Climate Change
The Real Implications:
Spatial and Temporal Regulatory Fidelity

Water Resources

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Climate Change Adaptation

Elements

Three Pinnacles of Climate Change Adaptation

Climate Change Science

Climate Change Policy

Infrastructure

Overarching Water Regulatory Framework
California U.S.A. Context
Water Resources

- Flood Control
- Environmental Flows
- Hydropower
- Water Supply
- Storing Water in Reservoirs
- Moving Water from Point A to Point B
California’s Hydrology

Spatial Variability in Precipitation
Two-three month lag time is a function of snowpack storage.
California’s Hydrology

California Water Balance

Negative Storage
California’s Hydrology

Reservoir Controlled

Terminal Reservoirs
California’s System Operation

Central Valley Operations Center

Joint Operations Center

Data as of Midnight: 01-May-2011

Basin SWE & Storm tracks

Forecasted Inflow

Downstream release requirements

Delta water quality

Exports
Why is it Important to Water Managers?

Progression of an Earlier and Altered Seasonal Runoff Response

Seasonal Shift – Compared Against Existing Regulatory Allowances
Snow Coverage Changes

Present Day

Future - 2°C Temp. Rise

Snow losses

Seasonal Melt Flux

Source: J. Shafer-Kramer, DWR Bay-Delta Office

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California’s Watersheds

Comparison of monthly reservoir inflows (thousand acre-feet per month) for the historical (blue/dashed) and future (red/solid) climate

California’s Future Climatic Variability

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<th>Mean Annual Precipitation (mm/yr)</th>
<th>Scenario B1</th>
<th>Scenario A2</th>
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<td>April 1st SWE (mm)</td>
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<td>Hydrograph Half $H_{50}$</td>
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Most Water Agencies in California Acknowledge this Shift
But is it really happening?

Spring-melt (April-July) has decreased by about 10% over last 100 years.
Annual Hydrograph Shift – More Closely

Upper American River Basin

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Big Creek Basin

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What are the Implications?

Water Supply
Water rights
Contract
allocations
Environmental Flows
STATE OF CALIFORNIA—STATE WATER RIGHTS BOARD

License for Diversion and Use of Water

APPLICATION 5653

PERMIT 3009
Santa Clara Valley Water Conservation District
15420 Almaden Road
San Jose, California

LICENSE 6243
Notice of Change (Over)

This is to certify, that

be made proof as of July 27, 1960,

the date of inspection) to the satisfaction of the State Water Rights Board of a right to the use of the water of
Guadalupe Creek in Santa Clara County

tributary to San Francisco Bay

for the purpose of irrigation and domestic uses
under Permit 3009 of the State Water Rights Board and that said right to the use of said water has been
perfected in accordance with the laws of California, the Rules and Regulations of the State Water Rights Board and the
terms of the said permit, that the priority of the right herein confirmed dates from August 1, 1927,

and that the amount of water to which such right is entitled and hereby confirmed, for the purposes aforesaid, is limited
to the amount actually beneficially used for said purposes and shall not exceed three thousand three hundred
two (3302) acre-feet per annum to be collected from about November 15 of each year
to about May 1 of the succeeding year.
Permitted Diversion Periods

**December 1st to June 1st**
- November 1st to May 1st
- January 1st to June 1st

**December 1st to April 30th**
- July 1st to September 30th

**November 30th to April 1st**

**April 1st to November 30th**

Note: Actual Permit/License Diversion Periods 1916-1960; including cities, conservation districts, and private water co.
Federal Water Contract Allocations

Example: Upper American River Basin

CVP — begin in fall
February 1st — Forecasts initiated
Precipitation to date
SWE accumulation
Runoff to date
Incoming storm tracks
February 15th — First announcement
Precipitation to date
Runoff to date
Incoming storm tracks
February 15th — First announcement
Updated monthly
Final allocations — April, May or June

*Historic 1975-2009*
*Early 21st Century 2010-2039*
*Late 21st Century 2070-2099*

50% Runoff Passed
Upstream Reservoir Spills – Downstream Flood Control

Upper American River Basin

Big Creek Basin

Peak Reservoir Spills

Today

Tomorrow

February 15th

Variability in Total Delta Inflow - 2011 and 2008

- 2011 - WET
- 2008 - DRY
Environmental Flows & Water Quality – Bay Delta

Example D-1641 Flow/Water Quality Standards

Export/Inflow Ratio

Vernalis Base Flows

San Joaquin Salinity

Shifted Delta Inflow Hydrograph

Total Delta Inflow for 2011 and Hypothetical Future

Export/Inflow Ratios

Future WET Year
Concluding Observations

Hydrologic regime has, is, and will continue to shift

That shift – “growing gap” – with Regulatory/Operational governance

Potential effect due to existing Regulatory/Operational governance is REAL!

Need to adapt and redefine – both!

*In the interim* – increasing struggle to meet regulatory standards established using old out-of-date thresholds/assumptions

Real Implications
Real Effects will be as much a result of Regulatory Constraints as the Changing Climate Itself
Climate Change
The Real Implications:
Spatial and Temporal Regulatory Fidelity

Water Resources

Thank You

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