the Delta making a profit on it? And if it is a project obligation to adhere to the ESA why doesn't DWR act cautiously to make sure that it keeps enough water above the Delta to assure their ESA obligations? All of these questions should be addressed in the EIR.

Energy Impacts

Since the SWP is a very large net consumer of power, and given the present urgency about energy use and global warming, the analysis of the project's energy impacts is very important. Probably the most important direct energy effect of the Monterey Amendments per se is the transfer of 130 TAF of water from agriculture in the San Joaquin to urban users, most of which are outside the San Joaquin Valley. For those transfers to Southern California the transferred water must be pumped over the Tehachapi Mountains, which constitutes a net increase of pumping energy over and above that which would have been required if the water was used in the Southern San Joaquin as originally called for in the contracts. However, there are many more facets to the impacts of energy requirements associated with this project.

First and foremost, because the project has rarely delivered close to full Table A allotments, there is the question of how the energy required for pumping will be supplied when the project deliveries approach the full allotments. Since the SWP is at present a net energy consumer, any additional deliveries must be presumed to require more pumping energy, which must necessarily come from commercial power from the grid. Given the difficulties that California has in meeting peak demands in the most recent years, it is not at all certain that additional pumping energy can be had without significant impacts on the competing demands of California residents. It may be argued that this particular problem would attend the SWP without Monterey, but we should point out that all of DWR's calculations with CALSIM II predict increased deliveries, so much so that they have made those calculations the basis of their reliability analyses. The same CALSIM II calculations also are used to claim that the amended SWP now has much less "paper water". In any event, to make their calculations consistent they should assess the net increase in pumping energy demands associated with their claim that they can deliver more water than in the past.

A correct reckoning and portrayal of the energy impacts should use the actual record of deliveries as a basis for comparison instead of the CALSIM II generated numbers for year 2020. (There is particular concern in the period 2000 to 2005 when increased Delta pumping during December, January, and February occurred and a tabulation and comparison to prior years would be very informative.) The energy problem is how the additional energy to get to 2020 conditions is to be generated.

Another aspect of the Monterey Amendments that impacts energy demands is the transfer of the Kern Water Bank to the Kern Water Bank Authority (KWBA) combined with the Monterey created delivery categories of Article 21, Carryover, and Turn-back Pool. The combined effect allows the KWBA to request water from these various accounts to put in the Kern Water Bank for the benefit of the KWBA, which incidentally comprises water entities that are not direct contract recipients of SWP. Thus a demand is placed on the SWP to pump water that would not have necessarily been pumped if KWBA had not been given the Kern Water Bank. The analysis must show how operations of the Kern Water Bank would have been expected to occur if it had remained as an SWP project facility. Also there is the question as to whether non-project participants, such as those comprising the KWBA, should benefit from project contractual provisions regarding the prices they pay for pumping energy. Given that additional energy increments above the previous baseline must come from commercial power, it seems that non-project participants should pay that marginal cost for pumping to fill the Kern water Bank. In other words all other legitimate SWP contractors must pay slightly more for their pumping energy needs because of costs imposed by operations of the KWBA.

In summary, the impact analyses must trace all the different flows that follow from the Monterey Amendments and accurately calculate the pumping energy differences and compare those differences to the previous actual baseline, and not to the year 2020 level of demand.

Land Use and Planning

In California one of the most important elements in land use planning is the availability of a reliable water supply. Because the first Monterey Agreement EIR failed to deal with the well-recognized inability of the SWP to deliver even close to full entitlements the EIR was held to be deficient. The Appellate Court made note that this lack of candid treatment in that EIR placed local planners in a difficult decision as to how much firm water they could count on in approving or rejecting development projects. Because the pre-Monterey contracts had provisions in them to allow DWR to bring entitlements into consonance with real capabilities to deliver and the Monterey Agreement made it a specific objective to eliminate those provisions, the Court stated that a new EIR must be drafted that analyses the consequences of utilizing the eliminated provisions to bring promises of delivery in accord with the project's capability to deliver. The current EIR has attempted to do this, relying on calculations with CALSIM II, but because of the total inadequacy of CALSIM II as presently configured those analyses are flawed. **This brings us to the point in the EIR impact analysis where a fundamental requirement promulgated by the Court of Appeals has not been fulfilled**. The present section of Land Use and Planning is therefore of little use. Nonetheless, there are some observations that can be made that may be useful in correcting the analysis in a future document.

The analysis of impacts on Land Use and Planning avoids the most obvious consequences of the project. Table 7.10-1 attempts to guide the reader to the most important impacts but ignores what must be considered the first order impacts. The table indicates that the only concern with the permanent transfers of water from agriculture to others is with the changes in land uses and agricultural practices of the land from which the water is transferred. However, it should be clear that any transfers to urban uses raises profound issues with changes in developed land use whenever additional water supplies are make available. A prime example of this is the development now being pursued in the Castaic region solely because the Castaic Lake Water Agency claims to have reliable additional water supplies made available from transfers from Kern County Water Agency, all under the auspices of the Monterey Amendments. How the EIR can be silent on this matter is beyond comprehension.

Furthermore, the amounts of additional, reliable water claimed in the transfers is solely based on DWR's CALSIM II calculations as they are presented in the settlement-mandated provision requiring a reliability report. Because CALSIM II has already been shown to be a grossly inaccurate calculator of reliable water, its use in assessing how much water can be relied upon just continues the problem of "paper water", which the Appellate Court and the Settlement Agreement state must be eliminated from land use planning.

The table also misses the point on the Kern Water Bank transfer. By changing the water bank from a SWP facility to one owned and operated for the benefit of a limited set of water users, the SWP plans for delivery have been necessarily impacted and as a direct consequence the plans regarding the use of whatever water the water bank could have made available for all the SWP contractors are impacted.

Also the Reliability Report fails to account for the presence or absence of local water sources and its guidance to SWP contractors is too simple to be of any practical planning use. For example, many SWP contractors, taking their cue from the Reliability Report, assume a number around 75% reliability, which they apply to their Table A amount in reckoning their reliable supply. In truth, the way that the 75% is calculated depends on the project being able to deliver substantial amounts of Table A to Kern County Water Agency and the Metropolitan Water District because they have large reservoirs and can accept these large amounts in off-demand periods. By contrast, most other SWP contractors do not have such storage means and must take their Table A amounts during seasonal demands and the average amounts that can be relied on under those conditions is much less than 75%. Accordingly, a planner depending on water from one of these other SWP contractors would be misled. It is also an interesting observation that any development which is permitted solely on the basis of a SWP supply can really only depend on approximately 15% of whatever Table A allotment it may have because that is the lowest delivery level in the record. This has proven to be a realistic possibility in Santa Barbara County where transfers of SWP allotments among SWP subcontractors are being made to support developments outside existing water district boundaries. DWR needs to instruct its SWP contractors on how to use the information developed by them respecting each individual contractor's ability to receive SWP water in concert with whatever other water sources it has available.

In summary, the analysis in the EIR of impacts on Land Use and Planning is too superficial and limited to be of any use in prospective project decisions.

APPENDIX A

An Analysis of Reverse Flows at the South Delta Pumps

Recently, additional information on several factors was obtained that could explain the observed Pelagic Organism Decline (POD) in the Delta. It had been posited earlier that unusually high pumping by the SWP in the months of December, January, February, and March could be the cause. The additional information now focuses on the fact that high reverse flows in the Old San Joaquin River brought on by SWP/CVP pumping may explain the loss of the Delta Smelt. The investigations that brought this information to light also were concerned with the same four months (D,J,F,M). This information has been analyzed to relate the Old River flows to export pumping, river flows at Vernalis on the San Joaquin, and the Sacramento at Freeport. To date one quantitative relationship has been developed that explains the reverse flows quite well. The method used was multiple regression analysis and the best relationship so far is given below:

OLDSJ = 243-0.942*EXP+.533*SJVER

Where SJVER = San Joaquin flow at Vernalis, cfs
EXP = export pumping, cfs

Since export pumping is generally much greater than flows at Vernalis, this relationship yields negative flows for Old River in most instances.

The data set covered the years 1981 to 2006. Two data points appear as clear outliers, 1983 and 1997, which were very high run-off years. The standard error for this equation is 430 cfs while the corresponding percentage error of the fit is 18.5%. All coefficients are very significant ("t" values are respectively, 15.11 and 20.23).

What seems clear is that export pumping is a very strong variable; reverse (i.e. negative) Old River flows could be reduced by directly reducing exports. It seems also clear from perusing the input data that San Joaquin flows at Vernalis are not substantial enough to overcome the export reverse draw. This is probably due to the fact that in most years almost all of the San Joaquin is diverted for irrigation.

Another factor not yet analyzed is the magnitude of the exports compared to the volumes of water in the sloughs and Clifton Court forebay. When exports typically average 10,000 cfs for days at a time, the transit time through the sloughs may be quite short. (For example, 10,000 cfs equates to 20,000 acre-feet per day, which could be on the order of the volumetric capacity of Clifton Court forebay.) It seems that the biologists should look at what happens at all the levels of the aquatic food chain when that happens. Perhaps the reduction in smelt numbers and the observation of smaller smelt later in the spring are related to the reduction in biologically available food.

It might also be profitable to take a restricted look at the months of just December and January. Using all four months tends to obscure the fact that quite often river flows in the first two months of the four month period can be quite low, so much so that exports would be even more devastating. The biologists should be asked to investigate the relationship of POD to just the pumping and flows in the first two months.

The sheer magnitude of the export flows is also interesting. There was a levy failure in one of the Jones tracts during a period when most observers would not have expected any stress on the levies. However, the maps show that the tracts in question are along the channels that lead directly to the pumps. Is it possible that the magnitude of the flows to the pumps was an important factor in the levy failure?

COMMENTS ON DWR'S TECHNICAL MEMORANDUM

"Progress on Incorporating Climate Change into Management of California's Water Resources", July 2006

By Arve R. Sjovold
September 2, 2006

In DWR'S year 2002 report on the "The State Water Project Delivery Reliability Report" it was explicitly acknowledged that climate change would affect the timing and amounts of snowfall and possibly precipitation and that sea level rise was likely. At that time the timing of these impacts was speculative. That report promised that more definitive studies of the impact on climate change would be provided, possibly as soon as the update of the California Water Plan Update 2003. Thus, it was with some anticipation that I looked forward to a comprehensive study of the affects of climate change on the SWP. The subject report fails to provide that comprehensive study. Although DWR did engage in some rather elaborate computerized calculations, the subject of those calculations studiously avoided the impacts, now more widely recognized, but clearly acknowledged in the 2002 Reliability Report. Any keenly interested observer of the debate on climate change would have expected a cogent and objective analysis of the effects of sea level rise and changed Sierra run-off patterns as first order effects.

The report devotes considerable of its quantitative analyses to the calculations of the effects of a very modest sea level rise of 15 inches on the ability of the Delta to deliver water to the pumps without severe violations of salinity thresholds. It does so based on assumptions that upstream reservoir operations are not changed and that sea level rise does not change the hydraulic network in the Delta. Another assumption for this analysis is that the salinity gradient in the western Delta does not change with this sea level rise. No supporting evidence or analysis is given as to why these assumptions are reasonable. In other words, a primary assumption is that the current system of Delta levies remains in tact with a 15 inch sea level rise. I won't argue that that level of sea level rise may indeed leave the levies operationally in tact, but it misses the first order question of what level of sea level rise will compromise the system of levies. There are good maps (produced by DWR, if I am not mistaken) of what the Delta may look like with 1, 2, 4, and 10-foot sea level rises. From these maps it is clear that somewhere between 2 and 4 feet of rise there is little assurance that the Delta can perform as a delivery network of fresh water to the South Delta pumps. Since the subject report acknowledges that 2.9 feet of sea level rise is likely under one of the scenarios studied by the International Panel on Climate Change (IPCC) by the end of the century, clearly the most important question to be addressed by DWR is to calculate at what level the Delta's levies cannot be relied upon. **The subject report does not do this and does not offer a qualitative discussion.**

The other major assumption underlying their quantitative calculations is that reservoir operations (that is, Oroville and Shasta) are not changed by climate change impacts. That this is an untenable assumption is apparent from the report's side study that shows, under 3 different scenarios, that peak discharge from the Feather River may be substantially altered. In fact, the most severe scenario carefully quantifies that peak discharge for a “15 year event” may be 2 ½ times the current estimate of a 15-year peak discharge. Clearly, any inquiring mind would wonder how reservoir operations might be affected by such a finding. Curiously, the report does not inquire further. But that may be the most intriguing finding of the report. If as a matter of hydrology peak discharges at any return level are 2 ½ times higher, such a finding would call into question the ability of the dams to function as designed. First, 2 1/2 times peak discharge would probably tax the design limits of dam spillways. Second, flood pools in reservoirs would have to be enlarged compromising water conservation objectives. Third, passage of discharges 2 1/2 times as large would undoubtedly cause havoc below the dams. None of this is addressed in the report even though that is where it should logically lead.

In conclusion, the report shows no scientific curiosity concerning the very likely first order impacts of climate change. The detailed quantitative analyses that are performed are totally irrelevant to what are the major questions that are posed by climate change. The report should candidly state that the most reasonable forecasts of what climate change might produce would seriously compromise the project, to the extent that the SWP may be obsolete in its current configuration within the current century. This is certainly a different tone than that conveyed by this report.

Specific Criticisms

1) The report still relies on CALSIM II as a reliable model to study the impacts of climate change. First, as we have so many times stated in the past CALSIM II is a fatally flawed model. It has not been calibrated and is not a true simulation model, as it is commonly referred to. Second, the indices that are use to drive the model in certain of its calculations are without scientific or practical merit. They provide the so-called simulation with perfect information of stream flows in advance of simulated operational decisions and the indices are highly distorted representations of the true stochastic nature of the operational problem, simulating operations in the face of uncertain future stream flows. It is particularly noteworthy that the CALSIM II run labeled “Base” in the report does not resemble the CALSIM II 2021-runs performed for the Reliability Report for ostensibly the very same assumptions. In fact, the variance between these two case studies, the “2021” study in the reliability report and the “Base” in the climate change study, is roughly the same as the differences reported between the “Base” case in the climate change study and the alternative scenarios. (See Table 1 below.) In stark terms, we are using a measuring instrument that is too imprecise to reliably distinguish differences among the scenarios. Scientifically, the model is inappropriate just on that finding and DWR staff should be required to establish why there are such differences between these two reports.

2) Throughout a significant portion of the report detailing previous hydrologic history of the Central Valley, there are many regression analyses results that are portrayed to establish certain trends that may have some significance. The report does not state why they may be relevant. I find it difficult to see any such relevance except if it is to acknowledge that some climate change may have already occurred. Even then, I fail to see the relevance absent any analysis that shows why it should be. Beyond that observation of relevance, there is the more important issue of deciding when a calculated trend is significant. It appears from the data presented in the report that many of the trends are statistically insignificant at normally accepted thresholds. Why such trends are reported as maybe “real” is puzzling.

3) The preoccupation with the affects of climate change on stream flow temperatures is probably misplaced. Given that current project operations are decimating species in the Delta, the concern seems an attempt to show that the species are doomed anyway and we shouldn’t worry about what the projects are doing now. That is a very shortsighted view and seems to be extremely self-serving with respect to current operations. My view would show more emphasis on characterizing future overall stream flow amounts and timing rather than on speculations on stream-flow temperatures as if the basic stream flows are relatively unperturbed.

4) The report does provide a fairly decent summary of the extant scientific theories supporting global warming and the effects on climate. The report depends most strongly on the work reported by the IPCC and the scenarios they cast. However, other more recent work out of the Goddard Space Science Institute (GSSI) strongly suggests that ice sheet breakup of the Greenland and/or Antarctic ice sheets may accelerate sea level rise significantly, an event that is not a major factor in the IPCC scenarios. If the GSSI theory is more correct the integrity of the Delta in the nearer future may be in doubt. Neither the IPCC nor the GSSI can offer precise timelines as to when significant sea level rise may occur. Nonetheless, it is vitally important that DWR include a candid appraisal of the likelihood of sea level impacts on the Delta beyond the mere 15-inch rise assumed in their studies. Calculations can easily show that the generally accepted existing level of climate forcing, .85 watts/m^2, is sufficient to melt sufficient ice to raise sea level by 0.4 feet per year. What is not certain is how future climate forcing will divide between melting ice and warming the biosphere. It is very clear right now that the rate of sea level rise cannot be estimated precisely but the potential for rapid sea level rise is the most important feature of global warming. The report should candidly state so.

5) The report summarizes the past history that has been developed for global warming over the past 650,000 years which shows that within our recorded history the Earth is near a peak warm temperature for this interval. (See; James Hansen, “A Slippery Slope”, Climatic Change, 68, 269-279, 2005). If the report had included the corresponding data on the coincidence of greenhouse gas concentrations and sea levels with temperature it would be quite clear that greenhouse gases are the most significant driver of temperature change and consequent sea level rise. The DWR report does include a table of the existing concentrations of CO_2 and methane, corroborated in the attachment, which are higher than ever measured by the ice cores within the past 650,000 years. This remarkable finding should require the widest possible range of possible changes rather than the restricted ranges chosen by the report. In short, the authors of the report did not delve deeply enough into the current research being performed on climate change and the report cannot claim to have met its objective of "incorporating climate change into the SWP."

6) The analysis to incorporate climate change into CALSIM II involves an intricate attempt to translate IPCC climate change scenarios into specific quantitative changes in major Northern California river run-off as the basis of the computer calculations that form the major effort of the report. It is noted in the analysis that the climate change scenarios are based on global models that incorporate only six grid points to characterize expected rainfall for all of California. The analysis then proceeds to use the information developed for these six grid points to generate estimated changes for 10 of the major rivers. Another model, the Variable Infiltration Capacity (VIC) model, is used to calculate these estimated changes of rainfall into run-off. An important assumption in this exercise is the use of the VIC model to develop perturbation ratios due to climate change that can then be used to modify the characteristic run-off measurements for these rivers. The clear flaw in this methodology is the measured run-off used to characterize the rivers. The analysts chose the year 1976, a readily acknowledged drought year to characterize the average or "normal" run-off. Since 1976 was well below average for any river system in California, this choice necessarily biases the estimated changes low. 1976 run-off was probably less than half the average. Therefore, on translating changed rainfall into estimated run-off for the major rivers feeding the CVP and SWP, the use of 1976 as a basis to scale from as described in the report necessarily underestimates the run-offs under climate change by a significant amount. Accordingly, the entire exercise with the Delta model, DSM, is not even a reasonable estimate. Since this computer exercise seems to comprise the most substantive portion of the report, it calls into question any and all of its findings. DWR should be required to justify the choice of 1976 (although on its face it seems that this can't be done). A standard analysis of this type would have done so as a matter of course.

Table 1
Comparison of “Base” and 2021 CALSIM II Runs

(Million acre-feet per year)

Water Year	**Climate Change Report SWP Exports**	**2002 Reliability Report SWP Exports Fixed Demand**	**Deviation**
76	2.97	2.78	.19
77	1.00	0.83	.17
78	3.61	3.91	.30
79	3.70	3.49	.21
80	4.10	3.46	.64
81	3.33	3.40	.07
82	4.71	4.13	.58
83	3.68	4.13	.45
84	3.42	4.10	.68
85	3.52	3.32	.20
86	4.20	3.01	1.19
87	2.57	2.84	.27
88	1.54	0.99	.55
89	2.72	2.90	.18
90	1.60	1.15	.45
91	1.10	1.00	.10
Average Deviation			**0.39**

APPENDIX B

Development of a Preliminary Algorithm To Guide Pumping from the Delta In the Months of December and January

A look at monthly flows for the runoff record reveals that significant runoff begins in December and increases on through May. The highest runoff measurements generally occur in the spring. However, from time-to-time there are some early winter runoffs that are quite high. When looking at just the dry year portion of the record it is quite clear that the drier years are almost always characterized by runoff in both December and January that are much below average. Thus if the water year is going to produce reasonable runoff it must come from above average spring runoff. But the operators of the projects cannot safely assume that spring will be above average and must then adopt prudent operations when beginning export in the fall and winter. Therefore, an operational procedure must be developed that begins with the assumption that the water year will be dry until conditions show that it is likely to be wet. (We dismiss the notion that the previous water year has any useful information contained in its runoff record as is intimated by the "40-30-30" index.) The question is then, how can we establish with some certainty how much runoff is likely for the year?

To answer this question, we analyzed the relationship between total runoff recorded by the end of the water year to the measurements of monthly runoff as they occur. A perusal of the record shows that trying to rely on December runoff alone does not provide a reliable indicator. Next we examined the potential of the combined runoff of December and January to indicate the character of the impending water year.

We started by defining simple indicator variables. Since we desire to provide indicators that are most useful in the early part of the water year we concentrated on the months of December and January to see how much they could tell us. The indicators that seem to work reasonable well are as follows:

DRYWINTER, which takes on the value of either one or zero. If it is one, then it signifies a combined December-January runoff that is quite dry for that period. We first tried a combined runoff of less than 2.5 million acre-feet (MAF), which is just over half the average for this period. Later we tried a value of less than 2.25 MAF which is just about half.

WETWIN, which takes on the value of either one or zero. If it is one then it signifies a combined December-January runoff of greater than 4.24 MAF, which is the average for this period.

WETSPR, which takes on the value of either one or zero. If it is one then it signifies a combined April-May runoff of greater than 7.4 MAF, which is the average for these two months. Later we tried a threshold value of 6.5 MAF, or slightly less than the average. We felt that more precision in the spring runoff is not necessary since one must wait until spring to measure the runoff. So the role of this indicator variable is to establish explanatory power for the desired relationship for predicted total runoff.

Besides operations can be modified once we have passed beyond the months of December and January and the water year record unfolds.

The best relationship that we could find is given below:

TOTAL= 12.81- 2.99(DRWWINTER) + 7.22(WETWIN) + 5.17(WETSPR)
Where:
TOTAL = total water year runoff in MAF
DRYWINTER = 1,0 where 1 is sum of Dec-Jan when less than 2.25 MAF
WETWIN = 1,0 where 1 is sum of Dec-Jan when more than 4.24 MAF
WETSPR = 1,0 where 1 is sum of April-May runoff when Greater than 6.5 MAF

These variables were then tried in a linear multiple regression relationship to examine their explanatory power. All of the indicator variables were highly significant and the standard deviation of the fit was 3.27 MAF. Nine of the 98 data points in the sample were deleted from the regression calculation as probably too extreme on a probability basis. 7 of those 9 were for extremely high runoff years. Since the problem of export pumping is much less dependent on very high runoff years these deletions are not of prime importance and their inclusion only tends to skew the results. It is also noteworthy that the deletion of these data points appears not to affect the coefficients materially but does improve the precision of the relationship.

Conclusions

With three independent, stratifying variables that take on either of two possible values there are 6 independent outcomes. They are:

DRYWINTER and a dry spring (1,0,0), which produces an estimate of TOTAL of 9.82 MAF.

A winter (December-January runoff) that is greater than 2.25 but less than 4.24 MAF and a dry spring (0,0,0), which produces an estimated total runoff of 12.8 MAF.

DRYWINTER and a WETSPR (1,0,1), which produces an estimated total runoff of 15.0 MAF

A winter that is greater than 2.25 but less than 4.24 MAF and a WETSPR (0,0,1), which produces an estimated total runoff of 18.0 MAF.

WETWIN and a dry spring (0,1,0), which produces an estimated total runoff of 20.5 MAF.

WETWIN and WETSPR (0,1,1), which produces an estimated total runoff of 25.7 MAF.

Of the 98 years of the runoff record, nearly half the points(47) are included in the three categories that have estimated runoff less than the average for the total record. Twenty four (24) of the 47 points are associated with the estimate of 9.82 MAF. 15 are associated with the estimate of 12.8 MAF and 8 are associated with the estimate of 15.0 MAF. All three of these categories are determined by the combined monthly runoff of December and January and make no assumption that the spring will be wet. Accordingly, one may conclude that all December and January operations should assume that the water year is part of the dry period until spring runoff dictates otherwise. It is particularly important to note that for fully one quarter of the record (24 years), only 9.82 MAF can be relied upon. This should be the starting point for developing operations criteria for export pumping that take due care to preserve the Delta environment.

At present it appears that December and January pumping are little modified by the hydrologic indications to that time. Since project demands are low at this time of the year, these months are used to fill south of the Delta reservoirs. Only the constraints on Delta outflow and salinity may limit the pumping; and the restrictions here are highly skewed because of the influence of the erroneous “water year index” discussed in the body of the text. Questions that should be asked include: Should there be much of any export pumping if December and January runoff is below 2.25 MAF? Can the health of the Delta fisheries and its broader ecology be assured under such low flow conditions? Of those 24 years that comprise this condition three are for years that are extremely dry, averaging just under 6 MAF. What would be prudent operations under those conditions? The same questions must be answered for the other two dry year categories. The biologists should be asked to weigh in on what would be desirable under these drier conditions to assure Delta health.

It is possible that integration of snow-pack measurements might improve the ability to forecast more accurately or at least earlier with the same accuracy. However, reliable snow-pack measurements are usually not available until the end of March. Accordingly, early runoff is the most readily available and reliable indicator that can be useful.

Attachment 2

HOW CALSIM II DISTORTS ESTIMATES OF AVAILABLE SWP DELIVERIES

By: Arve R. Sjovold
March 2, 2008

In my comments on the Draft Monterey++ EIR I provided a rather thorough examination of significant flaws in the CALSIM II model. The comments were couched in statistical terms whose significance may not be readily discerned. In this essay I try to provide more commonplace analyses to show what the consequences of the flaws really are.

There are two structural flaws in CALSIM II, the methodology by which the water indices are constructed and the use of these indices in the model. In addition, there is the matter of how CALSIM II results as measures of probability are reported in the Reliability Report and how the results are reported in the EIR. Then there is the matter of the how the hydrology is represented in the model. Here I will attempt to show how each of these factors operate to produce faulty estimates.

Problem 1: Faulty Indices

Indices are sometimes useful in models to categorize certain information to facilitate calculations. In CALSIM II the indices that are used in this fashion are the water year indices. These are constructed from measures of runoff from the major rivers feeding the Central Valley and are used to characterized whether a year is “wet,” “above normal,” “below normal,” “dry,” or “critical.” One of the problems in using this type of characterization is that there are two definitions of “year.” There is the “contract year,’ which is identical to the calendar year, and the “water year,” which is a characterization developed on the basis of hydrology and is particularly pertinent in a climate that has summer drought. The “water year” is the period from October 1 through the following September 30. This definition follows from the recognition that because of summer drought little runoff is generated in the summer as the streams become increasingly lower until fall and winter rains generate significant runoff, which is later followed by the more important spring snowmelt. Actual project operations must respect both the “contract year” and the “water year.”

The water indices that are used in CALSIM II try to span these two definitions by constructing an index that is a weighted average between the runoff from the preceding water year and runoff from the present water year. In so doing the index is made to represent a runoff from two water years that may have nothing to do with each other. It then becomes a flawed guide to operations and calculations.

I performed a correlation analysis on the series of annual measured runoffs (water year) in the Central Valley to find out whether a given water year is more likely to be wet (or dry) if the previous water year was wet (or dry). The result was that there is virtually no correlation, which means that each water year has to stand on its own. Thus the project should not base operational decisions on an index that is a composite of two water years in attempting to characterize the runoff. This is an important finding that has profound consequences on how much and when water can be delivered from the Delta.

First, there are several examples in both operations and in CALSIM II calculations where an erroneous index has led to a serious error in pumping. This circumstance occurs primarily every time a quite dry water year is preceded by a fairly wet water year. When this circumstance occurs, the flawed index indicates that the ensuing water year will be wetter than the actual case. If the quite dry year is followed by another quite dry year (the 1976 and 1977 years are a good example), more water will be pumped in the first of the two dry years with the result that the second dry year will be very short. The record shows that 531 kaf of surplus water was delivered in 1976, a year that delivered only about 30% of Table A entitlements. The following dry year, 1977, 323 kaf of surplus water was delivered while the project could only deliver about 15% of the Table A entitlements. Both of these years were well below average for runoff while the preceding year, 1975 was above normal. Clearly the project could have evened out the deliveries for the two years much better if it hadn't been misled by the erroneous index.

In my comments on the Draft EIR, I also analyzed how the projects should be prudently when each water year is treated independently. There I showed that until there was sufficient fall-winter runoff to indicate that the year would likely be average or better, that pumping should be curtailed. My analysis showed that that point wouldn't be reached until the end of January in most cases and could extend into February in a few cases. Because surplus water is declared available in the first three months of the calendar year, a reduction in pumping for any of these months would impact surplus water deliveries. The water index that is used by the project provides no such restriction.

The reverse case of a wet year following a dry year does not present an equivalent problem simply because project operations always respect the real time unfolding of the water year. Therefore, if the project operations begin in the fall with an index that is biased low, it soon becomes apparent in the actual runoff that conditions will be better than promised by the index. There is little risk that too little pumping will occur.

Problem 2: Perfect information in CALSIM II vs. Operations in the Face of Uncertainty

The next important flaw is with the use of the indices in the CALSIM II calculations. In CALSIM II a look-up table is created to store the water year type for use in the optimization calculations. The entries in this look-up table are single values for an entire year, including the unfolding water year. The indices are not modified in the course of the calculations. CALSIM II is structured to make water routing decisions based on the monthly runoff without knowing how the water year is unfolding except in the case of the indices which are used to set many important parameters in the calculation scheme. But the way the indices are used with respect to the parameters that depend on them is that they provide the advantage of knowing ahead of time the circumstances of the eventual water year. Thus, CALSIM II is armed with information that allows a calculation of the maximum amount of water that can be delivered from the Delta with near perfect knowledge, which must be contrasted with the operational decisions that actually unfold as the water year is experienced and is likely to result in decisions not to pump to avoid the risk that there will be insufficient water in the subsequent months. The difference is the amount that CALSIM II is in error, which can only be determined with a calibration.

Problem 3: Mischaracterization of the Central Valley Hydrology

Perhaps the worst flaw in the Draft EIR and the Reliability Report is the use of averages to describe impacts or outcomes. Most often in ordinary use the term "average" or "normal" connotes what is a most likely value, that which is expected more than any other value. These two terms are used extensively in both documents to depict impacts and outcomes. The problem is that if the "average" or "normal" is an unlikely event, is there any merit in presenting such values. An example will suffice to demonstrate the difficulty.

Say that the series of recorded annual runoff aggregates into two distinct sets, one set of years that we call "dry" which for argumentative purposes range between 5 and 15 MAF per year. The other set we shall call "wet" and they range between 20 and 38 MAF per year. Both sets have about the same number of years but of course they are randomly interspersed except for occasional drought sequences. The average of the entire record is about 18 MAF per year. Now from the way I constructed the two sets 18 MAF per year is an improbable event (actually it is more precisely an impossible event if my record is a precise recording of all the possibilities.) Recognizing this feature of the record we may ask is there any information disseminated by using the term "average," or as often is done "normal." The correct way to address the runoff record is to portray the data as two independent sets, a "dry" one with an average around 10 MAF per year and a "wet" one with an average around, say 25 MAF per year. It is entirely a different picture when one realizes that in any given year the runoff is either going to be 10 MAF +or – 5 MAF per year rather than 18 MAF or 25 MAF +13, -5 MAF.

The constructed runoff record above is fairly idealized but it is not far from the actual data for the Central Valley. According to the 8-river index the runoff indeed aggregates into two distinct sets, one with an average around 12 MAF and the other with an average around 25 MAF. (Please note that the 8-river index only captures about 80% of the total runoff when all the minor streams are accounted.) In the actual record the grand average seldom occurs. In other words, the so-called "normal" is not very normal and is certainly not a most likely event. Why is this important?

Misleading Results

In the reliability report the CALSIM II results over the entire record (93 years) are reported in a frequency diagram, which depicts how often the calculated delivery from the Delta is greater than a prescribed value. Remember delivery is driven by runoff. According to the reliability report the SWP can deliver 75% of Table A entitlement 50% of the time. This is a direct reading from the frequency diagram. However, if one looks at the likelihood of actually getting 75% +or -, it only occurs about 2 or 3 of 93 years. Hardly a likely result and certainly not what we mean when we refer to "normal."

The runoff record indicates that 56% of the time we can expect a runoff less than average and 44% of time it will be greater than average. The dry set (i.e. the 56% of runoff events) has an average runoff of about 12.5 MAF per year; the wet set about 25 MAF per year. The CALSIM II delivery record corresponding to the 93 runoff record used in driving CALSIM II mirrors the runoff record; slightly more than half the years where delivery is constrained by the “dry” set runoff and slightly less than half the years where delivery is nearer the maximum due to above average runoff.

The problem occurs when the information calculated by CALSIM II is presented in the over simplified frequency diagram and read as probability of delivery. Even though almost half the years are calculated to deliver more than 75%, the actual likelihood of getting near 75% is very poor. When a local planner sees this information he is led to believe that he can rely on 75% most of the time. However, in reality more than half the time he will have to deal with deliveries much less than 75%. If he chooses the 75% level as the reliable delivery and allows new developments to hook up to water supplies on that basis there will be virtually no chance of avoiding a severe shortage in more than half the years. This is the epitome of “paper water.” The Reliability Report does report the calculated results for various drought sequences. For instance, it reports that for a six year drought, like the 1929-1934 and the 1987-1992 periods the average delivery will be somewhere around 37%. With this information the local planner can calculated his ability to compensate during a drought episode. If he has no other sources it will be difficult to promise any development a reliable supply greater than 75%. Even then he has to figure out how to balance the variations in delivery within the drought. For example, in the 1987-1992 drought only 15% was delivered in the worst year. The planner would have to have sufficient other sources to make up another 22% just to make the average for the drought. Because of the way the SWP is set up it is difficult for local planners to decide on a reliable level of delivery from the project. The overly simplified frequency diagram is almost totally useless for the type of analyses that a local planner should be doing.

Attachment 3

PLANNING AND CONSERVATION LEAGUE

1107 9th Street, Suite 360, Sacramento, CA 95814
Telephone: 916-313-4520 + Email: gapatton@pcl.org

January 14, 2008

Delores Brown, Chief
Office of Environmental Compliance
California Department of Water Resources
Email: delores@water.ca.gov
(916) 651-9560

RE: Planning and Conservation League comments on the Draft Environmental Impact Report, *Monterey Amendment to the State Water Project Contracts (Including the Kern Water Bank Transfer) and Associated Actions as Part of a Settlement Agreement (Monterey Plus)*, SCH# 2003011118 ("Draft Monterey Plus EIR")

Dear Ms. Brown:

This letter is to provide comments on the Department of Water Resources' Draft Monterey Plus EIR (DEIR), a document whose preparation PCL has actively sought and anticipated for more than a decade. When finalized, this EIR will be used as the decision-making document framing a decision by DWR on the so-called Monterey Amendments. If such amendments to the contracts governing the operations of the State Water Project were adopted and implemented, they would result in a drastic contractual restructuring of the State Water Project, now 47 years old. Our comments here do not speak extensively to the legality (or not) of this proposed decision to modify provisions of the contracts governing operations of the State Water Project, which are based on and carry out directions specifically adopted by the voters of California. This letter focuses on the environmental review document, and its adequacy.

In the litigation that compelled DWR's preparation of this EIR, PCL sought to ensure that DWR—the only entity with the statewide duty to manage and administer the State Water Project[1]—would correct the profound errors of process and substance that fatally infected the

[1] DWR's State Water Project duties, as envisioned by Governor Pat Brown and approved by the voters of California, are codified in the Burns-Porter Act, Wat. Code, §§12930, *et seq.* They also formed the basis for the prototype State Water Project validated by the California Supreme Court in *Metropolitan Water District v. Marquardt* (1963) 59 Cal. 2d 159. No Court has yet addressed the validity of the Monterey Amendments, whose final status necessarily awaits DWR's decision-making.

Central Coast Water Authority's review and approval of the 1995 EIR supporting the Monterey Amendments. In *Planning and Conservation League v. Department of Water Resources* (2000) 83 Cal.App.4th 892 ("*PCL v. DWR*"), the Third District Court of Appeal unanimously vindicated PCL and its co-plaintiffs[2] on both grounds. Pointing to "the…contractors and the members of the public who were not invited to the table" in the negotiations that led to the Monterey Agreement, the Court held that "CEQA compels process…a meticulous process designed to ensure that the environment is protected." (83 Cal.App.4th at 905, 911.) Recognizing the "aura of unreality" surrounding discussions of the State Water Project, which has historically been unable to deliver even half the amounts referenced in Table A of the State Water Project contracts[3], the court found that CCWA's EIR "failed to meet the most important purpose of CEQA, to fully inform decision makers and the public of the environmental impacts of the choices before them." (*Id.* at pp. 913, 920.)

PCL entered into a 2003 Settlement Agreeement[4] with the expectation that DWR would counteract these historic errors and find "an effective way to cooperate" with the plaintiffs and other stakeholders in the preparation of an EIR fully complying with CEQA. DEIR, ex. D, and Exh. 3-A. Section III of the Settlement Agreement therefore confirmed, and elaborated on, DWR's EIR duties as previously recognized by the Court of Appeal. *Id.* at pp. 9-15.

The Settlement Agreement also made clear that the final outcome of the Monterey Amendments remains unwritten, so that DWR's new environmental review is not directed, even in part, at a *fait accompli*. While the Monterey Amendments are presently effective, they are effective only under an *interim* court order, made under Public Resources Code section 21168.9. The interim effectiveness of the Monterey Amendments will expire once DWR makes its new decision on all project components, recorded in new Notice of Determination, and files its return to the superior court's writ of mandate.[5] Once DWR completes an adequate environmental review, it is DWR's prerogative, and its duty as State Water Project manager, to render an entirely new final decision, and to choose which path to follow: the "Monterey Plus" project, the "no project" alternative, or one of the project alternatives reviewed in the EIR.

Since the Settlement Agreement went into effect (more than four years ago), PCL has participated in more than two dozen meetings of a Monterey Amendments EIR Committee, seeking to ensure that the EIR would produce a thorough and genuine CEQA analysis of the Monterey Plus actions. The EIR is the "heart and soul"[6] of both CEQA and the Settlement

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[2] The co-plaintiffs were Plumas County Flood Control and Water Conservation District, one of the 29 state water contractors, and the Citizens Planning Association of Santa Barbara County.
[3] See, e.g., DEIR, Appendix C (Long Term Water Supply Contract between DWR and Kern County Water Agency), § 6 and Table A.

[4] DEIR, Appendix D.

[5] DEIR, Appendix D, §§ II, V.F, VII.C; ex. 3-A.

[6] *PCL v. DWR*, 83 Cal. App. 4th at p. 911.

Agreement. Regrettably, DWR's Draft EIR falls far short of what CEQA requires from DWR. In short, the EIR is simply not adequate under CEQA. First, the DEIR does not adequately address specific concerns raised by the court in *PCL v. DWR*, including DWR's clear duty to analyze and disclose the consequences of implementing pre-Monterey article 18(b). That provision of the contract (which the Monterey Amendments would eliminate) requires DWR to reconcile contract amounts with the "humbler, leaner reality"[7] of deliverable supplies—prior to its elimination.

Second, the DEIR threatens a litany of potential new CEQA violations. To mention just several key problems:

- It improperly inserts key components of the Monterey Amendments into the project baseline, distorting the ability of the EIR to compare the project with the "no project" and project alternatives.
- It improperly uses an optimization model, CALSIM II, in a manner that effectively excludes the possibility of operating the project in a manner that would reduce rather than increase exports from the imperiled Bay-Delta Estuary, and fails to disclose project impacts to that estuary.
- It summarily rejects feasible alternatives and mitigation measures that would meaningfully address project objectives without requiring damaging and unlawful levels of new pumping.
- It fails to disclose the institutional and environmental consequences of transferring to local interests the ownership of a key part of the State Water Project—the Kern Water Bank, the world's largest underground storage facility—without any effective statewide accountability, and fails to study alternatives aimed at restoring that accountability.
- It evades, rather than engages, the "common-sense notion that land use decisions are appropriately predicated in some large part on the available water supply,"[8] thereby avoiding an analysis of the project's contributions to sprawl and environmentally destructive new growth.
- It avoids a required discussion of the project's creation of new "paper water" arising from a variety of sources, including the redefinition of article 21 "interruptible" water, administrative changes to the State Water Project, and overstatement of feasible deliveries in DWR's biennial Reliability Reports.[9]
- It fails to address the environmental consequences of the Monterey Amendments' financial restructuring of the State Water Project.

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[7] *Id.* at p. 914, n. 7.

[8] *PCL v. DWR*, 83 Cal. App. 4th at p. 915.

[9] PCL and its co-plaintiffs provided many of these comments to DWR in connection with its work on the Monterey EIR committee. Attachment A to these comments compiles some of these comments, which were not adequately addressed in the DEIR, or were simply ignored. These comment letters are therefore incorporated by reference in these comments, with the request that DWR specifically respond to them. We also incorporate comments made on behalf of PCL at public hearings.

• It recognizes the major problems that climate changes poses for the State Water Project generally, only to evade full assessment of project-related climate changes and defer the task to the very local decision-makers who will need to rely on DWR's programmatic assessment.

Finally, DWR must address these deficiencies at a critical juncture in California's water history, and make its final decision based on conditions as they exist in 2008, not 1995. The depth of the environmental crisis the State Water Project now faces deserves special emphasis. For the first time ever in 2007, the State Water Project's pumps were turned off temporarily to avoid an environmental catastrophe. Separate lawsuits have undercut DWR's ability to operate as in the past, without state permits and without federal biological opinions to justify continued pumping. Climate change, by the current estimations of DWR, could substantially cut project availability by mid-century. Moreover, California now faces the worst drought conditions it has experienced since the early 1990s.

These conditions underscore the crucial importance of delivering a Final EIR that fulfills, rather than avoids, the mandates of *PCL v. DWR* and the Settlement Agreement. In other settings, including Delta Vision, the California Water Plan, and recent reports and actions on climate change, California has commenced the difficult and necessary task of bringing to water policy a new era of realism that transcends the "build it and the water will follow" dictum of a previous generation.[10] Yet the DEIR seems conspicuously disconnected from the state's direction in other settings, to the point that "the plaintiffs" are chided for even suggesting alternatives that are sustainable and would not cause additional injury to the Delta.[11] To meet the hydrological, ecological and legal demands of our time, the Final EIR must rise to the occasion, rather than resorting to evasion.

Specific Comments

I. The DEIR evades key concerns raised by the Court in *PCL v. DWR*.

A. *PCL v. DWR* must serve as the starting point for DWR's EIR responsibilities.

As detailed below, the DEIR in key respects simply attempts to explain away, rather than directly address, the key holdings of the Court of Appeal in *PCL v. DWR.* The EIR must, as a starting point, analyze the substance of the court of appeal's decision in *PCL v. DWR* and ensure that its new project assessment is consistent with the Third District's analysis in that case. The key components of the ruling are as follows

• **Lead agency requirement**

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[10] R. Kanouse, "Water Supply Planning and Smart Growth," in C. Davis, *et al.*, Navigating Rough Waters (American Water Works Association, 2001), p. 84. See also E. Rarick, CALIFORNIA RISING (2005), p. 213 (quoting Governor Pat Brown's statement that "I wanted to build a water project, and worry about the philosophy of land use later on").

[11] DEIR, pp. 11-6, 11-7.

Holding that CCWA erroneously acted as lead agency, the court ruled that CEQA required DWR, the only entity with the requisite "statewide perspective and expertise," to assume its proper role as lead agency in preparing a new EIR. (83 Cal. App. 4th at p. 907.) The Court noted the interconnected nature of the statewide project that the Monterey Amendments would transform: "[T]he allocation of water to one part of the state has potential implications for distribution throughout the system. DWR is painfully familiar with the problems plaguing the Delta and the possible impacts of the Delta Accord, an agreement between the federal and state governments on the Kern Fan Element." (*Id.)*[12]

- **"No project" alternative**

The court also held that the CCWA EIR was fatally defective under CEQA for failing to analyze implementation of pre-Monterey state water contract terms, and particularly the permanent shortage provisions of article 18(b), as part of the EIR's no-project alternative. Under the contracts that the Monterey Amendments would change , a permanent shortage occurs when the state is unable to reliably to deliver the full 4.23 million annual acre-feet (MAF) of previously-labeled "entitlements" listed in Table A of the project contracts. In that case, article 18(b) requires the state to make a proportional reduction of each contractor's amount listed in Table A, to match the available supply. The court held that an adequate EIR must analyze the impacts of eliminating these provisions.

- **"Paper water" problem**

The relationship between so-called "entitlements" and land-use planning was central to the court's holding that the EIR failed to address the "no project" alternative. The court connected this error to the risk of statewide land-use decisions made on the basis of "paper" water entitlements not grounded in real, deliverable water. The court openly criticized the false expectation that the State Water Project will deliver on its full "entitlement" level of 4.23 million acre-feet when the project's historic capability, evidenced in DWR's own data, has only been roughly half this level. The ruling therefore noted the "huge gap between what is promised and what can be delivered." (83 Cal.App.4th at 908.)[13]

- **Validation procedure**

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[12] As described in section V below, the Kern Fan Element is an approximately 20,000 acre-foot property on an alluvial fan, and the site of the Kern Water Bank, the world's largest groundwater storage facility. Article 52 of the Monterey Amendments call for DWR to relinquish control of the bank to the Kern Country Water Agency, which held the bank for only one day before retransferring it to a privately controlled joint powers agency, the Kern Water Bank Authority. Whether any statewide accountability will accompany the bank's operation is a key issue for DWR's new project decision.

[13] With respect to the "humbler, leaner reality" of project capability, the Court also noted the implicit assumption in the Monterey Amendments' financial restructuring of the State Water Project (article 51) that key facilities originally envisioned for the SWP will not be built. (*Id.* at 914.)

In addition to ruling for the plaintiffs on these CEQA claims, the court of appeal found that the plaintiffs had properly initiated a proceeding to question the substantive validity of the Monterey Amendments, including DWR's transfer of a 20,000-acre conservation and storage facility—the Kern Water Bank. . The court rejected a procedural challenge based on the theory that nonparty state water contractors were indispensable to the validation challenge. (83 Cal. App. 4th at pp. 920-926.)

- **Scope of the new EIR**

DWR must prepare an entirely new EIR as lead agency addressing the project as a whole. In *PCL v. DWR*, the Court of Appeal opined that it "need not hypothesize on the remaining issues" presented by the plaintiffs—such as the presence of a faulty project definition and the inadequate study of the Kern Water Bank's divestment—"because DWR, with its expertise on the statewide impacts of water transfers, may choose to address those issues in a *completely different and more comprehensive manner.*" (83 Cal. App. 4th at p. 920 (emphasis added).)

B. Fundamental flaws in the DEIR undermine DWR's fulfillment of its lead agency duties recognized in *PCL v. DWR.*

As the court-directed lead agency with "principal responsibility " to carry out and approve the project (Pub. Res. Code, § 21067), DWR has an inherent responsibility to render a cohesive EIR that serves as the requisite environmental "alarm bell" in accordance with CEQA. The court recognized this obligation in *PCL v. DWR*, observing:

> The lead agency must independently participate, review, analyze and discuss the alternatives in good faith … Moreover, the agency's opinion on matters within its expertise is of particular value … As the process continues, "the lead agency may determine an environmentally superior alternative is more desirable or mitigation measures must be adopted … In sum, the lead agency plays a pivotal role in defining the scope of environmental review, lending its expertise in areas within its particular domain, and in ultimately recommending the most environmentally sound alternative.

(*PCL v. DWR*, 83 Cal. App. 4th at p. 904 (citing *Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal. App. 3d 692, 736-737).)

As elucidated further below, the current DEIR is not written in a way that will allow DWR to fulfill its lead agency obligations as required under CEQA. The DEIR consistently masks impacts and confuses readers. The DEIR obscures project impacts by presenting no project alternatives that include components of the proposed project. It fails, in other words, adequately to distinguish the proposed project from continued current conditions. The DEIR also limits options for decision makers by failing to provide alternatives distinguishable from the proposed action. These flaws prevent a sufficient analysis of the impacts and implications of moving forward with the proposed project. By limiting the outcomes of the alternatives included in the DEIR, and thus constraining the range of potential management decisions, the DEIR attempts to absolve DWR of its decisional responsibilities as a lead agency. Therefore, the DEIR prevents DWR from fulfilling the lead agency role as defined and anticipated by the court in *PCL v. DWR*.

C. The DEIR fails to analyze the No Project Alternative as directed in *PCL v. DWR* and the Settlement Agreement

1. *PCL v. DWR* and the Settlement Agreement establish clear standards for the assessment and review of the no project alternative.

CEQA requires that the no project alternative address “existing conditions” as well as “what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services.” (14 Cal. Code Regs. §15126(e)(2).) That requirement compels DWR in its new EIR fully to study the consequences of enforcing the terms of pre-Monterey water supply contracts prior to eliminating them.

To overcome the prejudicial error noted in the appellate ruling, DWR must “fulfill its mandate” in the new EIR “to present a complete analysis of the environmental consequences” of enforcing the pre-Monterey permanent shortage provision, article 18(b). (*PCL v. DWR*, 83 Cal.App.4th at 915.) Article 18(b) is the single most controversial aspect of the Monterey Amendments; controversy over its enforcement was the “driving force” behind the Monterey negotiations. (*Id.* at p. 908.) While the original contracts for the State Water Project (SWP) estimated the delivery capacity of the fully constructed SWP to be 4.23 million acre-feet of water, the contracts also anticipated the likelihood that this estimate could be wrong or fail to eventuate. The original contracts prudently included a safety valve in article 18(b), which would allow contracts to be reconciled with the “humbler, leaner reality” of SWP capacity. (*Id.* at p. 914, n.7.) The court of appeal recognized the need for such a safety valve, observing the “huge gap” between SWP entitlements and existing supplies connecting that holding to the risk of planning decisions grounded in “paper” rather than real, deliverable water.[14]

Because the Monterey Amendments, if adopted, would eliminate article 18(b), it is incumbent on DWR to come to terms with its “paper water” problem before finalizing that change to the project contracts. (*Id.*)The EIR must directly evaluate reduced Table A allocations resulting from application of that article. As a useful starting point, DWR should carefully review and perform the analysis requested in public comments referenced in the Third District’s opinion. (*Id.* at 908, 915.)[15]

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[14] “Paper water,” the court observed, was “always an illusion,” steeped in the “unfulfilled dreams” of a water culture that had fostered an inflated expectation of what could be delivered. (*PCL v. DWR* (2000) 83 Cal. App. 4th 892, 914 fn. 7.)

[15] As one comment accurately suggested, the EIR “must include a parametric analysis of alternative levels of a lowered project yield tested by use of DWR’s simulation model to establish which level of yield provides for the maximum reliability of deliveries given some tolerable threshold for failure to meet requests (i.e., with what frequency will Article 18(a) be

Section III.C.2 of the Settlement Agreement provides further guidance. It provides that the new EIR shall include "[a]s part of the CEQA-mandated 'no-project' alternative analysis, an analysis of the effect of pre-Monterey Amendment SWP contracts, including implementation of article 18 therein. This analysis shall address, at a minimum, (a) the impacts that might result from application of the provisions of article 18(b) of the SWP Contracts, as such provision existed prior to the Monterey Amendments, and (b) the related water delivery effects that might follow from any other provisions of the SWP Contracts." As PCL informed DWR in its March 28, 2003 scoping comments, two of the "other" contract provisions inevitably related to this assessment are articles 18(a) and 21, which prior to Monterey required, respectively, that agricultural contractors endure the first cutbacks in water allocations in times of temporary shortage and receive the first allocations in times of surplus.

The environmental effects of proportional reductions in Table A amounts, as calculated in the no project assessment, must be directly compared to those of the proposed project. As the court of appeal made clear in *PCL v. DWR*, neither claims of "infeasibility" nor purported legal disagreements can serve as an excuse for avoiding comparison of the environmental consequences of the no project alternative and the project. (*PCL v. DWR*, 83 Cal.App.4th at 918.

2. A dispositive error undermines the integrity of the DEIR's "no project" assessment.

The DEIR recognizes that if pre-Monterey article 18(b) were enforced, Table A amounts would be reduced to less than half their original levels—1.9 million acre-feet— to reflect the firm yield of the SWP. However, the DEIR assumes that this reduction in Table A would not tangibly reduce actual water deliveries, because water not delivered under Table A would be delivered as "surplus" water under article 21 of the pre-Monterey SWP contracts. In numerous passages, the DEIR offers variations on this same basic premise.[16]

This premise, the key to the DEIR's refusal to take article 18(b) reductions seriously, is startlingly close to reasoning in CCWA's decertified 1995 EIR that the Court of Appeal expressly rejected. CCWA's EIR posited that "[i]f Table A entitlements were adjusted, less entitlement water would be delivered and *more surplus water would be delivered pursuant to*

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invoked and with what consequences). All this can be accomplished without modification of the existing contracts." (83 Cal. App. 4th at 908.)

[16] See, e.g., DEIR, p. 2-16 (implementing article 18(b) "would not … have altered the amount of water that the Department delivered to the contractors in the many years when more than the minimum SWP yield was available in the SWP system. Instead, such water would have been delivered to contractors under Article 21"); p. 4-5 (with the elimination of article 18(a)'s agriculture-first shortage provision, "it no longer mattered whether a shortage was a temporary one or a permanent one, since the allocation of available supply would be the same in either situation"); p. 6-54 ("the altered allocation procedures provided for by Articles 18 and 21 result primarily in a shift in deliveries from one contractor to another and do not affect total deliveries").

Article 21. The total amount of water would be *essentially unchanged*." (*PCL v. DWR*, 83 Cal. App. 4th at p. 929 (emphasis added).) The court specifically addressed this assumption, stating:

> This response does little more than acknowledge the paper commitment to build SWP facilities and the obvious fact that the hopes and dreams upon which the entitlements are based do not create a greater annual supply of water. None of the commenters suggested that implementation of article 18, subdivision (b), altered the contractual and political commitment to complete the SWP. They did, however, suggest that the elimination of paper water would impact land planning decisions that might reduce the need for as many SWP facilities. Under that scenario, article 18, subdivision (d), might not be invoked nor would surplus water under article 21 be tapped and exhausted.

(*PCL v. DWR*, 83 Cal. App. 4 h at p. 919.)

For multiple reasons, this premise in the DEIR is as baseless now as it was when the failure of DWR to address this key issue resulted in the judicial decertification of the 1995 EIR. First, the DEIR simply assumes as a foregone conclusion something that was very much in doubt. In 1994, prior to the initial enactment of the Monterey Amendments, the California Research Bureau (CRB) prepared a paper analyzing twenty options for changing the State Water Project's repayment system, one of which (Option 5) called for the implementation of pre-Monterey article 18(b) (CRB Report).[17] The report found that "[t]here is no guarantee" that implementing article 18(b) "would 'create' any surplus water. If the DWR implemented Article 18(b), they might also change how it operates the SWP reservoirs. They might decide, for example, not to distribute 'surplus' water and instead decide to store the water for distribution as entitlement water in another year."[18]

Second, the analysis incorrectly assumes that demand for SWP water in the Monterey and non-Monterey scenarios would be the same. That assumption is untenable, because The Monterey Amendments, if adopted, would fundamentally change the definition of Article 21 water. In particular, those amendments delete the pre-Monterey proviso in article 21(g)(1) that "the State shall refuse to deliver such surplus water to any contractor" to the extent that "the State determines that such delivery would tend to encourage the development of an economy within the area served by a contractor which would be dependent upon the sustained delivery which would be dependent upon the sustained delivery of water in excess of the contractor's maximum entitlement."[19]

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[17] Dennis O'Connor, FINANCING THE STATE WATER PROJECT: OPTIONS FOR CHANGE (CRB, August 1994). This CRB Report is included as Attachment B to these comments.

[18] Attachment B (CRB Report), p. 21.

[19] See DEIR, p. 2-17; DEIR, Appendix C (Amendment No. 1 to Kern Contract, p. 9). Metropolitan Water District's pre-Monterey contract included this language in Article 21(g)(1). The Monterey Amendments delete this language. DEIR, Appendix C (Amendment No. 23 to Kern contract, p. 13).

Third, other Monterey Amendments-related managerial changes also could profoundly affect the demand for article 21water. These include the removal of limitations on access to storage facilities, and the creation of a “turnback pool,” which allows the contractors to sell their unused Table A amounts, acting as though the water resources of the state, which belong to the public, are actually the private property of the contractors. In short, the Monterey Amendments clearly removed constraints that would have limited demand for SWP water and capacity to accept SWP water. Yet the DEIR, recycling reasoning that discredited the 1995 EIR, assumes that these contract provisions are meaningless and have no bearing on demand or capacity to receive water.

Fourth, the DEIR fails to recognize that perceived and explicit disclosure of water reliability can impact demand for SWP water and the use of that water. The shortage provisions (article 18 (a) and 18 (b)) of the pre-Monterey SWP contracts recognized that the reliability of water fluctuates. The contracts also reflected the reality that the level of reliability necessary for certain uses also fluctuates. The pre-Monterey contracts attempted to reconcile water reliability and water allocation with article 18 (a) and 18 (b). The pre-Monterey SWP contracts recognized that water availability would fluctuate according to hydrology, area of origin demand, and environmental needs. Therefore, only a limited amount of water could be reliably delivered during drought and other shortages. The original contract provision of article 18(a) reflected that municipal contractors require a higher reliability of water than agricultural contractors. Thus, article 18(a) provided that level of reliability by providing municipal contractors a preference for water in drought and short term shortage.

In short, the existing (pre-Monterey) contracts recognized that article 21 water, the least reliable category of water under the contract, is unsuitable for use as a prolonged source of supply. Municipal contractors could not depend on sources of unreliable water in the same manner that they depend and use reliable sources, because doing so would put people, businesses and the environment at significant risk. Indeed, the risk that municipal contractors may inappropriately approve permanent development based on unreliable water is the essence of “paper water.”[20] Like the invocation of article 18(b), article 21(g)(1)’s prohibition against founding permanent economies on vulnerable “surplus” water provided a powerful “safety valve” against paper water-based development. It provided decision-makers with a clear understanding that deliveries beyond the SWP’s minimum yield are unreliable. In such a case, municipal water agencies would be legally and contractually restricted from relying on water in excess of the estimated minimum yield of water for development, as well as for prolonged supplies. By contrast, the Monterey Amendments—provisionally under the present implementation, and permanently under the proposed project—would remove these safeguards.

Yet the DEIR fails to analyze the impacts of these realities. Instead, the DEIR assumes that all water provided by the SWP, either Table A, article 21 or otherwise would be used in the same manner and would procure equal demand regardless of the explicit disclosure of reliability

[20] “Paper water always was an illusion. "Entitlements" is a misnomer, for contractors surely cannot be entitled to water nature refuses to provide or the body politic refuses to harvest, store and deliver.” (*PCL v. DWR* (2000) 83 Cal. App. 4th at p. 914, n. 7.)

by the state. The DEIR is thereby assuming that SWP contractors are able to utilize very unreliable water[21] in the same way they demand very reliable water. This assumption is not supported by analysis and is not supported by law. In short, the current DEIR attempts to recycle the same skewed logic that led to the 1995 EIR's specious dismissal of the "paper water" problem.[22]

II. The DEIR fails to provide an accurate, stable and finite definition of the proposed project.

A. CEQA demands an accurate, stable and finite project definition that addresses the "whole of the action" under review.

Leading CEQA decisions have long since recognized that "an accurate, stable and finite project definition is the *sine qua non* of an informative and legally sufficient EIR." (*County of Inyo v. City of Los Angeles (III)* (1977) 71 Cal.App.3d 185, 199.) The CEQA process cannot "freeze the ultimate proposal in the precise mold of the initial project; indeed, new and unforeseen insights might emerge during the investigation, evoking revision of the original proposal." (*Id.*)

Precision and consistency in a lead agency's characterization of the project under review also reinforces related principles of CEQA: that the project must embrace the "whole of the action" (14 Cal. Code Regs., § 15378(a)); and that assessments in an EIR may not be used to justify a decision already made. In sum, CEQA "compels an interactive process of assessment of environmental impacts and responsive modification which must be genuine." (*County of Inyo v. City of Los Angeles* (*VI*) (1984) 160 Cal.App.3d 1178, 1185.)

B. The DEIR substantially understates the scope of the Monterey Amendments' proposed restructuring of the State Water project, and does not explain the source of authority for that proposed restructuring.

The description of the proposed project provides a very abbreviated summary of the changes in the SWP that would accompany the permanent adoption and implementation of the Monterey Amendments – in other words, those changes that would become permanent if the project were approved. Adopting what might be termed a "greatest hits" format, the analysis is limited to five bullet points, a few clarifying paragraphs, and a title line for all the remaining parts of these complex amendments. DEIR, §§ 4.3-4.4, pp. 4-2 to 4.8. Similarly, the background paper on the SWP is limited to a brief description of several articles, divorced from their legal and institutional context. DEIR, Ch. 2, pp. 2-1 to 2-19.

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[21] See, e.g., DWR, 2005 RELIABILITY REPORT, p. 15 (article 21 water is "highly unpredictable and unreliable").

[22] *PCL v. DWR*, 83 Cal. App. 4th at p. 914.

These cursory discussions fail to illuminate critical aspects of the SWP that relate to the project's essential mission and statewide environmental accountability, and how this system would be fundamentally changed if the Monterey Amendments become permanent. In the deliberations that framed the SWP, the Governor, DWR, and the Legislature created a water project to enable the state to more evenly to distribute scarce water supplies, which the state controlled as a common good. To develop that resource, DWR and the Governor's office developed--and the Legislature and people approved--a system unique in the country. Unlike the federal Central Valley Water Project, where the federal government paid all project costs, the SWP focused upon water as a public good that belonged to the people.[23]

Authorization of the SWP therefore was premised on an understanding that the voters of California would therefore decide on whether they agreed to the distribution of water in the SWP. If they agreed to that redistribution, the voters would agree to back an issuance of bonds to construct the project with the provisos that (1) agencies contracting for the water would pay back the costs of constructing the project solely for the *right* to have water delivered to them through the project's facilities; and (2) although agencies would repay the costs of constructing the project, the facilities and the water would continue to belong to the State, as a *public* resource.[24]

The project framers also anticipated that the state water project would operate based upon long-term water service contracts that would remain in effect until the retirement of all water resources development bonds no sooner than 2035. These contracts would be unique, in that they were based upon: (1) DWR's inherent responsibility to manage the state's water resources fairly and equitably; (2) the principle that all contractors were to be treated equally; (3) the provision that any agency or district in California could contract with the department for water service; and (4) a trusteeship requiring the project to be constructed and managed for the good of the people of California.[25]

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[23] See P.A. Towner, *Brief History of the Negotiation of Water Supply Contracts for the State Water Project*, presented to the California Water Commission (Dec. 3, 1976).

[24] *Ibid.*

[25] The objective of the state water project to operate for the good of the people of California became part of the Bond Act. Once the Act was passed, it was incorporated into the Water Code (Wat. Code, §12930, *et seq.*) Governor Brown signed the prototype long-term water service contract with Metropolitan Water District just before the 1960 election. (Rarick, *supra*, at p. 221.) To further ensure that the people of California would not be responsible for repaying the bonds used to construct the facilities, DWR required agencies with which it contracted to have taxing authority, so that if the agency could not meet its payments to DWR, it would be required to tax residents to make these payments. (Wat. Code, §12937.) Conversely, if the SWP were "sold" into private ownership, it would potentially threaten the tax-exempt status of the project's general obligation bonds. Attachment B (CRB Report), p. 51.

To develop and secure approval of the state water project, DWR and the Governor first prepared a "statement of principles" for the long-term water service contractors.[26] These principles are derived from the "utility theory," which Governor Brown described to the Legislature as recognizing "our obligation to insure that water will be available to meet the proper demands of every part of the State."[27] These principles were the ones used to promote the project to California voters, and those principles reflected project sponsors' understanding that voters would not vote for project financing to support water facilities they did not own or control. Moreover, those principles specified that DWR would be acting as an agent and trustee of the people to manage water resources for the good of all Californians. After preparing these principles, the framers prepared and secured voter approval of the Burns-Porter Act.[28]

The SWP thus was premised on a fundamental *quid pro quo*: its contractors would benefit from project operation, but the public always would control the project itself, and the project's works truly were to be part of a "state" water project, which would be publicly owned and operated for public benefit. After securing passage of the Bond Act, DWR and the Governor determined the redistribution patterns of water throughout California based on estimated need and secured the water rights for those areas in the amount of estimated need until 2035, the end of the project repayment period. They also negotiated with agencies throughout California for water service contracts. The amount of water these agencies could expect to receive over the life of the project was subject to limitations, including limitations from water rights permits, climatological and environmental conditions. The contracts were to extend until 2035. The Department could not predict all conditions affecting water conditions until 2035. Consequently, state water service contracts were written so that DWR could not be held responsible for water it could not deliver provided that it made reasonable attempts to do so.[29]

On their face, key features of the Monterey Amendments, if made permanent, would differ sharply from the central tenets of the SWP contracts as originally framed, approved, and validated by the voters, shifting a substantial degree of control from SWP to the contractors. To name several examples:

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[26] Cal. State Senate Fact Finding Committee on Water Resources, Partial Report, *Contracts, Financing, Cost Allocations for State Water Development* (March 1960), pp. 51-52.

[27] E.G. Brown, Water Message to Legislature, Cal. Sen. J., Vol. 1 (1959) 222, 224-225. The Governor's principles constituted a "contemporary administrative directive, which was known to the voters at the time of the election," and were also accepted by the Legislature. (*Goodman v. County of Riverside*, (1983) 140 Cal. App. 3d 900, 907-908.)

[28] Wat. Code, § 12930, *et seq.*

[29] Under the state water project, contractors "are obligated to pay for their contractual entitlements of water" from the project, *"whether the water is delivered or not."* (*PCL v. DWR*, 83 Cal. App. 4th at p. 899.)

- Major changes in article 18 would remove the temporary shortage provision requiring "agriculture first" cutbacks (article 18(a)) and the permanent shortage provision requiring Table A amounts to be reconciled with available supplies.
- Article 51 transforms the financial structure of the SWP, allowing the contractors "a rebate for the costs previously assessed for facilities that have never been built."[30]
- Article 52 facilitates the transfer of the Kern Water Bank property to local control, in exchange for the "retirement" of 45,000 acre-feet of Table A amount that two agricultural contractors-- Kern County Water Agency and Dudley Ridge Water District—had no assurance or reasonable expectation of ever receiving in deliverable water.
- Article 53 authorizes the transfer of 130,000 acre-feet in new agriculture-to-urban transfers, eases requirements for other transfers, and allows the transportation of water in state facilities to other contractors, or entities other than non-contractors.
- Article 54 provides for local control and management of the two terminal reservoirs.
- Article 55 allows contractors to transport non-project water in SWP facilities at the lower costs referenced in the SWP contracts.
- Article 56 allows contractors to sell water outside their service areas.

Collectively, these changes far exceed any other changes in the project's history. At present, the Monterey Amendments are proceeding under the authority of the Sacramento Superior Court's interim order under Public Resources Code section 21168.9.[31] But the DEIR never identifies the source of authority to make the amendments permanent. DWR should address these changes in light of Water Code section 12397(b)(4), the source of DWR's contracting authority, which provides that "[s]uch contracts shall not be impaired by subsequent acts of the Legislature during the time when any of the bonds authorized herein are outstanding and the state may be sued with respect to said contracts." DWR should indicate the source authority, if any, for the project as proposed to become permanent without the approval of the Legislature, or of the voters of California.

This issue of authority cannot be marginalized as a mere "legal" issue divorced from the environmental consequences of the project. Rather, on a host of environmental issues discussed in these comments, a foundational question is for whose benefit the project exists, the people of California or the State Water Contractors. The answer to this question may have profound consequences for the environment, particularly in times of water scarcity. DWR's clarification of its source of authority may therefore help illuminate whether its approach to managing the SWP can proceed consistently consistent with its duties as CEQA lead agency.[32]

C. The DEIR does not adequately clarify the "uses of the EIR."

[30] *PCL v. DWR*, 83 Cal. App. 4th at p. 914, n.7.

[31] Settlement Agreement, Appendix 3-A.

[32] *PCL v. DWR*, 83 cal. App. 4th at 903-907.

When finalized, the EIR will be used primarily by DWR, as lead agency, to decide whether to approve, modify, or disapprove the components of the proposed project: the Monterey Amendments and the further actions described in the Settlement Agreement. The DEIR summarizes the proposed project in Chapter 4, which also briefly describes the Monterey Amendments and the Settlement Agreement. As required by the writ of mandate issued by the Superior Court to implement the decision of the Court of Appeal in *PCL v. DWR*, "upon completion and certification of the new EIR, Respondent DWR shall make written findings and decisions and file a Notice of Determination identifying the components of the project analyzed in the EIR, all in the manner prescribed by sections 15091-15094 of the CEQA guidelines."[33]

Despite some helpful language, the DEIR's section of the "intended uses of this EIR (DEIR, § 1.2) contains one phrase that is ambiguous. It indicates that DWR as lead agency, and the State Water Contractors as responsible agencies, will use the EIR to "decide whether to *continue* operating under the proposed project: the Monterey Amendment and the Settlement Agreement, as described in Chapter 4, or to decide to implement one of the alternatives to the proposed project." (*Id.* at p. 1-1 (emphasis added).

The Monterey Amendments are presently proceeding only under an interim order that will expire following DWR's new Notice of Determination and return to the writ. The use of the word "continue" should not suggest that the default condition will be to make that interim operation permanent, or that DWR's approval decision on the "Monterey" part of the Monterey Plus project can be relegated to the past tense.

Instead, DWR must determine, based on its assessment of project impacts, alternatives, and mitigation measures, whether to (a) approve and execute the Monterey Amendments as initially proposed in 1994 and approved and executed in 1995; (b) approve and execute the Monterey Amendments and the further actions described in the Settlement Agreement; (c) approve and execute the Monterey Amendments as further modified in response in response to the analysis in and public comment on the present EIR; (d) approve and execute an alternative to the Monterey Amendments; or (e) approve no project at all. The EIR will also be used to determine whether or not to authorize the permanent transfer of the Kern Fan Element, and to proceed with the 41,000 acre-foot Kern/ Castaic transfer as part of the final project.

The Superior Court's writ of mandate requires DWR's *de novo* determinations and actions, because at present no project elements have been approved, except for the Superior Court's interim order under Public Resources Code section 21168.9. The exercise of that discretionary power cannot vitiate the fundamental CEQA duties of lead and responsible agencies to precede their final project decisions by the completion and certification of a valid EIR. The EIR will thus be used to DWR to meet these requirements of law and proceed once the section 21168.9 order ceases to be in effect.

PCL requests that the EIR specifically address each of the following questions, which it raised more than a year ago in a letter to the DWR Director:

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[33] Settlement Agreement, Appendix 3-A.

1. Once DWR has completed and certified its EIR, will DWR make a new decision on all components of the project, recorded in a new notice of determination?

2. If DWR makes a new project decision, will that decision determine whether or not DWR will approve and execute the Monterey Amendments?

3. If DWR makes a new project decision to approve a project that includes the Monterey Amendments:

    a. Will the decision consider a no project alternative that includes no actions taken under the Monterey Amendments?
    b. Will the decision determine whether or not to adopt alternatives to the Monterey Amendments?
    c. Will the decision determine whether or not to adopt mitigation measures for any significant impacts of the Monterey Amendments?
    d. Will the decision determine whether to authorize the permanent transfer of the Kern Fan Element?
    e. Will the decision determine whether or not DWR approves of water deliveries under the 41,000 acre-foot Kern/Castaic transfer?[34]

III. The DEIR's "aura of unreality"[35] undermines its ability to meaningfully address the distinct environmental consequences of the project.

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[34] The 1999 contracts framing this agriculture-to-urban transfer were not the subject of a validation challenge. However, those transfer contracts were expressly based upon the Monterey Amendments, whose final authorization remains unknown, and DWR has never approved the transfer outside of the Monterey Amendments, which would subject it to the pre-Monterey agricultural deficiency provisions of article 18(a) and undermine its reliability to support urban uses. (See Attachment C (2002 letter of Castaic's counsel).) The Los Angeles Superior Court decertified Castaic's stand-alone 2004 EIR in May 2007 (*Planning and Conservation League v. Department of Water Resources* (LASC No. BS 098724.) While Los Angeles Superior Court Judge James Chalfant characterized the *1999* transfer contracts as "final," he recognized that DWR could still take actions that could "undermine" the ability of the transfer to deliver water. *Id.* at p. 13. He also relied partially on representations of DWR's counsel that DWR had the discretion to take steps that might curtail deliveries under the transfer. *Id.* at p.20 All parties except for DWR have appealed that decision, and it is pending in the Second District Court of Appeal. In addition to fully studying the Monterey-associated impacts of this sprawl-supportive transfer and appropriate mitigation, the EIR should fully consider PCL's proposed alternative that would consider alternative dispositions of its water. In a time of statewide water shortage, the need for DWR's careful evaluation is particularly acute.

[35] *PCL v. DWR*, 83 Cal. App. 4th at p. 912.

A. The DEIR analysis is predicated upon a defective environmental baseline.

Without the development of an adequate baseline condition, "analysis of impacts, mitigation measures and project alternatives becomes impossible." (*County of Amador v. El Dorado County Water Agency* (1999) 76 Cal. App. 4th 931, 953.)[36] The baseline for these assessments must be based on an analysis of "real conditions on the ground," rather than mere opinion or narrative. (*Save Our Peninsula Committee v. Monterey County Board of Supervisors* (2001) 87 Cal.App. 4th 99, 121.)

The DEIR accurately notes that that the baseline for assessment here is "complicated" by the implementation of the Monterey Amendments before 2003, when DWR issued its Notice of Preparation.[37] Nonetheless, a series of glaring errors undermine the baseline's integrity to serve as the basis for assessing the project's environmental impacts.

First, the DEIR states that the baseline has been "*adjusted to include events that are expected to occur over time*" that it assumes are "not related to the Monterey Amendment and the Settlement Agreement."[38] That "adjustment" constitutes an error of law under CEQA. It is the "no project" alternative, rather than the baseline, that, in addition to existing conditions, must account for "what would be reasonably expected to occur in the foreseeable future if the project were not approved, based upon current plans and consistent with available infrastructure and community services." CEQA Guidelines, § 15126.6(e)(2). But the "no project" alternative is "not the baseline for determining whether the project's proposed impacts may be significant, unless it is identical to the existing environmental setting analysis which does establish that baseline." *Id.*at 15126.6(e)(1). Here, where the "no project" analysis is much more complex, and by no means "identical" to the environmental setting, there is no basis for making these forecasting adjustments to the baseline, and the resulting mistake fatally infects the comparison between the baseline and impact assessment.

Second, the baseline does not accurately reflect pre-Monterey contract provisions that set limitations for contractors, and thus does not accurately reflect constrained demands or capacity

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[36] See also CEQA Guidelines, § 15125(a) (the environmental setting will "normally constitute baseline physical conditions by which a lead agency determines whether an impact is significant"); DEIR, p. 5-1.

[37] The DEIR inaccurately lists the Monterey Amendments' implementation date as 1995. DEIR, p. 5-2.

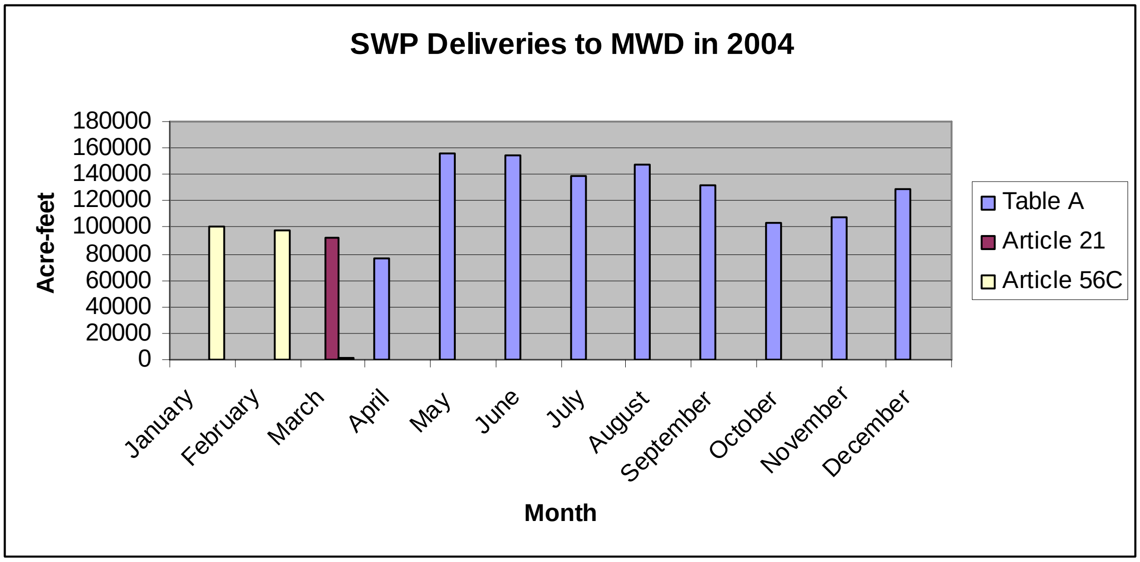
[38] DEIR, p. 5-2 (emphasis added); see also DEIR, p. 3 (postulating that "other changes and transfers" alleged to be "unrelated" to the Monterey Amendment, have occurred or are anticipated to occur by 2020). Although DWR attempts to project baseline and project conditions through 2020, the project involves changes to SWP project contracts that will remain effective until 2035. DWR's impact assessment does not demonstrate why it fails to make reasonable attempts to take account of the additional 15 years of project impacts.

to accept SWP water under pre-Monterey contracts. These provisions, changed under Monterey as noted above, include the following:

- The pre-Monterey contracts precluded SWP contractors from storing water outside of their own service areas. This provision limited contactors' capacity to accept SWP water to the real-time customer demands plus the amount of water that could be stored in facilities within the contractors' service areas. Eliminating this provision in the Monterey Amendments significantly expanded storage options available to contractors, and thereby enhanced contractors' capacity to take water. Yet the DEIR assumes that the baseline water demand is the same as demands when such limitations are not applied to contractors (as in the proposed project).

- The baseline also does not reflect how Article 21(g) (1) of the pre-Monterey contracts precluded the use and therefore demands for Article 21 water. As noted above, Article 21 (g) (1) prevents the state from delivering "surplus" water where it determines that it would contractor to the extent that the State determines that such delivery would tend to "encourage the development of an economy within the area served by sustained delivery of surplus water." This article established a specific limiting provision for delivery of Article 21 water, and the baseline should assume that DWR would implement it and withhold delivery of water where appropriate. By contrast, the Monterey Amendments have been in effect on an interim basis without that limitation. Several contractors now have economies that are dependent on continued delivery of Article 21 water. According to tables provided by DWR for water years 2004 and 2005, some urban contractors now take Article 21 and carry-over water in the winter months while taking little or no Table A supplies and take Table A supplies later in the year (see tables below). This indicates that some contractors are using Article 21 supplies to sustain the hard demands of their service area in winter months.[39]

[39] In fact, review of the historic deliveries of article 21 water demonstrates that municipal demands for Article 21 water supplies have *increased* since implementation of the Monterey project. Such use would have been prohibited under the pre-Monterey contracts. This increased demand for article 21 water should not be included in the baseline. The EIR should further analyze whether proposed contract amendments have indeed resulted in hardened demand for article 21 water, and corresponding shifts in delivery, demand, and request patterns for Table A supplies.


SWP Deliveries to MWD in 2004
Acre-feet
180000
160000
140000
120000
100000
80000
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40000
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February
March
April
May
June
July
August
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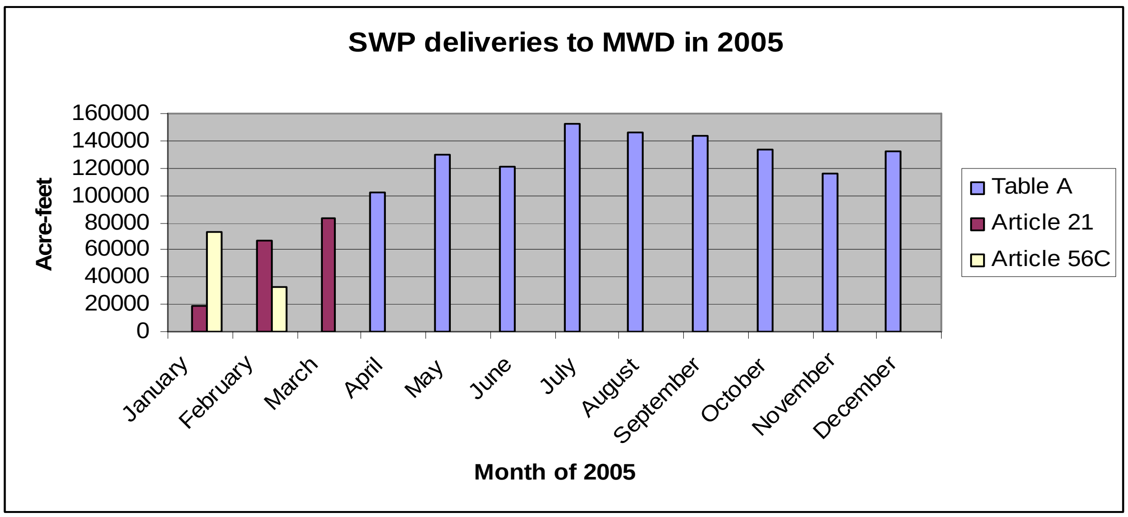
October
November
December
Month
Table A
Article 21
Article 56C


SWP deliveries to MWD in 2005
Acre-feet
160000
140000
120000
100000
80000
60000
40000
20000
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January
February
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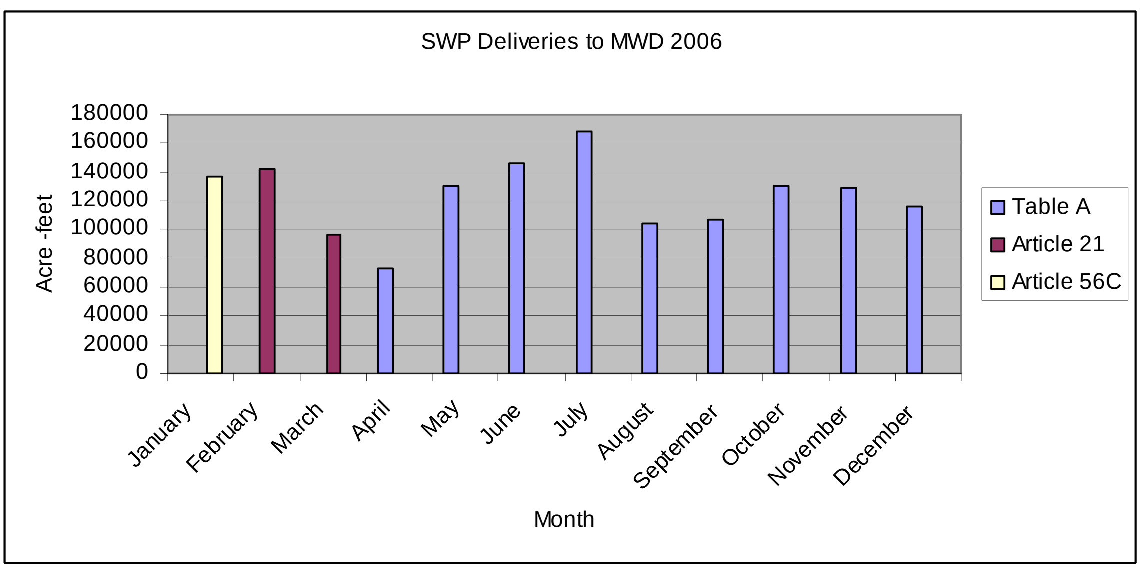
Month of 2005
Table A
Article 21
Article 56C


SWP Deliveries to MWD 2006
Acre -feet
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160000
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January
February
March
April
May
June
July
August
September
October
November
December
Month
Table A
Article 21
Article 56C

Source data provided electronically to Mindy McIntyre by DWR staff in 2007

Third, the baseline inappropriately excludes an accurate analysis of allowable operations under the current regulatory setting. The baseline does not include operational constraints of the federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA). As detailed further in section III.B, *infra*, recent state and federal court rulings have determined that SWP operations as modeled in the DEIR do not comply with either CESA or FESA, and are therefore illegal.[40]

Fourth, the DEIR fails to recognize climate change in the baseline (and in the analysis of alternatives). The DEIR incorrectly states that too little is known about climate change to warrant incorporation of findings into the baseline and alternative. Rather, the DEIR provides a cursory discussion of climate change in a separate section of the EIR[41]. This assertion is contradicted by numerous studies and findings, including research published by DWR well before the release of the DEIR.

DWR has prepared and released significant information on climate change impacts to the SWP system and to California water resources. The Department's own "Progress on Incorporating Climate Change into Water Management," outlines several feasible scenarios for climate change. CEQA does not require definitive information prior to incorporation into analysis. Indeed, as noted by the Intergovernmental Panel on Climate Change, it is very unlikely that future California hydrology will be the same as past hydrology:

> The IPCC (2001) ranked the confidence limits of major impacts to water resources due to observed and projected climate change as very high (0.95-1.00), high (0.67-0.95), medium (0.33-0.67), low (0.05-0.33), and very low (0.00-0.05). There is high confidence that the timing and amount of runoff is changing, and very high confidence that watersheds with substantial snowpack will experience major changes as temperature continues to rise. The impacts of this trend are a decrease in available water resources in California, primarily during the summer months, and a potential increase in wintertime floods. There is high confidence that California's Sierra Nevada will experience a continued trend of decreased snow accumulation

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[40] See, e.g., *Natural Resources Defense Council v. Kempthorne* (E.D. Cal. 2007), 2007 U.S. Dist. LEXIS 42263 (existing and planned future operations in the Central Valley Project and State Water Project may jeopardize the Delta Smelt, creating ESA compliance problems. While the baseline excludes compliance with these state and federal endangered species laws, the DEIR simultaneously relies on the FESA process to mitigate for many of the significant impacts of the proposed project. However, the DEIR provides no analysis to demonstrate that the FESA process is capable of mitigating these impacts.

[41] See DEIR, Ch. 12, addressed in section of these comments, *infra.*

and earlier snowmelt (e.g. Lettenmaier and Gan 1990; Jeton et al. 1996; Miller et al. 1999; Wilby and Dettinger 2000; Knowles and Cayan 2002; Miller et al. 2003).[42]

In fact, and as discussed fiurther below, widely available data demonstrate that climate change is already occurring in California, with trends of declining snowpack and earlier annual peak runoff.[43] Numerous studies, listed in attachment D to these comments, address climate change and its effects on water resources in California are available. Despite this overwhelming body of evidence of current and future climate change, the DEIR ignores climate change in the baseline and in all alternatives. Instead, the baseline and all alternatives are based on past hydrology.

In sum, the DEIR's baseline fails to provide an accurate basis for comparison of environmental impacts associated with the proposed project or other alternatives. The baseline must be adjusted to reflect the pre-Monterey SWP contracts, pre-Monterey SWP operations and the impacts of climate change. Without such adjustments, the baseline is an inadequate reference from which to determine the impacts of the proposed project and project alternatives.

B. The DEIR fails to reflect the current regulatory framework, and in particular the impact of the Delta Smelt/OCAP decision on the delivery reliability of the SWP.

DWR's final decision on the "Monterey Plus" must reflect and address SWP and environmental conditions as they exist now, rather than freezing them in 1995 or 2003. The recent ruling invalidating the biological opinion for the Delta Smelt is one of the most significant current environmental constraints for the SWP. Yet the DEIR fails to incorporate the impact of this decision in alternatives analysis or recognize this significant decision in Section 6.3 (Changes in SWP Operations Since 1995 Unrelated to the Proposed Project). The federal court's

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[42] *California Climate Change, Hydrologic Response, and Flood Forecasting* , Norman L. Miller Earth Sciences Division, Berkeley National Laboratory, Berkeley, California, USA . Presented at the International Expert Meeting on Urban Flood Management 20-21 November 2003, World Trade Center Rotterdam, The Netherlands April 30, 2004.
http://www.lbl.gov/Science-Articles/Archive/assets/images/2004/Apr-30/California_Flooding.pdf

[43] *Potential effects of global warming on the Sacramento/San Joaquin watershed and the San Francisco estuary.* Noah Knowles and Daniel R. Cayan, Geophysical Research Letters, VOL. 29, NO. 18, 1891, doi:10.1029/2001GL014339, 2002, http://natypete.andradedowns.googlepages.com/knowles2002.pdf; No. 119. Effects On Water Resources: Monitoring Snowmelt Runoff And Sea Level for Climate Change, Maurice Roos, California Department of Water Resources, presented at the U.S. Climate Change Science Program (CCSP) workshop on November 14-16, 2005, in Arlington, Virginia http://www.climatescience.gov/workshop2005/posters/P-WE2.8_Roos.pdf

summary judgment decision was issued on May 25, 2007, many months before the DEIR and the final ruling has now been issued.[44]

DWR has publicly recognized the impact of the Delta Smelt ruling outside of the DEIR. DWR's Chief of Project Operations Planning Branch, John Leahigh, stated that under the interim remedy actions proposed by the United States Fish and Wildlife Service (USFWS), SWP 2008 deliveries would be reduced anywhere between 8% (91,000 AF) to 27% (305,000 AF) from a baseline delivery of 1.15 MAFY in a dry year; and from between 8% (252,000 AF) and 31% (305,000) from a baseline of 3 MAFY in an average year. (Attachment F, *NRDC v. Kempthorne*, Doc. 398, Declaration of J. Leahigh, dated July 9, 2007, at ¶¶ 6. 36-37.)

While the ruling initially imposed an interim remedy only, it is reasonable to expect that the next biological opinion will impose permanent restrictions that are similar or more stringent to the interim remedy. It is very unlikely that the USFWS will issue a biological opinion significantly similar to the pre-ruling opinion. Given this likelihood, the EIR should reflect the operations imposed by the court in the Delta Smelt ruling. Indeed, the ruling demonstrates that existing operations, as modeled in the DEIR, are not lawful. The Delta Smelt ruling will alter the way the proposed project can be implemented. The interim remedy imposed by the court restricts winter and spring SWP pumping in the Delta. Such restrictions will necessarily impact deliveries of Article 21 water, as well as Turnback Pool transfers. Any conclusions included in the DEIR regarding deliveries of Article 21, Turnback Pool water and other water deliveries in the winter and spring are now inaccurate. The EIR must recognize the Delta Smelt ruling, and fully incorporate it into the environmental analysis for the project.[45]

C. The DEIR improperly uses CALSIM II as the principal tool to analyze baseline condition and environmental impacts.

The DEIR relies on CALSIM II to analyze the impacts of water allocation and deliveries under the baseline, the proposed project and the alternatives. CALSIM II results are relied upon to estimate SWP delivery and export impacts as well as to derive environmental impacts on the Delta and upstream tributaries. While CALSIM II may be a sophisticated and useful modeling tool for certain purposes, it is inappropriate for determining environmental impacts and for estimating impacts in export and deliveries. It has been criticized by a panel of expert reviewers for several weaknesses, including its lack of amenability to proper calibration. (*See* A. Close, *et al.*, *A Strategic Review of CALSIM II and its Use for Water Planning, Management and Operations in Central California* submitted to California Bay Delta Authority Science Program, December 4, 2003.

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[44] Attachment E, *NRDC v. Kempthorne*, 1:05-cv-1207 (EDCA), Doc. 560, Interim Remedial Order Following Summary Judgment and Evidentiary Hearing, dated Dec. 14, 2007, Attachment F, *NRDC v. Kempthorne*, Doc. 323, Order Granting In Part and Denying In part Plaintiffs' Motion for Summary Judgment, dated May 25, 2007.

[45] The EIR also needs to discuss the *time of year* in which cutbacks of pumping will be necessary to achieve the restoration of the Delta Smelt. The timing of these cutbacks may well occur in spring and winter, ordinarily a heavy period for SWP pumping.

In addition, CALSIM II assumes foresight on the part of operators, and thus assumes that operators will not take actions that will result in later violations of environmental standards or other operating constraints. This assumption can lead to great underestimation of environmental impacts, for in the real world operators do not have such foresight and thus may make decisions without realizing the consequences ultimately resulting from those decisions.

Furthermore a recent analysis has revealed additional flaws in the statistical basis for CALSIM II. ("Analysis of CALSIM's Statistical Basis,"by Arve Sjovold, December 28, 2004, previously provided to DWR).

CALSIM II predictions are only as accurate as the data and assumptions that are plugged into the model. Here, those assumptions may be wrong; for example, the DEIR assumption that future water flow patterns will be similar to those that have occurred in the past is inconsistent with the ample literature on the substantial effects of global warming on California water flows. These input data errors and uncertainties further undermine the ability of the DEIR's modeling analysis to make the kind of predictions necessary to support a genuine analysis of impacts.

Because CALSIM II is an optimization model that does not necessarily reflect options available to water operators, it may predict levels of exports. However, federal and state water quality and endangered species laws and regulations probably would prohibit such high export levels for water quality problem. The DEIR assumes that future water exports from the Delta will be nearly twice the historic average. Yet this prediction fails to recognize that DWR has chronically failed to meet water quality standards in the Delta under historic operations, and significant environmental degradation has taken place under such conditions, resulting in new regulatory actions. In light of the recent pelagic organism declines in the Bay Delta Estuary, and resulting rulings invalidating the biological opinion for Delta smelt, it is prudent to ensure the DEIR modeling assumptions predictions are conservative, rather than "optimizing" to ensure assumed deliveries would not violate conditions of the Federal Clean Water Act, the Federal or California Endangered Species Acts, or any other environmental permit condition, regulation, standard, or law.

Finally, the DEIR's presentation of modeling results is flawed. Throughout the DEIR, modeled predictions—for example, statements that salmonid mortality will increase by a certain percentage—are presented as though certain, and discussion of possible error or of ranges of possible outcomes is almost entirely absent. The models used cannot possibly produce such certainty, however; at best, they can predict, given a certain set of data and assumptions, a range of possible outcomes, with some outcomes potentially more probable than others, and with all predictions limited by both known and unknown sources of error. An accurate discussion of the DEIR's modeling results therefore cannot provide certain predictions, and instead should show the range of possible outcomes. By omitting both possible sources of error and potential outcome ranges, the DEIR projects a false certainty that the impacts of the project will be relatively small. Indeed, if the modeling results were properly presented, with ranges of outcomes fully described, the study might show that the models actually predict that significantly larger impacts are entirely capable of occurring.

PCL does not argue that models should never have been used to inform the analysis in the DEIR. But the CALSIM II used cannot possibly provide a near-certain conclusion that significant environmental effects will not occur, or will be fully mitigated especially when both common sense, existing knowledge of the Delta system, and the analyses of other agencies all indicate the extremely high likelihood of such impacts. Indeed, PCL believes that if modeling results were properly reported, they would indicate the reasonable likelihood of significant impacts.

As participants in the EIR Committee process, PCL has previously submitted comments expressing our concerns regarding the adequacy of CALSIM II for analyzing baseline conditions and assessing environmental impacts. The DEIR has not adequately addressed our previous comments, and we resubmit those comments on CALSIM II by reference to the DEIR.

If DWR includes CALSIM II model analyses in future EIR drafts, we request clear explanations and justification of all assumptions made in the CALSIM II model runs. In addition, we request that DWR explicitly state when findings are based on post processing and when findings are based on direct model results. When findings are based on post processing, the rationale behind these post-processing decisions should be clearly articulated.

V. The DEIR fails in its duty to analyze the transfer, development and operation of the Kern Water Bank, and alternatives that would restore its public accountability.

A. DWR must independently study, and exercise its own judgment on, the "transfer, development and operation" of the Kern Water Bank.

As provided in the settlement agreement, "the new EIR shall include an independent study by DWR, as the lead agency, and the exercise of its judgment regarding the impacts related to the transfer, development and operation of the Kern Water Bank" in light of existing environmental permits. (Section III.F.) That study "shall identify SWP and any non-SWP sources of deliveries to the Kern Water Bank." (*Id.*) The EIR must provide this analysis to ensure compliance with the agreement and the requirements of CEQA.

The 2003 Settlement Agreement, which allows the Monterey Amendments to proceed on an interim basis, that "KWBA shall retain title to the KWBA lands. KWBA may continue to operate and administer the KWB lands including the water bank, subject to restrictions herein."[46] The agreement also provides that "[t]he restrictions in this Section V shall become final only upon (1) filing of the Notice of Determination following the completion of New EIR, (2) discharge of the writ of mandate in the underlying litigation as provided below, and (3) conclusion of all litigation in a manner that does not invalidate any Monterey Amendment (or any portion thereof) or the Kern Fan Element Transaction."[47]

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[46] Settlement Agreement, § 5.A.

[47] Settlement Agreement, § V.F.

B. **The DEIR's study methods are too narrow to support DWR's independent judgment on the future of the Kern Water Bank.**

DWR's final decision addressing ownership and operation of the world's largest groundwater storage facility, the one million acre-foot capacity Kern Water Bank located west of Bakersfield, raises critical issues involving public trust accountability and environmental responsibility. The various stakes involved in the bank's operation—financial, institutional and environmental—are of immense importance to California's future. Built to capacity, the groundwater bank is capable of delivering 240,000 acre-feet of water per year, enough to supply the needs of roughly 500,000 households.[48]

The facility is also crucial because of its location, providing storage to the southern San Joaquin Valley.[49] When developed, the Kern Fan Element, in combination with the provisions of the proposed project allowing storage outside an SWP service area, significantly increase SWP contractors' capacity to accept water from the Delta.

But the DEIR's draft study on the Kern Water Bank (DEIR, Appendix E) says very little that would alert the reader to momentous environmental significance of DWR's forthcoming decision. The "methods" section of that study (DEIR, Appx. E, p. 5) suggests a possible reason for its benign assessment. Of the three sources of information noted in the study, the only information source that does not come directly from the Kern agencies, KCWA and KWBA, is that DWR contacted personnel from the California Department of Fish and Game and the United States Fish and Wildlife Service. That focus is far too narrow. The substantial environmental issues associated with the loss of statewide environmental accountability over the bank require a more probing analysis that could not be addressed simply by consulting wildlife and fisheries agencies, and it is DWR, as SWP manager, that must provide that analysis. As detailed below, even if the KWBA has been a responsible steward of the Kern Fan Element property that holds the bank, the concerns that arise from the decision for the bank to serve local rather than statewide interests would persist.

DWR's narrow study methods are surprising, because the broader issues surrounding the transfer, development and operation of the Kern Water Bank have been the subject of major public controversy, addressed in the media[50] and in reports that are referenced and discussed nowhere in the DEIR. One of those reports, prepared by Public Citizen, contends that while the

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[48] In August 1996, one day following DWR's transfer of the bank to Kern County Water Agency in its interim implementation of the Monterey Amendments in 1996, KCWA retransferred the bank to the Kern Water Bank Authority (KWBA), which consists of five local public water agencies and a private mutual water company.

[49] Sandino, *California's Groundwater Management Since the Governor's Commission Review: The Consolidation of Local Control* (2005) 36 MCGEORGE L. REV. 471, 489 n. 171.

[50] M. Arax, *Massive Farm Owned by L.A. Man Uses Water Bank Conceived for State Needs*, Los Angeles Times (online), December 19, 2003.

KWBA is formally public entity, it is effectively majority-controlled by one of the world's largest farming companies, Paramount Farming, and largely serves the interests of two corporations with large landholdings in the service area.[51] The Public Citizen report charges that the divestment of the bank from state authority has been environmentally destructive, raising issues that are nowhere addressed in the DEIR.[52] While we believe that DWR is very much aware of this report, and should thus have included a reaction to the report as part of the DEIR environmental analysis of the proposed transfer of the Kern Fan Element, we will attach the Public Citizen Report to these comments, so that DWR will have no excuse not to analyze its findings in connection with producing the final EIR.

Whether or not DWR concurs with them, it would be irresponsible not to address these well-known allegations before taking its final action on the proposed Kern Water Bank transfer.[53] Indeed, broad concerns about the lack of institutional and environmental accountability among Kern County's local water agencies have drawn the attention, not simply of environmental groups, but also some of the most respected scholars of California's water history. For example, Norris Hundley's discussion observes that such local districts "are ordinarily managed by boards of directors made up of a homogeneous, single interest body of people representing the large water users and guided by a rigid set of goals: maximization of water use at minimum cost with little or no regard for the environment or for the welfare of the people of California."[54] In short, the EIR will disserve decision-makers and the public unless DWR is able to step outside the mindset of the local Kern agencies, and address the Kern Water

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[51] J. Gibler, WATER HEIST (Public Citizen, December 2003)("Public Citizen report"), included as Attachment G to these comments. The EIR should specifically address the Public Citizen report as if it were set forth directly in these comments.

[52] See Public Citizen report, p. 2 (arguing that the bank should not "provide a handful of corporations with the keys to a virtual 'switchyard' for controlling water deals between agribusiness and real estate developers").

[53] To assist decision-makers and the public, PCL also requests that DWR include in the EIR a documentary appendix compiling key reference sources on the Kern Water Bank. The public should have an opportunity to directly review such key documents as (1) the 1987 DWR/ KCWA memorandum of understanding; (2) the purchase agreements framing the transfer of the Kern Fan Element from DWR to KCWA, and from KCWA to KWBA; (3) the 1995 KWBA Statement of Principles; (4) the 1995 KWBA Joint Powers Agreement; and (5) the 1995 KWBA Operations and Monitoring Memorandum of Understanding.

[54] N. Hundley, THE GREAT THIRST (2001), p. 536; see also R. Gottlieb and M. Fitzsimmons, THIRST FOR GROWTH (1991), pp. 96-97 ("With new purchases and related expansion of irrigated acreage becoming a speculative spiral, the Kern landowners raced to establish new water districts to contract for State Project water….The tendency toward concentration and overextension, already prevalent in the county from the days of *Lux v. Haggin*, was enormously magnified with the arrival of the aqueduct. A handful of landowners dominated the key water districts affiliated with the [Kern County Water Agency], and these districts, in turn, dominated the agency").

bank issues with the "statewide perspective and expertise" required in its stewardship of the State Water Project.[55]

C. The EIR fails to fully disclose how the transfer of the Kern Fan Element out of DWR's control alters the central purpose of the Kern Water Bank.

Although the DEIR briefly refers to the transfer of the Kern Fan Element out of state ownership, and its subsequent control by the KWBA (DEIR, p. 4-11), it never fully acknowledges how this transformation affected the fundamental purpose of the Kern Water Bank. The DEIR appendix on the transfer briefly references the 1987 Memorandum of Understanding (1987) between DWR and KCWA, which formed the basis for DWR's acquisition of the Kern property from Tenneco West.[56] But it never mentions how two key statewide and public protections referenced in the 1987 MOU were later removed:

- **Shift of bank purpose to serve local rather than statewide interests.**

The 1987 MOU clarified that the "primary purpose" of the Kern Water Bank is to "augment the dependable water supply of the State Water Project"; and that "[i]ncidental" to its primary purpose the bank will produce "local benefits." It defined the bank as a "SWP conservation facility" to be integrated with other SWP operations.

By contrast, the 1995 joint powers agreement for the KWBA reversed the priorities, ensuring that "the Authority will be operated and maintained "*for its benefit and the benefit of the Member Entities*."[57]

- **Failure to acknowledge statewide trust protection**

Although the MOU conferred upon the Agency a ten-year option to purchase the bank, it imposed conditions of that purchase that would have preserved DWR's trust responsibilities under the Water Code. Under the MOU, the Agency's purchase of the bank could only occur "[p]rovided that the *Department's right to use the area for project purposes* will be preserved. Consistent with section 11464 of the Water Code, the Department shall not sell facilities acquired for the Kern Water Bank."[58]

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[55] *PCL v. DWR*, 83 Cal. App. 4th at p. 907.

[56] DEIR, appx. E, p. 10.

[57] 1995 JPA for the KWBA, recitals at ¶ 5.

[58] The non-alienation provision in Water Code section 11464 provides that "no water right, reservoir, conduit, or facility for the generation, production, transmission, or distribution of electric power, acquired by the department shall ever be sold, granted, or conveyed by the department so that the department thereby is divested of the title to and ownership of it."

By contrast, neither article 52 of the Monterey Amendments, nor the conveyance agreements with the Kern agencies for the Kern Fan Element transfer, ever referenced or incorporated DWR's continuing authority, even in the context of local ownership, to use the bank as needed for SWP purposes. Instead, the transfer agreements took the form of unrestricted fee simple transfers, without any discussion of the state's underlying trust duties.

In its EIR, DWR must fully analyze the circumstances surrounding the removal of safeguards for the public and the state, and the environmental consequences of bank operation without these protections. It must also study alternatives that would not eliminate these protections, even in the context of local ownership and administration of the bank.

D. **The EIR must more fully describe DWR's experiences and purposes in attempting to develop the Kern Water Bank.**

The DEIR barely discusses DWR's original plans for the KWB and attempts to develop it. In a 1979 article, then-DWR director Ronald Robie described a variety of environmental advantages to DWR developing an underground storage facility for the SWP. He concluded that "an SWP ground water program will add flexibility to SWP operations and can be a hedge against earthquake or other disablement of the California Aqueduct."[59] Following the release of technical studies, DWR focused on the possibilities of developing SWP groundwater recharge operations in Kern County.

In 1986, DWR prepared an EIR for a state-run water bank, contemplating purchase of approximately 20,000 acres of land from Tenneco West, located on the Kern River's alluvial fan (the area that ultimately became the bank's site is sometimes referred to as the Kern Fan Element).[60] The present DEIR does not disclose that in its own environmental reviews, DWR recognized that operation of the bank might have an impact on the Bay-Delta.[61]

DWR made substantial investments in studies and other activities with the expectation of implementing the state-owned bank. Some estimates have placed the total amount DWR paid to develop the bank, including the initial purchase, over $70 million.[62] The EIR should disclose the full amount of that investment, including any investment in environmental study and mitigation.

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[59] *Id.* at 45.

[60] See also Kletzing, *Imported Groundwater Banking: The Kern Water Bank - A Case Study*, (1988). 19 PAC. L.J. 1225.

[61] DWR, First Stage Kern Fan Element Draft Supplemental Environmental Impact Report (1990). pp. 38-42.

[62] Public Citizen, p. 2.

E. **The EIR does not fully disclose the circumstances that caused DWR to relinquish control of the KWB.**

The EIR should more fully disclose the circumstances that caused DWR to stop developing the KWB. In this regard, several documents that PCL obtained from DWR, included as attachment H, are illuminating. During the early 1990s, KCWA, joined by other local water districts and the State Water Contractors organization, sought to have DWR cease all "planning, design and land acquisition" activities relating to the water bank, even requesting that it be "mothballed."[63] They also argued that since DWR would not be developing the bank, it should be transferred to local control. In response, DWR director David Kennedy ultimately endorsed divestment of the water bank to the Agency, which then became a key principle in the 1994 Monterey Agreement.[64]

Although DWR had earlier been trying to proceed with the state-run project, two factors--potential ESA impacts, and Kern non-cooperation—thwarted these efforts. The latter reflected both ESA impacts, which KCWA did not want to address, and partly KCWA's reluctance to allow DWR to protect statewide interests in the bank. DWR had reached a HCP addressing on-site impacts, and that HCP was satisfactory to everyone but the Kern interests. However, DWR staff reported that Kern "wanted to recharge and extract at their will and not pay for 'any stinking mitigation costs'. When DWR objected, Kern's Tom Clark responded, "if we think we must, we will buy it."[65]

F. **The EIR inadequately addresses the details of DWR's purchase agreement with Kern County Water Agency.**

The EIR identifies the agricultural contractors' retirement of 45,000 acre-feet of agricultural entitlement (almost all by KCWA) as the ostensible consideration (the price paid) for DWR's transfer of the Kern Water Bank. But it does not adequately analyze the circumstances surrounding that exchange:

- DWR estimated the bank's worth at just over $33 million. That figure was just two million more than the state had paid in 1988, despite the state's subsequent investment of approximately $40 million in the bank's development. The state apparently valued the element based upon its purchase piece of marginal agricultural land rather than its more important value—a capitalization of the land's highest and best use as a water bank.

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[63] Attachment H (February 18, 1993 draft letter from SWC to DWR).

[64] Attachment H (1992 SWC action report; February 18, 1993 draft letter from SWC to DWR; February 9, 1993 and April 19, 1993 letters from DWR to SWC).

[65] Attachment H (Memorandum of Jack Erickson, DWR to John Pacheco, dated February 13, 1996).

• KCWA's retired agricultural "entitlements" existed only as an accounting tool, and Kern had no realistic expectation of receiving actual wet water under those entitlements. Nevertheless, KCWA was obligated—pursuant to the contracts it signed—to pay the state for that entitlement amount. By retiring those entitlements, KCWA therefore relieved itself of a substantial liability while losing little, if any, chance at wet water. The retired debit would appear to have a substantially higher value than the retired entitlements.

• DWR and KWBA have yet to provide a full accounting of the sources of water going into the Kern Water Bank, an issue that DWR is called upon to address in the Monterey settlement agreement within the Monterey Plus EIR. It seems likely that the other inexpensive sources of water made available to the Kern agencies through the Monterey Amendments—including "interruptible" (formerly surplus) water, carryover storage water, and turnback pool water—might have more than replaced the purported "loss" of KCWA's 45,000 acre-feet of paper entitlements with less expensive sources.

• The state's divestment also included some of its water. DWR conveyed title to half the water stored in the bank, as well as all the water stored during 1995. As the KWBA recognized in its financial statement, "the participants [in the KWBA] received Kern Water Bank land and facilities and 42,380 acre-feet of banked water. The 42,830 acre-feet of water subsequently was transferred to each of the participants in proportion to their ownership. This transaction was reflected as a contribution of capital in the amount of $27,858,500 by the respective participants."[66]

G. The DEIR fails to analyze key environmental consequences of the Kern Water Bank's operation without statewide trust accountability.

The DEIR fails to study the major environmental consequences of the Kern Water Bank, other than some smaller issues that centrally focus on KWBA's administration of the Kern Fan Element lands. Notably, the analysis fails to answer important questions about foreseeable trends in water marketing and groundwater banking due to the project.[67] Instead, the DEIR abruptly concludes that impacts are less than significant because multiple factors increased groundwater banking, and because of a beneficial impact on groundwater levels.[68]

The EIR must carefully study the following issues:

• **Pressures on the Delta**

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[66] KWBA, *Financial Statements* (December 31, 2000 and 1999).

[67] Neither Chapter 8 on growth-inducing impacts, nor Chapter 9 addressing water supply reliability and "paper water," address the transfer and operation of the Kern Water Bank. The effects of available storage and related transfers must be included in those analyses even if the bank is addressed separately in Appendix E.

[68] DEIR, appx. E, p. 49.

The transfer of the Kern Fan Element resulted in a shift in use of the facility. The state had intended to use the facility as a drought mitigation bank. In local control, it has become a new resource to maximize deliveries of SWP water and an economic resource. Local agencies now benefit from aggressively developing the Kern Fan Element. Under the Monterey Amendments, all contractors can use the Kern Water Bank to store SWP water. Therefore, the bank transfer has a significant potential to increase demand for and export of Delta water. The DEIR does not adequately analyze the impact on SWP demand and Delta export resulting from the transfer and development of the Kern Fan Element.

DWR's records, although not yet disclosed in the EIR, suggest a possible close connection between the Kern Water Bank, Delta pumping, and Delta environmental issues. The bank's relationship to Delta pumping and environmental conditions came up repeatedly in DWR's correspondence with other agencies,[69]` as well as with the contractor constituencies represented in the Monterey negotiations.[70] In general, those records suggest DWR was well aware that operation of the Kern Bank could lead to increased Delta pumping, and that those increases could affect endangered species.

Additional research by PCL, previously brought to DWR's attention[71], also shows the Kern Bank's role in increased deliveries to southern contractors.[72] These documents highlight how filling the bank can impact the Delta. For example:

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[69] See, Attachment H, including: Letter from Wayne White, Department of Interior to David Kennedy, dated September 30, 1991 ("we are concerned about potential adverse effects of the project in the Sacramento-San Joaquin River Estuary (Delta) area in central California. The reason for this concern is that water storage capacity within the Kern Water Bank would be filled through additional water exports from the Delta averaging approximately 90,000 acre-feet per year"); *id.* (potential adverse effects on Delta smelt and winter-run Chinook salmon); Letter from John Turner, Department of Fish and Game, to Dan Masnada of CCWA, dated July 20, 1995 (development of storage facilities, along with other Monterey operational changes, "combine to create substantial potential for program effects in the Delta and upstream"); *id.* (full study of Kern Water Bank's "potential impacts on the Delta has never been completed").

[70] See Attachment H: MWD letter to Tom Clark dated May 29, 1992 (identifying relevance of Chinook impacts); Memorandum of Jack. A. Erickson, DWR, dated April 20, 1993 (acknowledging Delta issues associated with Kern Fan Element); DWR, Kern Fan Element Re-evaluation Study, February 1996 (acknowledging Kern-Delta link).

[71] See Appendix A.

[72] Several other provisions in the Monterey Amendments also facilitate increased pumping of KWB-bound water. These provisions include liberalized requirements for "interruptible" water, allowance of "carryover" water, and creation of a "turnback pool."

--A KCWA brochure reported that in 2001, the banking program had boosted local supplies by "almost 200,000 acre-feet" and urban Southern California supplies by 81,000 acre-feet.

--Numerous reports from the manager of KCWA member Lost Hills Water District document, among other things, Paramount Farming's use of water banking to obtain inexpensive sources of state water for future water transfers and sales.

--A Georgia State University paper on water sales from 1990-2001 recorded purchases from the Monterey Amendments turnback pool by KCWA, Dudley Ridge and other contractors at prices of $5.90 to $11.79 per acre.[73]

--The Urban Water Management Plan of the McAllister Ranch Irrigation District, a former agricultural area near Bakersfield that is turning to residential development with the assistance of the Kern Water Bank.

--KCWA's 1996 Water Supply report contradicts the assumption that Monterey provisions including the Kern Fan transfer have only had a minor effect on deliveries, reflecting an understanding that it expected the Kern water bank, along with Monterey managerial changes, to help increase its SWP yield.

- **Depleting the Environmental Water Account**

There appears to be significant evidence that effective possession of the Kern Water Bank enabled Paramount Farming subsidiary Westside Mutual and other interests within the KWBA to secure "surplus" water from the state, only to sell it back to the state's Environmental Water Account at a profit.[74] If DWR itself operated the bank, such privately-profitable sales would not have resulted in a transfer of money out of the state system; DWR could pump its own surplus water to the bank (rather than selling it at bargain-basement prices) and then at times of environmental need could pump that water, without paying marked-up prices for it, to users in lieu of Delta deliveries. By paying less for water, DWR thus could slow the depletion of EWA assets, which in turn would allow the EWA to take more protective actions. That change could become crucially important during a drought, for in times of scarcity the KWBA member agencies could charge far higher prices for their water, and the financial difference between a DWR-managed bank and a privately managed bank, and thus the difference in depletion of EWA funds, could be enormous.

- **Increasing the agribusiness footprint**

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[73] M. Czetwertynski, *The Sale and Lease of Water Rights in Western States: An Overview for the Period 1990-2001* (March 2002), pp. 16-17.

[74] The evidence is available at http://www.ewg.org/reports/CAWaterTakings/part4.php; http://www.watertransfers.water.ca.gov/water_trans/water_trans_index.cfm. Despite its prominent role in securing the divestment of the Kern Water Bank and benefiting from it, Paramount Farming—whose wholly owned subsidiary Westside Mutual Water Company owns more than 48 percent of the bank--is only cryptically referred to in the DEIR analysis of the Kern bank, and not by name. See DEIR, Appx. E, p. 17 (noting that Westside was formed by "a landowner").

The profit stream to Paramount Farming and other Roll International affiliates deserves further attention. The bank, which was intended to help balance out the state's water supply to cities, farms and fish, has instead allowed Paramount Farming to double its acreage of nuts and fruits since 1994."[75] If the Kern Bank has indeed allowed a private company to put substantial additional acreage to agricultural use, that change could have multiple environmental consequences, including local habitat loss, increased pollutant loading, and, perhaps more importantly, increasing and hardening overall south-of-Delta water demand, which in turn could increase Delta impacts in the next drought.

- **Constrained public uses**

Private operation of the bank outside DWR control would hamper the state's ability to manage water resources for a variety of public purposes, including drought storage for emergency preparedness, urban uses, environmental protection, river restoration, and water quality.[76] The specialty crops and urban uses supported by the bank, due to their inflexibility in times of drought, may increase pressure for water exports from the overburdened Bay Delta during times of critical shortage.

- **Supporting growth and development**

In KCWA's March 1995 newsletter, its general manager describes "our local groundwater basin" as "a multi-billion dollar resource."[77] The Public Citizen report alleged that the privately controlled water bank serves as "switchyard" for transactions between agribusiness and real estate interests in Southern California.[78] The DEIR must investigate these allegations, as well as suggestions that the bank may promote sprawl development.[79]

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[75] Arax, *supra*.

[76] "Water banking could be used as drought protection to statewide benefit and to help improve water quality in the heavily depleted San Joaquin Valley groundwater basin. Operating banks for water marketing will have the opposite effect, fueling increased dependence upon distant water supplies for new growth…." Public Citizen, *Water for People and Place* (Nov. 2005), p. 28.

[77] KCWA General *Manager* Jim Beck, quoted in *Water Age*, March 2005, p. 3.

[78] Public Citizen report, p. 2.

[79] See, e.g., V. Pollard, *Los Angeles Eyeing Kern Water Source*, Bakersfield Californian, March 24, 2002 (online) ("DWP officials have had early talks with representatives of Paramount Farming Co. and other participants in the about possible purchase of an as-yet-unspecified amount of water…The chairman of the Kern Water Bank Authority Board, Bill Phillimore, said sales from the water bank were contemplated from the time the bank was acquired by Kern County water agencies…."). The Public Citizen report asserts that Roll International affiliate WV Acquisitions has contracted with Lennar / LNR subsidiary Newhall Land and farming for

H. The DEIR fails to analyze alternatives that would restore state trust accountability to the Kern Water Bank's operation.

In light of the history and risks described above, it is essential that DWR develop and analyze a meaningful project alternative that would restore some measure of statewide accountability over the manner in which the KWB is operated. That alternative may even be compelled by the need to comply with Water Code section 11464 and other applicable laws.

Throughout its participation in this EIR review, PCL proposed two alternatives that would have addressed the Kern issues. The first was a "Kern Fan retention" alternative, which assumes state ownership and operation to enhance dry-year reliability. The second was a "Kern Fan Transfer with trust conditions" alternative that would allow the Kern Water Bank to remain in local control, subject to operational and financial criteria designed to maximize environmental benefits. It would require the bank to store environmental water in time of surplus and make it available at no cost to the state in time of drought, in exchange for allowing the asset to operate the rest of the time for local purposes. In sum, a variety of operating and financial arrangements must be explored to maximize the bank's contributions to the State's environment. CEQA requires a full analysis of these feasible alternatives, as part of the DEIR prepared on the proposed action.

Unfortunately, the DEIR summarily rejected the "Kern transfer with trust conditions" alternative with a cursory, untenable explanation. DEIR,§ 11.2.6, p. 11-16. The DEIR asserts that this alternative would fail to "meet the objectives" of the Monterey Amendment, but does not explain why. On the contrary, allowing local control of the bank to continue subject to the imposition of a state trust—which closely resembles the approach to local control of the bank already set forth in the 1987 DWR/ KCWA MOU—would be a balanced way to "[r]esolve legal and institutional issues related to storage of SWP water" in the county that would harmonize local and statewide interests.[80] In light of Water Code section 11464 and legal constraints

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sales of water entitlement. See http://www.hoovers.com/the-newhall-land-and-farming-company/--ID__11074--/free-co-factsheet.xhtml (describing Newhall as the "landing strip fot urban flight"). PCL has no independent knowledge of these accounts, but believes they deserve analysis.

[80] DEIR, p. 4-1 (listing project objectives). The "local control subject to DWR trust" approach does not appear incompatible with any of the other fundamental project objectives either. Moreover, the prospect that stakeholders might challenge the approach would provide no reason to summarily reject it as a project alternative. *PCL v. DWR*, 83 Cal. App. 4^{th} at p. 915. Nor would the need for local agreement and funding be grounds to summarily dismiss this alternative from consideration (cf. DEIR, p. 11-6), particularly if DWR finds that it is the only lawful manner to proceed with local ownership of the bank.

related to conditions in the Delta, this alternative may well constitute the only lawful manner in which DWR can make a final decision that allows the bank to remain in local ownership.[81]

I. The EIR must answer additional questions about the Kern Water Bank's transfer, development and operation.

PCL requests that the EIR answer the following additional questions, each of which relates to potentially significant environmental impacts, as outlined in this comment letter, and each of which CEQA requires be addressed:

1. Does the KWBA actually acquire and sell water, or does it merely provide a facility that allows its member agencies to store and recover water that they acquire and sell?[82]

2. If the KWBA does actually acquire and sell water, how much water does it acquire and sell on a yearly basis?

3. How much water have each of the KWBA members, including Westside, bought and sold during each year of the Kern Bank's operations, using the Kern Bank in connection with such purchases and sales?

4. To whom has water stored in the Kern Bank been sold?

5. At what price has Kern Bank water been sold? Does that represent a markup beyond costs?

6. How much has the KWBA charged for storage in the Kern Bank ?

7. Has DWR purchased Kern Bank water? For what purpose and place of use? How much has come from the KWBA, and how much from particular agencies? At what price?

8. What are the sources of water that go to the Kern Bank? Each year, how much has come from: (a) SWP Table A allocations; (b) SWP Article 21 water; (c) CVP water; (d) surface runoff; (e) Kern River water?

9. Is there any evidence that DWR delivered water to the Kern Bank knowing it would later need to repurchase that water? Or is there evidence that DWR

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[81] The DEIR's premise that alternatives cannot be used here simply to improve "the health of the environment" (DEIR, 11-6) could not be more at odds with the elementary requirements of CEQA, which may be used to *mandate* feasible alternatives or mitigation measures. Pub. Res. Code, § 21002.

[82] Under the joint powers agreement, the KWBA is empowered to acquire and sell water, but it is less clear where it would get such water, or how it would access recharge or withdrawal facilities; the JPA appears to assign shares of facility use exclusively to the member agencies.

delivered water to the Kern Bank while simultaneously repurchasing earlier-delivered supplies?

10. Does the KWBA pay taxes on the land it owns?

11. Does the KWBA pay taxes on profits from water sales (if sales are above-cost)?

12. Does Westside profit from water sales, and if so does it pay taxes on those profits?

13. Have the KWBA member agencies obtained SWRCB approval for changing (either temporarily or long-term) the place or purpose of use of water stored in the Kern Bank and transferred to different users?

14. What are the KWBA member agencies doing with the profits from their sales, and what are the environmental consequences?

VI. The DEIR's assessment of alternatives is defective.

A. The DEIR presents multiple muddled versions of the No Project Alternative, blurring the distinction between "no project" and project alternatives.

CEQA defines the purpose of a No Project Alternative as, "to allow decision makers to compare the impacts of approving the proposed project with the impacts of not approving the proposed project" (CEQA Guidelines, § 15125).[83] Making up in quantity for what they lack in accuracy, the DEIR identifies multiple iterations of the No Project Alternative. As demonstrated here, each of these attempts is incoherent, and in some instances, they muddle the distinction between the No Project Alternative and project alternatives.

A brief synopsis of these attempts highlights their flaws:

- The No Project Alternative 1 (NPA1) assumes at the state would have developed the Kern Fan Element to a capacity of 350,000 acre-feet by 2003 and to 500,000 acre feet by 2020. The capacities used appear to be entirely arbitrary, and may well serve simply to narrow the distance between the no-project and the project without factual foundation. Moreover, the EIR appears to be internally inconsistent as the subject of how much state bank development was foreseeable.[84]

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[83] PCL has already explained above why the no project assessment has not met the requirements of *PCL v. DWR*. This section describes, in addition, how the DEIR develops no project alternatives that are muddled with project alternatives.

[84] Inclusion in the No Project Alternative suggests a belief that state development could be "reasonably expected to occur in the foreseeable future," CEQA Guidelines, § 15126.6(c)(2); but

• The No Project Alternative 2 (NPA2) includes a number of the Table A transfers facilitated under the Monterey Agreements, conveyance of non-project water, and storage of contractor water outside of the contractors' service area-all key components and other provisions of the proposed project that were implemented as of 2003. The DEIR argues that these projects and policies would have been approved by the Department regardless of the Monterey project. However, that argument is entirely speculative, and in no way excuses the CEQA-mandated no project analysis. Each of these components was initiated as a direct result of the Monterey Amendments. As such, they are components of the very action under review and cannot be included in a no project alternative.[85]

• Court-Ordered No Project Alternative 3 (CNPA3) and Court-Ordered No Project Alternative 4 both contain significant flaws. As discussed above, neither of these alternatives provided the rigorous review anticipated by the court in *PCL v. DWR* and by plaintiffs in the settlement agreement.

• CNPA3 is also based on water allocation methods that were not in place at prior to the Monterey agreement. CPNA3 does not reflect the agricultural and groundwater replenishment priority for article 21 that was a specific requirement of the pre-Monterey contracts. Without the Monterey Amendment, this contract provision would remain in place. Therefore the only appropriate no project alternative is one which includes all pre-Monterey contract provisions, including the "agriculture first" and groundwater replenishment provisions of Article 21.

• The no project alternative must reflect the actual 'no project' condition. Rather than speculate that DWR might alter contract provisions, approve water transfers and overcome significant challenges to aggressively develop the Kern Fan Element, the no project alternative should assume that DWR would have implemented the pre-Monterey SWP contracts as written, including enforcement of all limitations and conditions.

B. The DEIR summarily rejected feasible alternatives to the project.

The DEIR must examine a range of reasonable alternatives that would feasibly obtain most of the project objectives, but avoid or substantially lessen any significant adverse effects of the project. (14 Cal. Code Regs. §15126.6.) In its screening and review of alternatives, the EIR must provide more than "cursory" analysis. (*PCL v. DWR*, 83 Cal. App. 4th at 919.) It should not construe project objectives so tautologically that only the proposed project could conceivably be capable of achieving them. Nor should the EIR allow the mere "threat of litigation" under a proposed alternative to prevent its environmental review. *Id.* at 914.

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in DWR's Kern study, it asserts that uncertainties made state bank development "infeasible." DEIR, Appendix E, p. 10

[85] Rather than include these components in the NPA2, subsequent drafts of the EIR must include this analysis of a limited set of policies (as opposed to the entire suite of Monterey Amendments) in the alternatives section of the EIR.

DEIR summarily eliminated *nine alternatives* that were suggested by PCL and the two other plaintiffs within the EIR committee process, each without any satisfactory explanation.[86] These alternatives were offered in order to provide a reasonable range of alternatives within the EIR analysis consistent with the requirements of CEQA. But the DEIR provides unjustified conclusions for each alternative that derailed any further review of them. Although increasing exports south of the Delta is notably (and properly) absent from the list of project objectives (DEIR, p. 4-1), the DEIR's alternatives analysis implicitly appears to assume that unless the contractors' pumping objectives are met, an alternative is infeasible.

The DEIR also gratuitously, and incoherently, chides "the plaintiffs" for seeking in proposed alternatives to improve the *environment.* (DEIR, pp. 11-5 to 11-7.) That reasoning would have been faulty if DWR's EIR had been done in 1995, but it particularly suspect in 2008, in light of the pelagic organism decline in the Delta and recent court rulings, discussed above, that will require constraints on pumping south of the Delta. Moreover, the summary exclusion of alternatives that attempt to balance contractors' and environmental objectives is entirely inconsistent with efforts the state is engaged in elsewhere, including Delta Vision and updates to the California Water Plan. Indeed, the state has long been aware of a variety of approaches that would serve the SWP's financial, management and operational goals while *also* considering environmental protection.[87] This context underscores the practicality of PCL's proposed alternatives.

A review of the grounds for dismissing the **"Improved Reliability through Environmental Enhancement" (IREE)**[88] alternative illustrates how the DEIR avoided analyzing a reasonable range of alternatives. Similar grounds were also used to reject other alternatives. The EIR's reasoning suggests that DWR views the project objectives so tautologically that seemingly only the Monterey Amendments (or a negligible variation on them) could feasibly accomplish them:

- The DEIR claims that the IREE "alternative was not considered in detail in the EIR because it would not meet any of the objectives of the Monterey Amendments. Furthermore, it would be in conflict with the basic terms of the long-term water supply contracts." DEIR, p. 11-6. But in summarily dismissing this alternative, the DEIR provides no substantiating evidence or analysis to demonstrate that the alternative would not meet any of the project objectives.

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[86] These alternatives, listed in PCL's December 18, 2006 comments on the last administrative draft EIR (Attachment A) pp. 12-15, are incorporated by reference. PCL proposes again that they be considered for full-fledged review rather than summary rejection.

[87] CRB report, attachment B to these comments.

[88] This alternative "would involve the Department reducing stress on fishery resources in the Delta by directly implementing water use efficiency measures, water recycling, storm water capture, and other local water system enhancements that stabilize water demand and improve SWP reliability." DEIR, p. 11-5.

• The assertion that IREE would not meet any of the project objectives is false. A key objective of the project provided in the DEIR is to increase the flexibility of the SWP. DEIR, p. 4-1. DWR specifically identifies environmental regulations as a primary limitation, in addition to hydrologic conditions, to delivery of water through the SWP. [Cite] [89] It is reasonable to expect that enhancements in the environment of the Delta would reduce the need for regulatory agencies to set new regulations or mandate actions to enforce existing regulations. Reduced regulatory actions would result in increased flexibility of the SWP. The DEIR does not provide any analysis which would indicate that such an assumption is unfounded or inaccurate.

• The DEIR's further claim that the IREE alternative is in conflict with the basic terms of the water supply contracts is also without merit. The proposed project is a set of contract amendments. It follows that alternatives to the proposed project would appropriately incorporate contract amendments. In fact, many of the provisions of the proposed project are in direct conflict with the basic terms of the pre-Monterey long-term water supply contracts.[90]

• The DEIR's rejection of IREE rests heavily on the notion that DWR already operates in compliance with Delta water quality and flow objectives "as constrained by the need to protect threatened and endangered fish species listed pursuant to federal and state Endangered Species Acts." DEIR, p. 11-6. As discussed above, the pelagic species crash and the *Kempthorne* decisions on the Delta Smelt shatter the foundations of this assertion, which must now be revisited. There is now a compelling legal, as well as environmental, reason not to summarily reject an alternative that could feasibly accomplish most of the project objectives, while also reducing injury to the Delta.

• The DEIR also rejects IREE on the preposterous theory that "the Monterey Amendment is not an appropriate tool for mandating that |SWP water be used to benefit the Delta environment. DEIR, p. 11-6. That is a remarkable assertion, considering that, as discussed elsewhere, the proposed project could result in increased pumping and thereby injure the Delta.

• Finally, the DEIR rejects IREE, as well as some other alternatives, based upon the legally erroneous theory that it would require action by local agencies; according to DWR, such agencies would have to propose water efficiency measures, which DWR recognizes it could

[89] In fact, environmental problems in the Delta were contributing factors which led to the reductions in SWP deliveries in the early 1990's, and the contractor disputes that precipitated the Monterey Amendments. *PCL v. DWR*, 83 Cal. App. 4th at p. 908.

[90] For instance, eliminating the "agriculture first" reduction in article 18(a) of the contract, as is proposed in the proposed project, is in direct conflict with the pre-Monterey contracts. If such conditions were applied to all alternatives, then the proposed project would also have to be eliminated. Alternatives should not be held to a standard that is not imposed on the proposed project.

fund. DEIR, 11-5,11- 6. That misstates CEQA, which does not foreclose an alternatives assessment simply because other agency action may be required.[91]

C. The DEIR fails to analyze a reasonable range of alternatives to the project.

While unreasonably rejecting all of the alternatives proposed by plaintiffs, the DEIR remarkably provides *only one* project alternative to the DEIR. Alternative 5 "would be the same as the proposed project except that the Monterey water management practices would not be implemented." DEIR, p. 11-3. The DEIR's very limited range of alternatives is misleading and incomplete. In order to provide for reasonable comparison, alternatives to the proposed project must be distinguishable from the proposed project. However, alternative 5 (and NPA2) inappropriately includes significant portions of the proposed project. As a result the DEIR inappropriately concludes that all available courses of action have roughly similar impacts and outcomes.

The DEIR rationalizes this approach by suggesting that many of the actions taken under Monterey could have occurred under the original contracts. Prior to Monterey, however, these policies were not widely adopted by the SWP and they were not commonly practiced under the previous contract. Had DWR decided to implement these actions under a different hypothetical approach, DWR would still have had to complete CEQA review prior to taking those actions. Therefore, it is not appropriate to include these actions in Alternative 5 or NPA2. Since DWR has proposed to take these actions as part of the Monterey Amendments, these actions must be properly treated as potential decisions rather than assumed components of the no project alternative.

In sum, the EIR should include alternatives that are clearly distinguishable from the "no project" and proposed project. These alternatives should not include polices or actions that are being proposed for implementation as part of the proposed project.

VII. The DEIR contains faulty and legally unsupportable assessments of project impacts.

A. The DEIR uses inconsistent time periods for its analyses.

In the historical analysis provided in Chapter 6 the DEIR uses different time periods for analyses in various sections of the EIR. For instance, carryover in Dan Luis is analyzed from 1996 through 2004, while the flexible starage provisions are analyzed from 1996 through 2003 (see DEIR at 6-57 through 6-58).These variations make it impossible to determine the full impact of any of the proposed project and alternatives included in the DEIR. No explanation is provided as to why certain sections are analyzed under differing time periods. Subsequent draft EIR analyses must use a consistent time period throughout the EIR.

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[91] See, e.g., *Friends of the Eel River v. Sonoma County Water Agency* (2003) 108 Cal. App. 4th 859. 864-867. Similar grounds are improperly used to summarily reject other of PCL's proposed alternatives, such as the "urban preference and dry year reliability" and "no urban preference and dry year reliability" alternatives. DEIR, pp. 11-4, 11-5.

B. The DEIR inadequately analyzes impacts resulting from eliminating and changing contract provisions.

- **Altered Article 21 rules for "surplus"**

As extensively discussed in connection with the baseline, the DEIR failed to analyze the impact of eliminating article 21(g)(1), the prohibition on using "surplus water" (or post-Monterey, "interruptible" water) to build permanent local economies. The EIR must fully analyze how eliminating this provision and simultaneous transfer of the Kern Water Bank and allowance of water storage outside of the SWP service area has altered or will alter SWP contractor demand and ability to receive article 21 water.

The EIR must analyze the degree to which eliminating use provisions for article 21 and providing urban users with increased access to article 21 water resulted in new uses of that water, including serving new growth-fostering water transfers. Analyses should also identify the degree to which altered article 21 previsions have shifted scheduling and delivery of Table A water and whether such shifts have resulted in changes to SWP operations (including changes in the timing or amount of water released from Lake Oroville and San Luis Reservoir).

The proposed project would eliminate pre-Monterey allocation rules for article 21. The priority for agricultural use and groundwater replenishment would be removed, and a new allocation method allowing access to article 21 based on Table A amount percentages would be adopted. Eliminating pre-Monterey contract allocations allows more contractors, including municipal contractors that had not historically received significant deliveries of article 21, to access this water and put it to use for purposes that are much different than per-Monterey uses of Article 21.

The DEIR fails to disclose the implications of this potential change in allocation. In particular, the DEIR fails to clearly account for the impact resulting from allocating Article 21 to municipal contractors that may use the water for hardened demand and development. Subsequent versions of the EIR must include analysis and clear disclosure of the implications of altering Article 21 allocations.

- **Turnback Pool**

With the Monterey Amendments in place, all SWP contractors have an incentive to request their full contract amounts. In addition, the Turnback Pool provisions of the Monterey Amendments provide a new incentive for SWP contractors to maximize their annual demand for their full contract amounts. The DEIR recognizes that pre-Monterey some contractors could not use their full Table A amounts, and in some cases that resulted in reduced water deliveries through the SWP. That water which was not captured or delivered by the SWP would have thus been left instream for environmental benefit.

However, the Turnback Pools allow the contractors to benefit financially by requesting their full Table A amounts, even if that contractor does not require such water within its own service area. Other contractors who can make use of the water are encouraged under the

Monterey Amendments to purchase Turnback Pool water. It follows that under the proposed project, all contractors would request full contract allocations, regardless of need for that water. As PCL has long since noted, that tendency is likely to harden, and increase, the demand for Delta pumping.[92]

- **Storage Outside of Service Area**

In allowing SWP contractors to store SWP water outside of their service area, the proposed project significantly expands SWP contractors' ability to accept water, and increases the demand for water from the Delta. The DEIR obscures this fact by assuming that much of the water stored outside contractors' service areas under the provisional implementation of the Monterey Amendments *could* have been stored within the contractors' service area. This assumption is very speculative. It assumes that infrastructure including transport facilities was available; cost of delivery, water quality, access to the right to store water, and other factors impacting the availability of storage capacity within the service area would not have prevented storage of that water within the service area. None of these factors were analyzed when the lead agency determined that water delivered out of the service areas could have been received within the service areas. Rather, the DEIR explains that the assumption is based on, "a telephone survey of contractors conducted by DWR." [93]

The DEIR further seeks to reduce the perceived impact of water delivered to out of service area storage by assuming that such water would have instead been stored in San Luis Reservoir and delivered to other contractors via article 21 or increased Table A. Again, this assumption is purely speculative. It assumes that other contractors could have received the water and placed it within service area storage. These assumptions clearly seek to minimize the appearance of impacts. Indeed, through this methodology, the DEIR determines that of the 1,092,647 acre-feet of water delivered to out of service area storage between 1996 and 2003, only 44,000 acre feet are actually attributable to the proposed project. This is due to the multiple assumptions inappropriately incorporated into the baseline. However, as explained above, these assumptions do not belong in the baseline, and must be removed from the EIR.

- **Altered allocation under Articles 18 (a) and 21**

The DEIR fails to disclose the impacts of altered allocations under article 18(a). Specifically, the DEIR fails to how altered allocations that expose municipal contractors to reduced reliability could tend to encourage municipal contractors to increase demand for water in normal and wet years in order to restore dry year and shortage reliability.

The pre-Monterey article 18(a) provision requiring an agriculture-first reduction in the event of water shortages provided municipal contractors with a higher degree of drought reliability. Under the proposed project's alteration of article 18(a) this protection is eliminated. The proposed project thus exposes municipal contractors to reduced water reliability during

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[92] See Attachment A (PCL comments on Draft Chapter 9, p. 6.)

[93] DEIR, p. 6-60 (No details of that survey are presented).

periods of shortage. Moreover, because the Monterey Amendments would, if finalized, permanently delete article 18(a)'s agriculture-first cutbacks, they would remove a major obstacle to agriculture-to-urban transfers that facilitate growth.[94]

It is reasonable and foreseeable to expect that municipal contractors will seek to mitigate the impact on their water reliability. In fact, the proposed project provides water management tools that would assist contractors in such an effort. The proposed project allows these contractors to greatly expand storage options, it provides these contractors with greater access to article 21 water and eliminates restrictions on use of that water, and it establishes the Turnback Pool giving these contractors greater access to water that would not be used by other contractors.

It is reasonable to assume that given the changes proposed, municipal contractors would have a greater incentive to maximize use of the tools provided in the proposed contract (maximizing Table A requests, utilizing article 21, Turnback Pool and carryover provisions to maximize water in newly available storage) in order restore their dry year and shortage reliability.

It is important to note that both Turnback Pool and article 21 water are usually available in the winter and the spring. SWP exports during these periods have been identified as a primary contributor to the Pelagic Organism Decline in the Delta Any action that would tend to encourage increased demand and increased export for these categories of water would therefore have a significant impact on the Delta.

The EIR must explicitly disclose the impact of eliminating the protections for municipal contractors under Article 18 (a), and the resulting impacts on the Delta. As elaborated below, the DEIR omits analysis of impacts or provides inadequate analysis of significant impacts associated with the proposed project.

- **Environmental consequences of financial restructuring under Article 51**

The DEIR briefly describes, but never analyzes the environmental consequences of article 51, one of the most important structural revisions in the SWP system that would be initiated by the Monterey Amendments, should they be adopted. DEIR, p. 4-8. Among other revisions, article 51 changes the way that DWR addresses revenues exceeding the cost of operating the SWP system.[95] As Environmental Defense documented years ago in legislative

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[94] The record of such transfers during the interim enforcement of the Monterey Amendments deserves careful study. There is no evidence to support the speculative assertion that these Table A transfers would have occurred anyway in the absence of the Monterey Amendments. Rather, as the EIR correctly points out (DEIR 6-10), only one occurred previously (Devil's Den), and it was expressly subject to agriculture-first cutbacks even after transfer to urban use.

[95] In *PCL v. DWR*, the court of appeal recognized the interrelationship between revised articles 18 and 51 in the Monterey Amendments. The court "agree[d] with plaintiffs that inclusion of article 51 in the amended contracts implies that DWR and the contractors have forsaken their expectation that the SWP facilities will be built as planned and will deliver 4.23 MAF of water annually. Article 51 allows contractors a rebate for the costs previously assessed for facilities

testimony on the Monterey Amendments, appended as attachment I, the revenue stream returned to the contractors under article 51 is enormous over the life of the project contracts.

The new EIR must carefully analyze the environmental consequences of article 51 as an integral part of the Monterey Amendments, rather than summarily assuming that because this provision is "economic" in nature it would not contribute to such impacts. Although CEQA does not require analysis of purely economic or social changes, it requires analysis of environmental impacts that can be traced to such changes. (See, e.g., 14 Cal. Code Regs, § 15131; *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656, 695-98.) Here, the EIR must analyze the relationship between articles 18 and 51, and must compare the project to the no-project scenario in which table A amounts are reduced *without* article 51 rebates. The EIR must also evaluate the environmental consequences of article 51's effect on water rates, and consider the financial adjustments made in article 51 when making its assessment of project alternatives and mitigation.

- **Reduction of state oversight of water transfers under Article 53**

Prior to the Monterey Amendments, DWR had contractual responsibility to oversee and approve transfers of water through the SWP. Under the proposed project, DWR largely excuses itself from this responsibility for certain transfers. Contractors are now permitted to transfer project and no project water at their convenience. DWR has essentially given up effective ability to control where and how water is used within the SWP.

This provision is particularly important for its implications on growth in California. As stated above, the pre-Monterey contracts recognized the difference between municipal reliability and agricultural reliability. Agricultural Table A amounts were explicitly conditioned by their reliability. Thus, it would be inappropriate to use agricultural water transfers for certain purposes, including development. However, provisions of the proposed project including elimination of article 18(b) and changes in 18(a) now imply that all water in the SWP has equal reliability. This new dynamic risks creating, rather than eliminating, a paper water problem. Under the proposed project, DWR would abandon its role in clearly articulating the difference in reliability of water and hand that responsibility to local agencies.

The proposed project implies that all water under the SWP has equal reliability, yet very little water has been removed from the total Table A amount. Given that the original contracts explicitly stated that Table A amounts for agriculture were not as reliable as municipal contracts, it is illogical to assume that suddenly, the SWP can reliably deliver water to all contractors. Yet under the proposed project, agricultural to municipal transfers will be more common and there will be no requirement to address the issue of reliability. This scenario risks inducing growth based on unrealistic assumptions of water reliability.

- **The DEIR fails to disclose impacts to the Bay Delta Estuary.**

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that have never been built. Indeed, fiscal and environmental pressures militate against completion of the project." (83 Cal.App.4th at p. 914, n. 7.)

As discussed above, the Bay Delta Estuary is in critical decline. Fisheries populations have declined dramatically since 2000. Several fish species, including the Delta Smelt, are now at historic low population indices. State and Federal scientist have determined that increased Delta exports, and in particular, exports occurring in the winter and spring are a significant contributor to these declines.

Yet many of the provisions of the proposed project would *increase* the amount of water exported by the SWP during times of “excess” in the Delta. Excess conditions usually occur in the winter and spring, the very time that delta smelt have become vulnerable to project operations. For instance, the DEIR admits that the Turnback Pool and Article 21 are both provisions that seek to capture water earlier in the year. Yet the DEIR fails to incorporate that timing factor into the analysis of impacts in the DEIR.

C. The DEIR fails to adequately growth-inducing impacts, and impermissibly defers the responsibility to analyze them.

The DEIR attempts to absolve DWR of fully analyzing and mitigating the growth inducing impacts of the proposed project. That evasion has profound environmental consequences, due to the stakes involved: as the DEIR concedes, the combination of new table A and article 21 deliveries in the project could support new populations ranging from 405,103 in the “more resource-intensive” scenario, and 561,684 in a “less resource-intensive” scenario. DEIR, p. 8-9. Yet the DEIR asserts in that DWR is *not* required to extensively analyze the growth inducing impacts of water delivered by DWR because DWR is not responsible for land-use decision. *Id.* at pp. 8-13, 14. The DEIR further holds that DWR is not responsible for differentiating between the impacts of water deliveries that stimulate new growth and the impacts of water deliveries used to enhance dry year reliability. *Id.,* p. 13.

This indifference to a major environmental consequence of the project, if finalized, would constitute a major evasion of CEQA responsibility. CEQA requires a lead agency, such as DWR, to analyze the full environmental consequences of its decisions. That responsibility creates a duty to analyze the consequences of removing an obstacle to growth, or accommodating growth. In this context, the DEIR’s principal strategy—to defer the real analysis to post-decision *local* determination, is completely untenable.[96] None of these local decision-makers will have the opportunity to analyze the cumulative consequences of accommodating half a million Californians before the suite of growth-inducing changes in the Monterey Amendments become a *fait accompli*. Moreover, particularly given the decade-plus history with interim enforcement of the Monterey Amendments, there is no basis to support the EIR’s premise that the consequences are speculative. Remarkably, the EIR does not even attempt to address the growth-inducing or growth-accommodating impacts of known projects that have relied, in whole or in part, on the Monterey Amendments.[97] The EIR must disclose the impacts associated with

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[96] See DEIR, p. 8-14.

[97] The EIR should start by analyzing the documentary history of such projects as Dougherty Valley in Contra Costa County, as well as numerous projects in Los Angeles County: among

the decision to remove the state oversight of SWP water that was embodied in the original pre-Monterey contracts.[98]

While the DEIR argues that DWR does not have responsibility for how water is put to use, it is indisputable that DWR has specific and fundamental responsibilities for overseeing the use of SWP water. Under the Monterey Amendments, DWR has given local agencies increased flexibility, and therefore increased ability to use the water in a way that would potentially impact the environment. While DWR cannot be expected to predict with absolute certainty how contractors and land-use agencies will use the water in the future, DWR has a responsibility to disclose all *potential* significant impacts resulting from this decision and the proposed project. DWR simply cannot be excused from disclosing the impacts of eliminating previously held responsibilities.

The EIR must include adequate analysis of growth inducing impacts, including analysis of how, where and for what purpose water made available under the Monterey Amendments has been put to use, and will likely be used should DWR adopt the proposed project. This analysis must disclose the growth inducing implications of eliminating article 18(b) and article 21(g)(1) of the original contracts, facilitating transfers between agricultural and urban contractors, conveying non-project water, providing municipal contractors increased access to Article 21, permitting unlimited storage outside of the service area, and implementing the Turnback Pool. In addition, the EIR must fully disclose how these provisions may tend to increase the demand for such water and the resulting impacts on the Delta and upstream operations of delivery of such water.

The EIR must specifically state the percentage of water which contractors now have access to under the Monterey Amendments that is likely to be stored for dry year reliability and the percentage which will be used for new growth. Also, the EIR must disclose the degree to which water made available under the Monterey Amendments will be used for resource-intensive growth and urban sprawl. Impacts analysis should include a study of the impacts of the growth likely to be induced by the proposed project water deliveries (i.e. resource intensive sprawl or infill development). For instance, water made available to Castaic Lake Water Agency is likely to result in development of open space and agricultural lands (and require new annexations), whereas water made available to Los Angeles Department of Water and Power is likely to result in development in already developed areas.

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them, West Creek, Gate-King, Riverpark, Northlake, Mission Village, Soledad, River Valley, and Newhall Ranch.

[98] Prior to the Monterey amendment, DWR had explicit oversight of storage of SWP water, water transfers through the SWP, Table A transfers, use of article 21 water, and allocation of water in times of shortage. article 18(b) also required DWR to provide explicit information on the reliability of SWP water through determining the minimum yield of the Delta. Furthermore, under article 18(b), DWR has the authority to reconcile Table A amounts with that minimum yield. Such authority provided the State will direct discretion over the amount of water that could be determined to be reliable.

In addition, as discussed extensively in section V above, the EIR must analyze how the transfer of the Kern Water Bank to local control has facilitated growth-inducing uses of the facility, as compared to operations that would prioritize dry year reliability.

D. The DEIR's assessment of the reliability of water supplies and growth evades, rather than analyzes, the problem of "paper water."

Regrettably, the DEIR's chapter on the reliability of water supplies (Chapter 9) and growth virtually ignores everything that PCL submitted to DWR on the subject during years of EIR planning that preceded the public draft. PCL therefore references its previous submissions on this issue[99] and once again requests specific responses. In a case of "fighting the hypothetical," the DEIR does not seriously engage the "common sense" connection between water availability and growth identified in *PCL v. DWR*, and instead, undertakes to dispute the premise. Essentially, DWR argues that growth based upon paper water never existed, that its extent has been exaggerated, and that new measures (biennial reliability reports, Urban Water Management Plans, and SB 221/ 610) will prevent it from happening in the future. DEIR, pp. 9-2 to 9-11.

This analysis is fatally flawed. First, it asks the wrong question about the historical role of paper water, focusing on whether inflated water reliability estimates have subjectively motivated land-use decision-makers to approve projects. The DEIR answers the question in the negative, not because paper water isn't real, but because ignoring water reliability has been so pervasive that Table A amounts can't be considered uniquely responsible. DEIR, p, 9-10. But a "but for" causation test is not what CEQA requires. What matters is the following:

- Historically and recently, land use decision-makers in California have frequently approved projects with little regard for the availability of adequate water supplies to support the development. Many of these projects have involved State Water Project water resources.[100] Moreover, a consistent body of CEQA case law, from *Kings County* through *Vineyard*, underscores the depth of the problem of decision-makers ignoring the reliability of water supplies,

- The pre-Monterey Amendments SWP contracts had mechanisms that could have been used to take "paper water" out of the calculus regardless of decision-makers' subjective motivations where SWP water was involved: enforcement of article 18(b)'s permanent shortage provision, and article 21(g)(1)'s proscription on using "surplus" water to build permanent economies.

- If the Monterey Amendments become permanent, these safeguards will disappear from the SWP contracts, regardless of what local decision-makers may later do in review of specific projects.

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[99] See Attachment A, particularly the comments addressing the chapter on paper water and growth.

[100] See Attachment J (Kanouse/ EBMUD study).

The problem of "paper water"—stated in its simplest terms, of development decisions grounded in expectations of water supplies exceeding what can actually be delivered—emerged as one of the central themes in the Third District's ruling, and is perhaps the issue with which *PCL v. DWR* is most closely associated in both case law and in public discussion. [101] Rather than providing the thorough and candid assessment of "paper water" and development anticipated in the appellate ruling, the DEIR provides little more than a cursory historical summary, a description of planning laws and practices, and a superficial discussion of Urban Water Management Plans. Indeed, the analysis presented here bears more resemblance to arguments about "paper water" unsuccessfully presented to the court of appeal than the probing and comprehensive assessment anticipated in the appellate ruling and settlement.

A puzzling duality pervades the DEIR's discussion. The historical overview is dismissive of the notion that inflated expectations of SWP deliveries affected development decisions. But rather than debunking the notion that such inflated expectations were present in projects relying on SWP water, the chapter argues, if anything, that they were all too real; that decision-makers so pervasively failed to consider potential constraints on SWP water deliveries that they would have paid little attention to the amounts of "entitlement" referenced in the project contracts.

The core of this analysis posits that planners assume that *local water agencies* will obtain the supply necessary to meet the long-term water demand that results from planned growth. But far from "disproving" reliance on SWP paper water, this analysis points to planners and decision-makers trusting the water agencies; in other words, they are presumed to have relied upon the same pervasive "water culture" in which the court grounded its historical analysis of the "huge gap" between entitlements and available supplies. Instead of analyzing the historical paper water problem, the DEIR repackages it.

A similar circularity pervades the chapter's extremely cursory analysis of SWP water supply and urban planning in the future. From the historical position that planners and decision-makers rarely even considered water supply, the draft swings to a somewhat exaggerated faith that they now "get it," due in part to changes produced by the *PCL v. DWR* decision and settlement, and in part due to parallel legislative changes (notably, SB 610 and SB 221). But the DEIR does not even begin to show that the "modern" mechanisms, such as SB 610/ 221 and Urban Water Management Plans, have now made paper water disappear.[102] Notably, the DEIR does not even analyze two new sources of paper water that are specifically associated with this project. The first, extensively discussed above, is the growing reliance on article 21 water to support permanent developments. The second is that DWR's over-reliance on CALSIM in its reliability reports, which have induced local decision-makers to rely on estimates of SWP yield

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[101] See, e.g., *Santa Clarita Organization for Planning the Environment v. County of Los Angeles* (2003) 106 Cal. App. 4th 715, 721; Kibel and Epstein, *Sprawl and 'Paper Water': A Reality Check for the California Courts* 20 CALIFORNIA REAL PROPERTY JOURNAL 22, 23 (Winter/ Spring 2002).

[102] Indeed, the DEIR has not yet addressed PCL's earlier criticisms of its analysis of Urban Water Management Plans, included in Attachment A,

that are vastly beyond historical deliveries. DWR still has yet to come to terms with this "cyber water" problem, which PCL identified in its scoping comments more than four years ago.[103]

D. The DEIR avoids, and impermissibly delegates to subsequent local review, project-related climate change impacts.

Climate change has been extensively addressed above in connection with baseline issues. The separate chapter on climate change in the DEIR (Chapter 12) creates additional CEQA problems, by systematically avoiding full and responsible discussion of project-related climate impacts. First, the analysis relies heavily on the dubious premise that, because DWR had concluded that the project would not affect *statewide* population growth, it would not affect growth-related greenhouse gas emissions "within the SWP service area as a whole." DEIR, p. 12-14. But DWR provides no support for the speculative premise that the location of development is inconsequential to greenhouse emissions. In fact, sprawling patterns of development cause considerably more greenhouse gas emissions than more compact forms of development that occur within existing urban areas. Turning "surplus" water into water that facilitates permanent new development in areas that are currently rural or agricultural will have a very significant impact on greenhouse gas emissions, and the DEIR needs to analyze how the proposed Monterey Amendments will affect that possibility.

Second, the DEIR does not study whether the elimination of pre-Monterey safeguards—including the permanent shortage provision in article 18(b) and the proscription on using "surplus" water to build permanent economies in article 21(g)(i)—may impact climate change by removing useful tools to reconcile supplies and deliveries in a climate-constrained project. The DEIR should study from a climate change perspective whether there is a difference between those pre-Monterey approaches and the post-Monterey approach (reliability reports and liberalized use of article 21).

Finally, the DEIR does not analyze whether would be a project-related difference in emissions due to the difference between serving urban and agricultural contractors. The elimination of the pre-Monterey "agriculture first" preference may make that distinction tangible.

E. The DEIR inadequately addresses cumulative impacts.

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[103] As PCL observed in its March 2003 scoping comments (p. 8), a detailed analysis by Dennis O'Connor, then of the California Research Bureau, concluded that DWR's reliability report had no credible explanation for exceeding historic deliveries by around 50 percent. He concluded that the results were inconsistent with previous estimates and models, and recent deliveries were lower than the modeled conditions. His assessment also observes that CALSIM II is not calibrated or otherwise verified, and that the reliability report did not use the CALSIM II model as designed. O'Connor's analysis warns that DWR's assessments of reliability should not replace the "paper water" problem with a new, simulation-based "cyber water" problem. While O'Connor was addressing the draft 2002 report, the problems have never been corrected.

Although the cumulative impacts discussion (Chapter 10) mentions the Central Valley Project, it does not analyze the important question of how the project will affect the environment via CVP use of Delta export capacity. The DEIR analyzes the impact on the availability of water (DEIR, pp. 7-55 to 7-57), but the environmental impacts due to increased pumping from the Delta were not.

VII. Recommended mitigation of impacts

PCL expects that with the additional analysis suggested above, the Final EIR will determine that the proposed project has significant impacts on the environment. Therefore, we provide the following recommendations that could be utilized to mitigate for some, although not all, of the significant impacts identified in these comments.

- To partially prevent growth inducing impacts, the EIR can require DWR to provide a clear statement that Article 21, transfers of Article 21 and reliance on Turnback Pool water are not reliable sources of water and that such sources are not suitable for support of permanent economy, including development. To avoid any confusion, the EIR should commit DWR to excluding these sources of water from the Report on the Delivery Reliability of the State Water Project.

- To partially mitigate impacts associated with eliminating Article 18(b), the EIR should commit DWR to provide explicit guidance on how to interpret reliability curves included in the SWP Delivery Reliability Report.

- To partially mitigate potential impacts to the Delta from increased pumping of Article 21 water, the EIR can prohibit declaration of Article 21 when fish agencies determine that there would be threat to fish species from export of such water.

- To partially mitigate for the loss of statewide oversight of the use of SWP water, the EIR should commit DWR to providing full disclosure of accounting, pumping and delivery of SWP water to the public in a timely (weekly) basis.

- To partially mitigate for the loss of the Kern Fan Element as a public trust resource, the EIR should impose conditions requiring that public trust agencies will have priority for the capacity of the Kern Fan Element for the storage of water to protect public trust resources including the health of the Delta.

These measures would not fully mitigate the impacts of proposed project. Impacts such as increased demand for SWP water to offset dry year by municipal contractors would not be addressed by the proposed mitigation measures above. However, the final EIR would need to address all impacts of the proposed project.

As an original plaintiff in the Monterey Amendments litigation, PCL has an interest in ensuring that the final EIR provide the public and decision-makers with an accurate and thorough analysis of the proposed Monterey Plus actions and a thorough comparison of viable and feasible alternatives, consistent with the original *PCL v. DWR* court decision.

We are distressed that despite the direction provided by the Court of Appeal, and despite our participation in the EIR process, and despite the significant events that have occurred since 1995, including the collapse of the Delta, the Monterey Plus DEIR is largely based on the same unfounded assumptions included in the CCWA EIR, and EIR rejected by the Court of Appeal.

The current DEIR manifestly fails to provide the full review demanded by the Court – and by the California Environmental Quality Act – and that was anticipated by plaintiffs in the settlement agreement.

We urge DWR to remedy the significant flaws in the current DEIR by fully analyzing, disclosing and mitigating the impacts of the proposed project in future versions of the EIR, as CEQA most emphatically requires.

Thank you for taking our strongly felt comments into consideration.

Sincerely yours,

Gary A. Patton, Executive Director

Roger B. Moore
Rossmann and Moore, LLP

CC:
Lester Snow
Arve Sjovold
Naomi Kovacs
Brian Morris
Senator Machado
Senator Steinberg
Senator Lowenthal
Assemblywoman Wolk
MWD Board
SWP contractors

STATE OF CALIFORNIA -- THE RESOURCES AGENCY **ARNOLD SCHWARZENEGGER,** *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 25, 2008

Ms. Mindy McIntyre, Water Program Manager
Planning and Conservation League
1107 9th Street, Suite 360
Sacramento, CA 95814

Dear Ms. McIntyre:

This letter responds to your letter dated March 16, 2008 providing comments of the Planning and Conservation League (PCL) on the draft of the State Water Project Delivery Reliability Report—2007 (DRR(2007)). Your letter criticizes the timing of the release of the report, expresses concern about using CalSim II for determining absolute values of exports and deliveries, and makes several recommendations for improvement. Responses to your specific comments are included in the attachment.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department of Water Resources (DWR) responses.

Attached is a summary of your comments and DWR's responses that will appear in final of the 2007 Delivery Reliability Report.

Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

Attachment

cc: See attached list

Lester A. Snow, Director
Department of Water Resources
Post Office Box 942836
Sacramento, California 95814

Antonio Rossmann
Rossmann & Moore, LLP
380 Hayes Street
San Francisco, California 94102

Roger Moore
Rossmann & Moore, LLP
380 Hayes Street
San Francisco, California 94102

Senator Don Perata
State Capitol, Room 205
Sacramento, California 95814

Senator Darrell Steinberg
State Capitol, Room 4035
Sacramento, California 95814

Senator Sheila Kuehl
State Capitol, Room 5108
Sacramento, California 95814

SWP Contractors
Terry Erlewine
1121 L Street, Suite 1050
Sacramento, California 95814

Senator Michael Machado
State Capitol, Room 5066
Sacramento, California 95814

Senator Christine Kehoe
State Capitol, Room 4038
Sacramento, California 95814

Senator Denise Ducheny
State Capitol, Room 5035
Sacramento, California 95814

Assembly Member Lois Wolk
State Capitol
P.O. Box 942849
Sacramento, California 94249-0008

Assembly Member Eng
State Capitol
P.O. Box 942849
Sacramento, California 94249-0049

Susan Kennedy, Chief of Staff
State Capitol Building
Sacramento, CA 94249

Attachment

Comment:
DWR should commit to releasing the Draft 2009 Delivery Reliability Report in June 2008 and the final report by February 2009 in order for local water agencies to have sufficient time to incorporate the information in the report into the 2010 Urban Water Management Plans (UWMPs).

Response:

DWR agrees with the goal of producing the 2009 Delivery Reliability Report according to a timeline which will allow for the information in the report to be incorporated into the 2010 UWMPs. The objectives of DWR for the report are to encourage public discussion and understanding of the estimation of the SWP delivery capability, meet the conditions of the settlement agreement, and provide the best available quantification of SWP deliveries. It is unfortunate that the DRR (2007) could not be finalized in 2007. Given the 2007 federal court order on new SWP operation criteria to protect delta smelt, DWR chose to delay the completion of the report until the impacts of this court order on SWP delivery reliability could be assessed. Re-consultation under the Endangered Species Act is underway for the SWP and CVP. The resulting biological opinions will define the operation rules for the water projects. The biological opinion from the U.S. Fish and Wildlife Service is expected to be completed this calendar year (2008). However, the biological opinion from the National Marine Fisheries Service will be completed in Spring 2009. The information contained in the next Delivery Reliability Report will incorporate these new rules and, therefore, the draft report is expected to be issued in mid-2009.

Comment:

The draft DRR (2007) fails to articulate how reliability should be factored into water planning.

Response:

Chapter 7 of the draft DRR (2007) presents two examples of how to use the information in the report to estimate SWP deliveries at 5-year increments between 2007 and 2027. Example 1 illustrates this process for calculating average annual supplies, a single dry year, and average deliveries over multiple dry years. Example 2 illustrates how to develop similar information for years or sequences selected by the individual SWP contractor.

By providing examples of a hypothetical contractor with Table A amounts of 100,000 af and using the delivery data in terms of percent of maximum Table A amount, the report makes the examples easy to apply by any contractor. Each SWP contractor has a unique mix of local and imported water supplies, relies on SWP supplies for a different proportion of its needs, and has an individual conservation flexibility to accommodate supply variations. DWR believes that individual contractors can best determine under which conditions to rely upon current and future SWP deliveries, given a contractor's other supply sources or given the locally acceptable risk level for water delivery shortages.

Comment:

The draft DRR (2007) fails to disclose the implications of reliance on water that cannot be reliably delivered, in particular Article 21 water. Article 21 water should not be included in the list of water supply sources in any table.

Response:

The draft DRR (2007) clearly communicates the conditional availability of Article 21 deliveries. The first mention of Article 21 water in Chapter 4 includes a footnote which lists the limitations for the availability of this water. Chapter 5 includes a discussion of Article 21 of SWP contracts allowing contractors to receive additional water deliveries only under four specific conditions:

1. The water is available only when it does not interfere with Table A allocations and SWP operations;

2. The water is available only when excess water is available in the Delta;

3. The water is available only when conveyance capacity is not being used for SWP purposes or scheduled SWP deliveries; and

4. The water cannot be stored within the SWP system. In other words, the contractors must be able to use the Article 21 water directly or be able to store it in non-SWP facilities.

Chapter 5 of the report also points out that in the absence of storage, Article 21 water is not likely to contribute significantly to local water supply reliability. In addition, Tables 6-8, 6-9, 6-17 and 6-18 compare the results of the annual amounts of Article 21 available during prolonged dry periods and wet periods for the DRR (2005) and the DRR (2007). The variability of the annual amounts and the reduction in the amounts estimated in the DRR (2007) clearly illustrate the uncertainty associated with Article 21 supplies.

DWR believes that the issue of incorporating supplies received under Article 21 into the assessment of water supply reliability is a local decision based on specific local circumstances, facts, and level of water supply reliability required. Article 21 water is presented separately in the report so local agencies can determine whether it is appropriate to incorporate this supply into their analyses. In many cases, water supplies available under Article 21 of the water supply contract are an important yet ephemeral source of water from SWP facilities that needs to be included in the DRR.

Comment:
The draft DRR (2007) fails to inform the reader that CalSim II model runs very likely overestimate the reliability of the SWP because the studies in the DRR do not account for Delta risk factors and the need to respond to environmental, water quality, and area of origin legal requirements.

Response:

“Delta risk factors” is an all inclusive term that has numerous components. It is not accurate to claim that CalSim-II simulations do not account for them. The simulations in the DRR (2007) account for restrictions due to potential protective measures for endangered fish, water quality requirements, and climate change. These potential impacts are extensively addressed in Chapter 4 of the DRR (2007). Implementation of potential limitations to exports from the Delta to protect delta smelt are represented in the current level study in the DRR (2007) by incorporating the interim decision of the federal Court. The future level studies incorporate climate change and these fish protection measures. CalSim II simulations do not account for a catastrophic levee failure but the potential interruptions to water supply are discussed in the report (ref. DRR 2007, P.8, PP.18-19). It is also inaccurate to claim that CalSim-II does not account for the “area of origin legal requirements.” The estimates of water available from the source areas have been developed with assumptions on future population growth in upstream areas and the resulting consumptive demand, as well as projections of crop acreages in the valley floor and the resulting evapotranspiration demand.

Comment:

The draft DRR (2007) fails to provide guidance to SWP contractors on how local and overall water supply reliability could be improved.

Response:

Providing guidance to SWP contractors on how local and overall water supply reliability could be improved is beyond the intended scope of the DRR (2007). The purpose of the report is to present DWR’s current information regarding the annual water delivery reliability of the State Water Project for existing and future conditions. A key objective of the California Water Plan is to provide guidance to local agencies and governments and regional partnerships on ways to increase regional self sufficiency in meeting their future water demands. The Water Plan includes a diverse set of resource management strategies that can be implemented in different combinations to provide water supply reliability and to meet other water related resource management needs in different regions of the state.

Comment:

The DRR (2007) should include a discussion regarding the reliability of all types of water delivered from the SWP.

Response:

The report provides information on the water supply categories most important to SWP water contractors, Table A and Article 21. The conditions associated with the supply under Article 21 are fully discussed in the report. More detail on the characterization of Article 21 supply is provided in the third response contained in this attachment.

Comment:

The DRR (2007) should include water supply source tables for each SWP contractor. DWR should include a clear and understandable forecast of how much water (both Table A and Article 21) the SWP can deliver under current and future conditions for each SWP contractor.

Response:

The DRR (2007) provides estimates of Table A supply for the entire range of delivery probabilities, zero to 100 percent. Calculating a Table A delivery amount for an individual contractor is a direct calculation based upon the maximum Table A amount in the contractor's water supply contract. The maximum Table A amounts for each contractor are contained in Appendix C, *State Water Project Table A Amounts*. Determining the acceptable level of risk associated with the estimated Table A delivery amount is a local decision based on specific local circumstances, facts, and level of water supply reliability required. Article 21 water is presented separately in the report so local agencies can determine whether it is appropriate to incorporate this supply into their analyses. Some SWP contractors will have no ability to receive Article 21 supplies. Estimating the amount of Article 21 deliveries for each SWP contractor is beyond the scope of the DRR (2007), as is developing an inventory of each SWP contractor's water supply sources.

Comment:

The DRR should provide estimates of SWP delivery reliability for the period required by the following UWMP (which would be 2030).

Response:

The DRR for 2009 will include estimates for 2009 and 2029 which can be used for the updated Urban Water Management Plans.

Comment:

The DRR should clearly disclose the limitations of modeling, the implications of modeling assumptions, and provide recommendations to water agencies for appropriate use of modeling results.

Response:

The points PCL includes in this comment are ones which were included in your letters commenting on the draft DRR (2002) and draft DRR (2005). The responses to these comments are included in the appendices of the corresponding final reports and referenced here. Disclosing the limitations of modeling is accomplished through clearly disclosing significant assumptions that are made in the modeling process, and that disclosure has been done fully and extensively in the DRR (2007). Chapter 7 of the report illustrates how to interpret and apply the results should local planning agencies choose to use these estimates as one of the components of their resource management decisions.

Comment:

The DRR should include a more comprehensive analysis of climate change impacts on water delivery reliability, including issues of Delta water quality and sea level rise, consumptive use of water in areas of origin, availability of hydropower, and flood safety. DRR should provide guidance to water agencies on how these omitted impacts are likely to affect deliveries.

Response:

DWR is a leader in applying climate change factors to projections for water supply and we will continue to take a leadership role in this endeavor. The DRR (2007) uses four climate change scenarios for rainfall and runoff to develop the range of delivery estimates for the future. The Department is investigating methods to estimate the effects of sea level rise on Delta water quality. The DRR is published every two years and we will use the best information and analytical methods available to develop the latest projections for delivery capability under potential climate change scenarios. Flood safety and hydropower effects are beyond the scope of the report.

Comment:

The DRR fails to evaluate variable levels of demands, including the goal of a 20% reduction in per capita consumption. The DRR should use the three demand scenarios presented in DWR's 2005 State Water Plan.

Response:

The DRR is intended to provide information on the amount of Table A and Article 21 water that can be delivered considering a variety of hydrologic conditions, climate change factors, regulatory constraints, and other factors. It also illustrates how that water would be allocated among contractors based on their Table A amounts. The DRR is not intended to evaluate how a comprehensive demand reduction might affect the demand for SWP supplies of individual municipal and agricultural contractors.

A reduction in per capita consumption may not affect SWP demands. If individual contractors can reduce their demand for SWP supplies as part of their total water supply portfolio, they could either offer any unneeded water to other contractors or request delivery of less water from the SWP than would otherwise be available to them. In the latter case, DWR could allocate the unclaimed amount to other contractors by increasing the percentage allocation of Table A supplies available to them. In other words, the same amount of water would continue to be allocated, but in different proportions to the contractors. In addition, factors such as water quality of the source supply and the costs associated with treating the supply for municipal use are significant considerations for SWP contractors. For some SWP contractors, the quality of the SWP supply is better than other sources and it is used to reduce treatment costs for municipal supply. In this situation, demand on another source of supply may be reduced due to conservation measures and the demand for SWP supplies would be unchanged.

SWP contractors should consider their current water demands and future demand scenarios to help determine the mix and amounts of water supply sources, including SWP supplies, they will need to meet their water demands and other water resource objectives. It would be advisable for local water agencies to consider a future demand scenario that assumes a reduction in per capita water use because it could change how much they decide to invest in different water supply sources. These evaluations, and their implications to the demand for imported water from the SWP and other sources, is a responsibility of the SWP contractors and can be a part of their 2010 Urban Water Management Plans.

Comment:

The DRR should consider operations beyond the Wanger decision to include those that are consistent with State and federal fishery agencies for protection of threatened or endangered species.

Response:

The estimates for delivery capability will be updated when the rules of operation to protect endangered fish are defined in the revised federal biological opinions for the operation of the SWP and Central Valley Project.

Comment:

The DRR must recognize that DWR has not yet issued a final decision and EIR for the Monterey Plus Project.

Response:

The DRR will be updated in 2009, and will include the most current information available regarding the status of the Monterey Plus Project and any relevant decisions of DWR regarding the project. It is not possible to predict at this time what those decisions might be and whether they would affect the reliability of SWP deliveries.

Comment:

As participants in the Monterey Plus EIR Committee process, PCL has previously submitted comments to DWR expressing our concerns regarding the adequacy of CALSIM II for use in water management planning and deliveries assessment. Rather than resubmit those comments, we incorporate them by reference here, and highlight some particular issues below.

Response:

Most of the comments PCL incorporates from comments submitted on the Monterey Agreement DEIR are ones that are addressed above or have been previously responded to as comments to the DRR (2002) or DRR (2005). We refer to those responses. Our response to the comment regarding bimodal distribution of water years follows.

Comment:

Exceedence charts in the DRR hide the bimodal distribution of water years in California. CalSim II is ill-suited to address bimodal distribution of water years because the model produces an exceedence chart that hides this reality.

Response:

Currently CalSim-II uses 82 years (water years 1922-2003) of historical flow records to reflect the hydrologic variations in Central California. The historical flow records are adjusted for the influence of land-use change and upstream flow regulation in order to represent the possible range of water supply conditions at a given level of development. The model assumes that facilities, land use, water supply contracts, and regulatory requirements are constant over the 82 years of study period. Using a monthly time step, CalSim II model simulates operation of CVP and SWP system storage and conveyance under specified operations rules. Model output provides project operations under a given level of development for the entire study period. One of the key model outputs is simulated SWP annual deliveries, which are ranked from low to high and plotted in an exceedence chart. There is no intention to hide any inherent statistical properties of historically observed flow data.

Comment:

DRR fails to recognize that DWR has chronically failed to meet water quality standards in the Delta under historical operations and it fails to recognize the significant environmental degradation under the historical operations.

Response:

DWR operates the SWP to meet water quality objectives established by the State Water Resources Control Board (Board) and incorporated into DWR's water rights permits for the SWP. The water quality and fish flow requirements are contained in the Board's Decision 1641. In addition, the SWP is operated to meet requirements contained in the federal ESA biological opinions. Operation of the SWP has consistently met all water quality requirements except for those established for the south Delta, for which the salinity source is the San Joaquin River and not ocean-derived salts. The SWP does not contribute in any way to salt loads in the San Joaquin River and the southern Delta. The SWP is operated to help in achieving the south Delta salinity standards however, SWP operation cannot control south Delta water quality. This is because of the effects of the local flow and water quality conditions attributable to areas of stagnation, agricultural diversion and return flows, local wastewater discharges and lower quality water from the San Joaquin River. DWR is pursuing the installation of operable gates in the south Delta to improve circulation and, hence, water quality in the area.

Comment:

DRR should list potential sources of errors and show the range of possible outcomes due to these errors and provide recommendations to water agencies for addressing modeling faults-for example reduce the amount of deliveries predicted by CalSim II by some percent. By omitting both possible sources of errors and potential outcome ranges, the DRR projects a false certainty that reported deliveries are likely.

Response:

Quantifying the amount by which DRR estimates should be reduced or increased in order to achieve more accurate estimates of reliability requires a scientifically sound analysis of the uncertainties for numerous variables, each with their own error band, and developing a method to combine these uncertainties to get an estimate of the resultant uncertainty and its effect on the delivery reliability of the system. This is the approach that DWR is pursuing in conjunction with identifying and quantifying uncertainties associated with the system reliability in the face of the climate change phenomenon. However, until we can make reasonable and scientifically sound statements on uncertainties, we must rely on identifying a handful of variables that we know by experience could significantly affect SWP system reliability and provide the users with a sense of how much over-estimation or under-estimation might be involved. An example would be reducing the input data on rim flows to major storage facilities of the system by a certain percentage and reporting the difference in simulation results. Such a study was done in the CalSim-II sensitivity analysis conducted in 2005 and presented in the 2005 Delivery Reliability Report.

March 13, 2008

STATE WATER CONTRACTORS
SWC
Served by the State Water Project
FOUNDED IN 1982

Department of Water Resources
SWP Delivery Reliability Report – Attn: Cynthia Pierson
P.O. Box 942836
Sacramento, CA 94236-0001

Re: Comments on Draft State Water Project Delivery Reliability Report, 2007

Dear Ms. Pierson:

On behalf of the State Water Contractors (SWC), I am writing to provide comments on the Department of Water Resources' (DWR) Draft State Water Project Delivery Reliability Report, 2007 (2007 Report). The SWC is a non-profit association of 27 public agencies from Northern, Central, and Southern California that purchase water under contract from the California State Water Project (SWP).[1] The SWP is the state's largest water delivery system, and collectively, members of the SWC deliver SWP water to more than 25 million residents throughout the state and more than 750,000 acres of highly productive agricultural land.

The SWC have reviewed the 2007 Report and found that it provides a reasonable assessment of current and future SWP delivery reliability, given the limitations and future uncertainty discussed in the report. We believe that the following comments will help improve the final 2007 Report and provide additional information that will be useful to the SWP Contractors in applying the delivery reliability results from the report into their own planning efforts.

[1] The members of the SWC are: Alameda County Flood Control and Water Conservation District Zone 7, Alameda County Water District, Antelope Valley-East Kern Water Agency, Casitas Municipal Water District, Castaic Lake Water Agency, Central Coast Water Authority, City of Yuba City, Coachella Valley Water District, County of Kings, Crestline-Lake Arrowhead Water Agency, Desert Water Agency, Dudley Ridge Water District, Empire-West Side Irrigation District, Kern County Water Agency, Littlerock Creek Irrigation District, Metropolitan Water District of Southern California, Mojave Water Agency, Napa County Flood Control and Water Conservation District, Oak Flat Water District, Palmdale Water District, San Bernardino Valley Municipal Water District, San Gabriel Valley Municipal Water District, San Gorgonio Pass Water Agency, San Luis Obispo County Flood Control and Water Conservation District, Santa Clara Valley Water District, Solano County Water Agency, Tulare Lake Basin Water Storage District.

1121 L Street, Suite 1050 • Sacramento, California 95814-3944 • 916.447.7357 • FAX 916.447-2734 • www.swc.org

1. **Studies in 2007 Report are based on interim operations and will need updating with new OCAP operations**. The updated studies included in the 2007 Report all include the interim SWP and CVP operations rules imposed by the December 2007 Federal Court order. These interim operations rules are temporary and will be imposed only until a new Operations Criteria and Plan (OCAP) and biological opinion are issued, which is anticipated to occur in September 2008. In spite of the temporary nature of these interim operations rules, these rules are included as operational constraints in the 2007 Report's updated studies, not only for 2007 but for 2027 as well. This may provide the mistaken impression that the constraints are long-term, which is not the case.

   The new OCAP and biological opinions will most likely include operations rules that differ from those in the interim Court order. As a consequence, the results in the 2007 Report will be outdated as soon as the new OCAP is available in about six months. If DWR proceeds with finalizing this 2007 Report based on the interim operations rules, the final report should more clearly stress the interim operations upon which the 2007 Report studies are based and the limitations of the results presented, and DWR should commit to updating the report's studies based on new OCAP operations when it is available. Or alternatively, since there seems to be little value in finalizing a report that will almost immediately be outdated, DWR could delay finalization of this report until the new OCAP is finalized and studies can be updated (and in the interim, data from this draft 2007 Report would be available for use by anyone needing reliability data). This updated reliability information will be particularly important given that many agencies will begin preparation of their Urban Water Management Plan (UWMP) updates during 2009 (updates are due by December 31, 2010), and the final version of this 2007 Report will serve as guidance for their SWP supply analyses.

2. **Changes included in 2007 Report studies should be disaggregated.** A number of new factors are included in the 2007 report studies (i.e., modeling improvements, current interim operations, and climate change), each with a different degree of uncertainty. The CALSIM II modeling improvements should provide more accurate results, and presumably a corresponding improvement in certainty of results. However, the interim operations, which are in part based on real-time conditions that can produce a range of operational restrictions, introduce a new degree of uncertainty on delivery reliability. Further, the inclusion in the 2027 studies of a range of potential climate change impacts introduces an additional dimension of uncertainty. To provide readers with better information on which to make more informed judgments regarding the impacts on reliability of each of these factors and the varying levels of uncertainty associated with them, the final 2007 Report should present additional studies that separate out the effects of the new factors included, as discussed further below.

   a. **Effects of CALSIM II improvements since 2005 Report should be shown separately.** In the 2007 Report, results from studies in the 2005 Report are shown for comparative purposes along with results from the 2007 studies. The model studies in the 2007 Report were based on a version of CALSIM II that was modified from the CALSIM II version used in the 2005 Report to include several modeling improvements (i.e., improved San Joaquin River module, improved Artificial Neural Network to estimate Delta salinity, and an extended hydrologic period used to simulate operations). The effects of these modeling improvements should be shown separately so that the changes in estimated delivery reliability resulting from this change alone can be ascertained. The SWC suggest including an additional study, under both 2007 and 2027 conditions, using the 2007 version of the model with its modeling improvements, but using the same SWP/CVP operational criteria as in the 2005 Report (i.e., based on 2004 OCAP operations). This comparison could be included as part of Appendix A, or possibly in Chapter 2 as part of the discussion of CALSIM II.

In the remainder of the 2007 Report, it is these added studies based on the 2007 version of the model and 2004 OCAP that should be used for comparative purposes to the 2007 Report studies presented, rather than the 2005 Report study results which are based on an earlier version of the model and a different hydrologic period. This would then provide an apples-to-apples study comparison, rather than the apples-to-oranges study comparison now included in the 2007 Report.

b. **Effects of changed operations (either interim or new OCAP operations) should be shown separately.** The SWC suggest that the effects on delivery reliability of the change in SWP/CVP operations rules since 2005, isolated from the modeling improvements, be presented. For the current conditions (2007) analysis in the 2007 Report, this could be shown by comparing the updated studies currently included in the 2007 Report, to the added study with the 2007 CALSIM II model version based on 2004 OCAP (described in Comment 2.a above). For the future conditions (2027) analysis, this could be shown by comparing studies that include just the change in SWP/CVP operations without the potential effects of climate change, to the added study with the 2007 CALSIM II model version based on 2004 OCAP (described in Comment 2.a above). Existing studies of future conditions that do not include the effects of climate change are currently included in Appendix B, but they are only used for interpolation purposes. The results of these studies should also be presented in the body of the report in Chapter 6, for comparative purposes alongside the other study results.

c. **Potential effects of climate change should be shown separately.** For the future conditions (2027) analysis, a comparison of the studies with climate change included in the 2007 Report to the existing studies without climate change (described in Comment 2.b above) would show a range of potential effects of climate change on SWP deliveries, isolated from the modeling improvements and change in SWP/CVP operations since 2005. Since there is a great degree of uncertainty associated with the broad-brush estimates of potential climate change included in the 2007 Report, it is appropriate to show these impacts separately from the better known and more certain effects of assumed future operations. This will also enable any refined estimates of potential climate change effects to more readily be compared to the range of delivery impacts included in the 2007 Report. In addition, separation of the potential climate change effects will be useful for UWMP preparation, as it will enable agencies to incorporate that information into their plans as a stand-alone analysis.

3. **Full range of future conditions scenarios should be shown.** In the 2007 Report, interim operations, which are based in part on real-time conditions that can produce a range of operational restrictions, are evaluated in two separate studies, one study with the high end of those restrictions the other with the low end. The results of these two studies are then averaged for each year and it is those average results that are presented. We agree that this average is a reasonable estimate of likely operations in a given year. For the future conditions, however, it would be informative to show the more complete range of potential deliveries by presenting the full range of non-averaged results.

We appreciate the opportunity to review and provide comments on the 2007 Report. If you have any questions about these comments, please contact me at (916) 447-7357.

Sincerely,

Terry L. Erlewine
General Manager

cc: SWC Member Agencies

STATE OF CALIFORNIA -- THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Mr. Terry L. Erlewine, General Manager
State Water Contractors
1121 L Street, Suite 1050
Sacramento, CA 95814

Dear Mr. Erlewine:

This letter responds to your letter dated March 13, 2008 providing comments of the State Water Contractors on the draft of the State Water Project Delivery Reliability Report—2007 (DRR(2007)). Your letter expresses concern that the SWP delivery reliability analysis in the DRR (2007) is based upon interim operation rules to protect delta smelt which may change in 2008 and requests that study results in the report be disaggregated and not averaged to provide readers better and more complete information. Responses to your detailed comments are provided below.

Comment: Studies in the 2007 Report are based on interim operations and will need updating with new Operations Criteria and Plan (OCAP) operations. DWR should either delay finalizing the report until the new OCAP is finalized and studies can be updated or DWR should more clearly stress the limitation of using interim operations in the report's studies and commit to updating the report's studies based on new OCAP operations when they are available.

Response: Your point about concern for the use of interim operation rules in estimating current and future SWP delivery reliability is well taken. The estimates of SWP delivery reliability in the DRR (2007) necessarily reflect the best information available at a point in time. It is recognized that operation rules under the new OCAP may differ from the interim rules assumed in the DRR (2007) and that estimated SWP delivery reliability could subsequently change. When the new OCAP and biological opinion are issued, DWR will update and make available the studies and analyses presented in the DRR (2007).

Comment: The final 2007 report should include studies in which the version of CalSim II used in the DDR (2007) evaluates SWP deliveries under the 2004 OCAP operation rules used in the 2005 report. Results of these studies should be compared to the results from the 2005 report and also be used for comparative purposes to the 2007 report studies presented.

Response: The updated estimates of SWP delivery reliability in each report reflect the use of the best available tools and information at the time of the report. The focus of the presentation of delivery reliability in each report are the updated estimates of current and future SWP deliveries not the effect of changes of the tools upon the estimates. The DDR (2007) includes a discussion of how the updated estimates compare to those in the previous report.

As you note in your comments, the version of CalSim II used in the 2007 draft report is different from the version used in the 2005 report because it uses an improved San Joaquin River water quality module, an improved Artificial Neural Network model to estimate Delta salinity, and an extended hydrologic period under which operations are simulated. DWR documented the improved Artificial Neural

Network model in CalSim II in Chapter 3 of the 2007 edition of its annual report, *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh*. This report is accessible at http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/annualreports.cfm and selecting “Entire Report” under 2007. The San Joaquin River module in CalSim II was documented in U.S. Bureau of Reclamation’s 2005 report, *CALSIM II San Joaquin River Module (DRAFT),* available at http://science.calwater.ca.gov/pdf/calsim/CALSIMSJR_DRAFT_072205.pdf. This module was subsequently reviewed by an expert panel in a 2006 report for CALFED titled, *Review Panel Report: San Joaquin River Valley CalSim II Model Review*. This report is available at http://science.calwater.ca.gov/pdf/calsim/calsim_II_final_report_011206.pdf

Comment: Since the estimates of effects of climate change have a great degree of uncertainty, potential effects to SWP delivery reliability due to climate change should be shown separately from the better know certain effects of assumed future operations.

Response: The relative uncertainty of the effects of climate change is appreciated. However, Governor Schwarzenegger's Executive Order S-3-05, signed on June 1, 2005, directs the Secretary of the California Environmental Protection Agency to coordinate with State agencies to biannually report on the impacts to California of global warming, including impacts to water supply. The Department of Water Resources identifies climate change in the 2005 update of the California Water Plan (Bulletin 160-05) as a key consideration in planning for the State's future water management. This is because analysis has shown that climate change may in the future seriously affect the State's water resources, particularly SWP's ability to deliver water. In DRR (2007), the Department recognizes the uncertainty of climate change projections by evaluating future State Water Project deliveries under four scenarios of climate change: weak temperature warming and weak precipitation increase in California under model PCM; modest warming and modest drying under model PCM; modest warming and modest drying under model GFDL v. 2.0; and weak temperature warming and weak precipitation increase in California under model GFDL v. 2.0. Simulated deliveries under these scenarios of climate change were then interpolated to estimate deliveries in the year 2027. The annual SWP deliveries under future conditions with and without climate change are contained in Tables B-4 through B-11 in the Appendix B of DRR (2007).

Comment: For future conditions, it would be helpful if the full range of potential deliveries were presented that weren't averaged by simulations using higher and lower operational restrictions in accordance with the 2007 interim operations.

Response: Since the real-time conditions that would determine the extent of operation restrictions are unknown, we believe that averaging the deliveries under assumed higher and lower operation restrictions is reasonable. The annual Table A and Article 21 deliveries under both the higher and lower restrictions to operations are presented in Appendix B and have been made available electronically at the SWP Delivery Reliability Report website.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

From: Stuart Robertson [stuart@robertson-bryan.com]
Sent: Thursday, January 31, 2008 3:11 PM
To: 2007DRRComments
Subject: Comments

You are way off base to focus on climate change – this is more speculation than science as to timing and magnitude.

Delta conveyance is a far bigger, real and eminent threat. The weakness of the Delta levees is a known risk. One major failure due to a rodent, earthquake (quantifiable) or yes, global warming would catastrophically impair the SWP.

Get off the climate change and address something we can deal with within 20 years

Stuart Robertson, President
ROBERTSON-BRYAN, INC.
voice: (916) 687 - 7799
stuart@robertson-bryan.com

STATE OF CALIFORNIA -- THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, *Governor*

DEPARTMENT OF WATER RESOURCES

1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

August 11, 2008

Mr. Stuart Robertson, President
Robertson-Bryan, Inc.
9888 Kent Street
Elk Grove, CA 95624

Dear Mr. Robertson:

This letter responds to your email of January 31, 2008 providing comments on the draft of the State Water Project Delivery Reliability Report—2007 (DRR(2007)).

In your email, you state that the draft DRR (2007) places too much focus on climate change and should instead focus on less speculative risks which can be addressed in the next 20 years, in particular the threat posed by weak Delta levees.

The relative uncertainty of the effects of climate change on SWP delivery reliability are appreciated. However, Governor Schwarzenegger's Executive Order S-3-05, signed on June 1, 2005, directs the Secretary of the California Environmental Protection Agency to coordinate with State agencies to report every two years on the impacts to California of global warming, including impacts to water supply. The Department of Water Resources identifies climate change in the 2005 update of the California Water Plan (Bulletin 160-05) as a key consideration in planning for the State's future water management. This is because analysis has shown that climate change may in the future seriously affect the State's water resources, particularly SWP's ability to deliver water. The DRR (2007) recognizes the uncertainty of climate change projections by evaluating future State Water Project deliveries under four scenarios of climate change: weak temperature warming and weak precipitation increase in California under model PCM; modest warming and modest drying under model PCM; modest warming and modest drying under model GFDL v. 2.0; and weak temperature warming and weak precipitation increase in California under model GFDL v. 2.0. Simulated deliveries under these scenarios of climate change were then interpolated to estimate deliveries in the year 2027.

The draft DRR (2007) acknowledges the real threat of levee failure to State Water Project delivery reliability, citing key findings in the Draft Delta Risk Management Study (DRMS) Phase 1 Report. The draft DRMS Phase 1 report also points out that the impact of a levee failure on SWP deliveries would depend upon when and where the levee failure occurred. The draft DRR (2007) includes a discussion of DWR's development of an Emergency Operations Plan that will establish procedures for emergency preparedness and incident management activities to enhance the State's ability to prepare for, respond to, and recover from a Delta levee failure disaster and will provide DWR with a plan focused specifically on a catastrophic levee failure disaster.

The final report will be issued soon and will include an appendix containing the comment letters on the draft report and the Department's responses. Thank you for your comments. If you wish to discuss this report further, please contact me at (916) 653-1099 or kkelly@water.ca.gov.

Sincerely,

Original Signed By

Katherine F. Kelly, Chief
Bay-Delta Office

References

Resources Agency. 2007. *Pelagic Fish Action Plan*. 39 p.

The Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis Report*. p 52.