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A Framework for Regulatory Transition

Accommodating Projected Climatic Shifts at the Operational Level

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A New Regulatory Prescription for California?

Climate change is shifting our State's hydrology in ways never before experienced. Regardless of cause, such shifts are a chronic threat to long-standing operational water management practice. At some point in the future (and perhaps this point has already been reached), many of our current regulatory instruments will have surpassed their ability to effectively administer or regulate their intended activities based on the hydrologic conditions of the day.

The reason for this apparent disparity is simple; all water-related regulatory "instruments" were written under very different hydrological assumptions than what exists today and, more importantly, what is projected to exist tomorrow. This includes the range of water right permits, licenses, certifications, waste discharge allowances, water compacts, Biological Opinion RPAs, FERC licensing conditions, and many more.

Our long-held water regulatory structure has not, in all cases, kept up with changes in the hydrologic environment. For a regulatory framework to effectively serve its intended purpose, it should be synchronized with the very natural ecosystem that it is attempting to regulate. Climate change science has been well established and there is ample policy acknowledgment in the public domain. What has been missing, however, is the prescient dialogue necessary to fully examine the implications of this growing disparity between our existing regulatory framework and the State's climatically-forced hydrologic regime. That, after all, is the essence of "climate change".

Today, regulators, water purveyors, power utilities, NGOs, and interested stakeholders could stand to benefit from a frank discussion of these potential implications. Our collective ability to meet existing regulatory requirements, let alone optimize current and future operational practice, will depend on how intently we genuinely embrace this seemingly growing disparity. Adaptation in water resources management, in its most effective form, requires that all elements be evaluated; even long-entrenched regulations.

Today's Hydrology

California's hydrology is best defined by the State's water balance. On average, the State receives about 200 million acre feet (MAF) of precipitation annually. This annual water input, however, is both spatially and temporally distributed. In fact, it is this distribution that defines our unique water management areas such as our upland watersheds (e.g., Sierra Nevada and north coast), export areas (e.g., southern Central Valley) and indeed, even our seasons (e.g., winter rainy season). As Californians have come to know, this distribution can also be highly variable between years. Interestingly, most of the water we receive through precipitation, we do not even touch. Of the approximate 200 MAF of precipitation we receive on an average annual basis, we "manage" only about 40 percent (or about 80 MAF) – the remainder is largely "unmanaged", lost to either direct evaporation, vegetative evapotranspiration, losses to deep groundwater/salt sinks, or direct outflow to the Pacific Ocean.

Today, it is *that* inherent hydrology that is being altered under climate change. And while it is true that our hydrology has always changed, forced climatic perturbations along with other potential causal factors have *nudged* the variability of our inherent hydrology beyond that historically observed. Moreover, recent projections confirm that those shifts will continue and become even more pronounced over the next several decades. It is this shift, outside our accepted notion of what is "normal" that is the cause for concern. Every public trust natural resource agency at the federal and State levels have now come to accept the idea of an ongoing shift in inherent hydrology. The question that then arises is; *what do we <u>really</u> do about it*?

Operational Practice

Given California's inherent hydrology, what we undertake is the *management* of that annual hydrology in what we commonly refer to as *water resources* management (as opposed to *hydrology* management). This includes all of the water allocations, hydropower generation, instream flows, reservoir flood evacuation, transfers/conveyances, refuge/wetland filling, and the many other "managed" uses of water across the State. Operationally, this is where water resource managers apply their expertise, analytical tools, and collaborative platforms to best prescribe and put into practice the range of actions needed to meet the societal demands placed on this vital public trust resource. This is done under an established regulatory framework that includes complex rules, procedures, and prescriptions. Under an increasingly shifting hydrologic baseline (see below), however, water managers will be progressively more constrained by what they can actually accomplish. They are limited by the established regulatory framework – which was never geared towards a shifting hydrology of the kind predicted by most climate change experts. Operationally, both regulator and those regulated will encounter increasing difficulties in meeting their obligations within the bounds of currently imposed regulations.

A Shifting Hydrologic Baseline

California's historic hydrology or, its historic record is often referred to as its hydrologic *baseline*. Put simply, it includes the past record of the State's hydrology – precipitation, river flows, water temperatures,

etc. This baseline includes the inter-annual (between-year) as well as seasonal variability that we have come to know and accept. It defines our "wet" or rainy season, our summer "dry" season, and our spring "peak flow" periods. Graphically depicted, the baseline is represented by the annual hydrograph – rivers responding to late-fall/winter precipitation, snowpack storage, and the primary hydrological event of the year -- the annual spring freshet or snowmelt runoff period. As global temperatures rise, hydrologic response in California will also continue to shift. The most noteworthy change will be the alteration in precipitation form – from snow to rain. That change alone will revise the nature of our hydrologic baseline. It will prompt increasing late-fall/mid-winter river flows and reservoir storage, deplete upper basin snowpack (i.e., water storage) accumulation, and significantly reduce the late-spring freshet or snowmelt pulse that has typically characterized our peak river flow period. As that overall shift and the inter-annual variability that goes along with it extends beyond that historically observed – a new hydrologic baseline will be upon us. In fact, many experts across the State believe that this condition is already here. It is the shift beyond traditional norms that is the essence of *climate change*.

The Challenge

Our regulatory framework, established and implemented over many decades, relied (and continues to rely) on a fundamental premise -- that the hydrologic baseline was a "constant". In other words, whatever we implemented, assigned, or prescribed by regulation would remain valid since the hydrologic baseline upon which they were based would never change. As we now know, however, that assumption was false. Any constancy or stationarity in our hydrology that we may have previously assumed has been now shown to be overly optimistic at best and just plain wrong at worst.

But, what do we mean by regulatory framework? This includes all of the water right permits, licenses, federal/State water contracts, waste discharge requirements, minimum instream flows, salinity standards, Biological Opinion prescriptions, FERC fish by-pass flows, and indeed every other water-related regulatory instrument or prescription that is empowered under statute and implemented by regulation. Quite simply, it is the means by which we approve, allow, and monitor the use of our water resources.

As our hydrologic baseline continues to shift, those established elements of our *regulatory framework* will become increasingly out-dated and, in many cases, irrelevant with what the shifting hydrology will make available to us. There will be (or already is) a growing disparity between regulatory fidelity and our inherent hydrology. Our challenge it would seem is to either make a conscious commitment towards improving or updating our existing regulatory framework or, accept the fact that these growing disparities may cause increasing hardship, protracted legal battles, and administrative inequities and, simply concede their inevitability.

Both options come with real cost implications. The only difference being that one is assertive, while the other, *ad hoc* and reactionary. With this disparity threatening the very core of our water resources management practices, the salient question for California is: *which option do we wish to follow?*

Examples of Potential Disparity

Numerous examples can demonstrate how a shifting hydrologic baseline will impair or otherwise adversely affect existing water-related regulatory oversight and governance at this, the operational level. A brief listing of these is provided below:

- **Water Rights** – long-established water rights have defined periods of diversions, set quantities, and specific locations (PODs or PORDs). All were established under the presumption that those prescriptions would forever remain implementable to the water right holder. Shifting river flows (volume and timing) may soon demonstrate the invalidity of that assumption.

- **Federal/State Water Contracts** – currently established procedures for CVP/SWP contract allocations are based on a series of river indices tied to upper basin snowpack water equivalency potential. These indices, in part, help define annual WY types. As river flow patterns (hydrographs) continue to shift, the continued application of these current metrics and allocation procedures, unattenuated to the realities of shifting river flow timing and discharge volumes, will impart their effects to water contractors.

- **Reservoir Flood Control** – existing reservoir flood control operations and indeed, most current Congressionally mandated flood encroachment rules were developed based on the historical hydrologic baseline. Climate-adjusted hydrology under a new baseline will impair the effectiveness of these flood control curves as late-fall inflow will force greater early season evacuation. While the late-spring refill potential (a threat to flood control) would be increasingly curtailed, this, however, would have significant implications to water suppliers who depend on that late season refill.

- **Flood Control Protection** – probable maximum floods and flood event return periods (recurrence intervals) are based on the number years on record and the number of occurrences of the events being considered. A shifting hydrologic regime will increasingly obviate the relevancy of many of those earlier estimates. *How meaningful is a 200-year level of flood protection, when based on historic records?*

- **Waste Discharge Requirements/NPDES** – long-established metrics for evaluating appropriate wastewater discharge requirements were based, in part, on the historical hydrologic baseline as an indicator of required ambient flows for point-of-discharge dilution calculations. Climate-adjusted hydrology under a new baseline will alter river flows previously assumed in dilution calculations.

- **Water Agreements/Compacts** – many water agreements still use a prescribed range of unimpaired flows (i.e., upstream of terminal reservoirs) as the basis for various water management actions (e.g., permissible diversions). Such flows, under a shifting hydrologic baseline will impair the continued rationalization of these agreements since it is exactly the upstream unimpaired flow regime that is shifting under climate change.

- **Minimum Flow Standards** – existing minimum flow standards used the historic hydrologic baseline to establish prescribed minimum flows. The assumed hydrologic response range of the river reach, balanced against ecosystem requirements, provided the context for setting these standards. As that “response range” continues to migrate towards a “new response range”, those

pre-set flow standards will no longer reflect current day hydrologic conditions in the river and increasingly deviate from anticipated future hydrologic conditions.

- **Delta Salinity Standards/Water Quality Control Objectives** – these long-established standards/objectives were based on the historical hydrologic baseline and relied significantly on upper basin (or tributary) releases and river flows. A shifting hydrologic baseline will alter the availability (timing and volume) of these flows from the upper basin watersheds and, as noted previously, impose new challenges to reservoir operations. This is a critical facet of any downstream flow regulation; since reservoir operations will dictate the volume and timing of freshwater flows to the Delta.

- **Biological Opinion Terms and Conditions** – many CVP/SWP related Biological Opinions contain specific terms and conditions under various RPAs developed to avoid jeopardy to certain listed fish species. These terms and conditions were based on an assessment of the historical baseline and did not universally consider climate-adjusted hydrology or changing basin response conditions in the upper watersheds. More importantly perhaps, there is little evidence today that these terms and conditions (e.g., flow and temperature targets on the upper Sacramento – "Fall Actions") are, have, or will be made open to re-consultation based on known and anticipated changes in hydrology.

- **FERC Relicensing Term and Conditions** – many instream restrictions (e.g., fish bypass flows) established as part of FERC licensing provisions were based on the historical hydrology of the river. By-pass flows, as one example, were evaluated based on the range of timed flows that the river reach had historically been able to provide. Changing runoff patterns in these upper basins (where hydropower generation is more prevalent) will affect the reliability of many of these types of river flow provisions.

- **Operations and Criteria Plan (OCAP)** – the complex operations of the CVP and SWP rely on an accurate and fundamental application of California's water balance, input, and distribution hydrology. The OCAP, in its varied elements, has traditionally relied on the historical hydrologic baseline as the modeled basis for many of its integrated and coordinated actions. A changing upper basin hydrology, which provides the *critical* input to all CVP/SWP terminal reservoirs, will have significant effects on how, overall, the current OCAP can be effectively implemented.

The preceding examples reflect only a small sampling of situations where this growing disparity is evident. Numerous other examples exist since, as noted earlier, any water resources management action that relies on California's inherent hydrologic baseline will be affected.

Initial Framework Recommendations

The implications of a changing hydrology are significant to California water resources management. The ramifications of re-assessing the entire water-related regulatory framework, however, are equally significant. Acknowledging that the do-nothing alternative is unacceptable, California is faced with a real challenge. Fortunately, California is one of the global leaders in acknowledging climate change so it is not overly optimistic to suggest that it could take a similar leadership role in this new contemporary challenge.

Indeed, every public trust resource agency with regulatory authority over water resources in California has already accepted climate change as a reality. What is missing is the next step; the graduation from climate change policy and education to actual *regulatory transitioning*. For it is here, that the true effects of climate change will be ***felt by all water users***.

At a broad, general level, initiating such an undertaking possesses an enormity that, in many ways, overshadows almost all other water resource management initiatives. For when was the last time any threat was tied to such long-revered institutions for example, as our State's water rights process? Unlike other past threats, however, climate change eclipses all previous threats in both its magnitude and irreversibility (e.g., unlike listed species, one cannot *recover* shifts in hydrology). Its effects influence inherent Statewide hydrology and, therefore, every water resources management activity we plan for and put into practice.

Accordingly, any such an undertaking should be carefully staged. A few potential initial steps as conceptual ideas are identified below:

Overall General Recommendations

- Establish an Oversight Steering Group under the California Resources Agency (include membership from key water-related resources agencies (federal/State);
- Establish a priority schedule of key regulatory areas potentially affected by the shift in hydrologic baseline (e.g., Federal ESA, California Water Code, Porter Cologne, Reclamation Law, Federal Power Act, etc.);
- Establish a priority listing of key elements within those regulatory areas that stand to be affected (e.g., water rights, federal/State water allocations, flood control operations, Biological Opinion Terms and Conditions/RPAs, NDPES, FERC relicensing, etc.);
- Establish an interactive linkage matrix to determine how each water-related program and/or initiative in the State stands to be affected or can offer some form of offsetting mutual benefit (e.g., Water Plan Update 2013, CV Flood, BDCP, Reclamation Basin Studies, etc.);
- Establish a technical liaison Panel that can serve as an ongoing scientific resource (e.g., use existing Independent Science Review Boards where possible, perhaps tailored to a smaller more specifically focused climate change hydrology panel);
- Seek input from other State, national and international entities/governance and regulatory bodies that have, or are addressing this same challenge;
- Establish a liaison group with water users, NGOs, interested stakeholders, and the general public to garner feedback and maintain transparency of process;
- Encourage support from key legislative leaders through ongoing briefings, public forums, and interest group advocacy; and,
- Consider promoting an inclusion within a revised Water Bond to ultimately fund the recommendations of the Oversight Steering Group to proceed with whatever actions it proposes.

Recognizing the very complex, multifaceted, and comprehensive nature of any such undertaking, other related recommendations would likely naturally arise over time. It is somewhat premature, however, to attempt to fully develop these now, but these would likely include more detailed aspects of specific regulatory processes, environmental reviews, analytical methodologies, and the tools currently used (and

how they are used), to help redefine a new curriculum of regulatory conformity. Some of these may include:

- Establishing a new standard future hydrological (CVP/SWP) cumulative condition (modeling scenario), climate-adjusted, and used by all agencies consistently;
- Considering the streamlining of permits/approvals based on an applicant's use of the "new" climate-change hydrology modeling runs (this would enhance overall consistency between documents and help agencies maintain uniformity in their technical reviews and approvals);
- Re-assessing assumptions of upper basin inflows to models such as CALSIM II;
- Re-assessing the empirical processes of runoff generation from upper basins that will migrate from snowmelt runoff to direct rainfall-runoff under continued climatic forcings; and,
- Reconsidering the heavy focus on GHG emission analysis in environmental review documentation.

Conclusions

For climate change, the science is no longer the issue; California's natural resource management agencies and indeed its primary water resources agencies, the Department of Water Resources and the State Water Resources Control Board, together with each of the federal agencies operating in the State (e.g., U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, FEMA, U.S. EPA, U.S. Fish & Wildlife, NOAA, U.S. Forest Service, U.S. Bureau of Land Management, etc.) all now accept climate change as a reality. Regardless of causation, we know that the hydrology of the State is shifting.

It is notably recognized that while much of our current and recent past efforts regarding climate change have focused on policy development, technical investigation, and public dissemination of climate change related information including public awareness, the same level of effort has not yet been dedicated to *how* our existing regulatory framework can accommodate these anticipated shifts. Operationally, we are still far behind. Moreover, no Statewide integrated program yet exists where climate change is fully incorporated into joint *operational* planning between State and federal agencies and where the various elements of each program/initiative is cross-correlated against both existing and anticipated future regulatory permitting needs.

We have an excellent opportunity to coalesce all of the admirable work that has, and continues to be undertaken in the areas of climate change policy, climate change science, and adaptation. By accessing the many programs, initiatives, and technical expertise of the Department of Water Resources, State Water Resources Control Board, Regional Boards, Department of Fish & Game, along with their federal counterparts, we can productively review how climate change will affect operations, jointly or separately, and how the various regulatory authorities (e.g., permits, licenses, contracts, agreements, BiOps, etc.) can be adapted to be more *climate-sensitive* and attuned to the hydrologic realities of both today and tomorrow.

Societal investment in climate change-related actions should be directed towards those that have the best means of imparting a genuine and measurable public benefit. A new regulatory prescription for California, based on a transitioning of its regulatory framework, while daunting, is the last missing piece in our adaptation to climate change. To best accommodate the known implications of climate change across the breadth of water resources management activities it may indeed be time to consider taking that important next step.

About the Author

Robert Shibatani is an empirical hydrologist and long-standing advisor to the California water industry on new water supply development, climate-adjusted hydrology, and dynamic watershed process. His current work includes various physical process integration methods in GCM/RCM and HM bias correction, watershed spatiality, near-stream function, subsurface translatory processes, climate-sensitized watershed balancing procedures, hydrologic non-stationarity, and infrastructure resiliency planning. He is on the Editorial Review Board for the *Journal of Water & Climate Change* (London, UK) and an IWA Specialist Group Member on the *Committee on Climate Change and Managed Adaptations* (The Hague, NL). Robert is based in Sacramento, California.
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