Witness Testimony of Robert Shibatani

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"A Roadmap for Increasing Our Water and Hydropower Supplies: The Need for New and Expanded Multi-Purpose Surface Storage Facilities"

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Good morning Mr. Chairman; distinguished members of the Subcommittee.

I want to thank you for the opportunity of appearing before you today. I appreciate your indulgence in allowing me to share with you what I feel are prescient opportunities in improving U.S. water supply security and resiliency. These same opportunities also allow us to address the chronic need to improve ecosystem functionality and species recovery, and reassess the persistent dichotomy between long-standing flood control management and water supply development. The opportunities I speak of are related to new water storage and, in particular, high elevation storage.

Such facilities in my view, can serve as an effective new platform to directly meet the challenges posed by a growing population, refocus attention on retaining a larger portion of a valuable public trust resource for a wide variety of beneficial uses, encourage a broader commitment to improving the nation's aging water infrastructure, and provide direct climate change adaptation. Ensuring water security can provide a vital foundational basis for robust national economic recovery.

By way of brief background, I am physical hydrologist and current CEO of The Shibatani Group, an international climate change hydrology, water governance, and water resources development advisory firm based in Sacramento, California. I have been working exclusively in the fields of hydrologic research and applied water resources management consulting for 30 years. While my technical specialties are in snow hydrology and climate change watershed functionality, my applied specialties are in new water storage and water supply development.

The focus of my testimony this afternoon centers on the current new era in dam/reservoir revitalization, particularly those elements associated with what I term high elevation storage, and some of the factors that are making this contemporary era of dam/reservoir planning quite different than those of past eras. I draw upon examples from California, but the principles are consistent wherever unattenuated surplus flows exist and, particularly, under climate change, to snow dominated watersheds.

To be sure, new dams and reservoirs evoke strong emotions and in many ways represent an identifiable icon in the long-standing polarity between environmental and development interests. Yet, the functional basis for this polarity is diminishing even if perhaps the rhetoric is not.

Changing hydrologic conditions in many of our nation's watersheds are compelling water managers to look at long-term water management quite differently than they ever have before.

To begin my testimony, let me start by defining high elevation storage. High elevation storage includes primarily, those new on-stream dams and reservoir sites above existing or terminal reservoirs. So, taking the expansive Central Valley of California as an example, it includes new reservoirs that would be constructed above the existing federal, State, and local agency impoundments that circle the Central Valley, and are known as the "terminal" or "rim" reservoirs.

Given their location, there are numerous factors that distinguish these types of reservoirs from others and provide certain advantages relative to their historic counterparts. They are located at high elevation and so, are at the source areas of snow accumulation and the areas where the effects of climatic forcings are first being observed. They are typically in remote areas so population displacement risks are minimized. Moreover, typical construction-related effects such as sensitive receptors to noise, air quality, traffic disruptions, and land use conflicts are significantly reduced, relative to those closer to more populated areas. Their proximity to the Delta and the presence of intervening reservoirs means that they are largely unaffected by the regulatory impositions for Delta water quality.

Hydrologically, their location above existing terminal reservoirs provides several benefits. By capturing precipitation at its upstream source, downstream flood protection is addressed at the point of runoff generation. Retaining additional water in high elevation upstream areas provides relaxation of the flood encroachment rules in the downstream terminal reservoirs. This of course has positive implications to water supply and other later season environmental water uses since the terminal reservoirs would not have to be drawn down as far during the winter season as they are now. The risk of non-refill, therefore, is reduced relative to the size of the new reservoir and overall annual yield of the watershed.

To be candid, this is where I have often run counter to levee proponents in the flood control debate who posit that levees by comparison represent the first line of defense in flood protection. While commonly stated, this thinking ignores the truism that flood risks result from unattenuated high flows from *upstream* areas. The first line of defense is more aptly represented by eliminating or at least reducing the *upstream* flood release in the first instance. Additional storage does just that.

New high elevation storage reservoirs offer significant additional operational flexibility for water resource managers in many other areas. The premise is really quite simple. Capturing a larger portion of water that would otherwise be lost during the rainy season provides the additional *assets* that water managers can then put to direct beneficial use later on. In many ways, it converts what can be viewed as wastage and simply holds it in reserve until it can be used more beneficially later in the year.

One of the significant advantages of high elevation storage is the conversion of energy from potential to kinetic. By simply running water through turbines along its natural oceanic migration we generate a natural and highly reliable energy source based on the facts that 1) it rains every year and 2) water always runs downhill.

The resulting higher carryover storage in those downstream reservoirs also provide many environmental benefits including habitat flows, side channel/pond replenishment, fish attraction flows, pulse flows for maintaining downstream water quality (particularly important where estuarine salinity is an issue), and dilution potential for the thousands of NPDES permits and waste discharge allowances in existence. Moreover, in the upstream areas, which are traditionally dry after the spring melt period, additional storage provides enhanced opportunities to maintain instream wetted perimeters and reduce upper basin desiccation.

Anything requiring instream flow augmentation will benefit from new storage and high elevation storage maximizes the potential for those many benefits.

This added storage also provides significant improved flexibility for water supply deliveries; both locally and regionally, as well as helping to enhance local water-related recreation, tourism, and local small businesses.

At the Statewide level, additional storage provides enhanced opportunities to improve overall CVP/SWP operational flexibility. Moreover, it provides increasing capabilities to offset recurring shortages imposed by the federal/State water projects through an active and robust water transfer market. This is an important consideration since water transfers serve as a significant revenue source to several local special districts based on A) a commodity that is replenishable annually; B) would have otherwise been "lost" to the ocean, and C) can provide concurrent environmental benefits in its carriage water function.

From an endangered species mitigation perspective, high elevation storage can provide direct hydrologic benefit to a major stressor that has contributed to the threatened state of listed anadromous fish species along the west coast.

NOAA's Biological Opinions for Central valley steelhead and the various runs of Chinook salmon associated with the long-term operation of the federal/State water projects in California identified water temperature as a critical issue. It is not the only issue, as invasive species, exports, water quality, genetic alteration, and ocean conditions all play a role, but water temperature is a significant issue.

Instream water temperature is largely controlled by releases from the terminal reservoirs. Again, with additional high elevation storage, the need to maintain existing flood encroachment in the downstream or terminal reservoirs is reduced. If then, greater refill is allowed to occur then, on average, we can expect higher carryover storage as we enter into the irrigation or high demand season. If we make the assumption that there is a linear relationship between reservoir total volume and the hypolimnitic volume, that is, the coldwater pool at the bottom of reservoirs, then additional coldwater can be generated by the mere existence of new high elevation storage reservoirs. Such coldwater pool assets for ESA-related anadromous fishery protection – covering thermally sensitive life-cycles of these listed fish species would provide significant benefit to NOAA's mitigation actions. This would help improve, protect or otherwise restore vulnerable salmon and steelhead populations within our freshwater systems.

In other words, with new high elevation storage, we can, through coordination operations, significantly improve the ability to address a major stressor that has contributed to the decline of these federally listed endangered species.

As with dams, climate change is also a subject that in contemporary discourse possesses passionate responses. We have all seen plenty of examples of this.

As a hydrologist, as with most applied practitioners I hope, I tend to strip climate change of all the political rhetoric and focus solely on its physical implications. Climate change adheres to the same physical laws as the hydrological environment for which it is imposing an effect.

The fact remains, regardless of the causation debate, our hydroclimatic regimes here in the U.S. and indeed across the globe are changing and, in many cases, changing rapidly. As the recent IPCC WGI Report released earlier this month in Stockholm confirmed, anticipated climatic forcings will continue (and more aggressively) affect our watersheds. How, where, and when to apply new physical and operational prescriptions to accommodate such changes are only just beginning. And new storage will play an important role in this managed adaptation.

But how does climate change factor into the discussion regarding new dams? New dams, as numerous studies are now demonstrating, provide an effective adaptation measure to the effects of climatic shifting on hydrologic regimes. How? By providing attenuation capability of additional water made available within high elevation watersheds. Runoff response will be more instantaneous as more precipitation will fall as rain as opposed to snow, thus eliminating a natural storage reservoir we have relied on for decades. With increased early season runoff, the antecedent moisture within most watersheds will also increase leading to earlier saturation and accentuating the runoff response later in the season.

As water practitioners increasingly accept the hydrological realities of these changing conditions, many have accepted the necessity of new storage as an effective means of preserving our control over this vital resource. New high elevation reservoirs provide that first line of management control. Focus is centered on the exact areas where climate change will first affect a region's entire water availability.

A common argument against new dams is the blockage of historic fish passage; most notably the listed anadromous fish species that have had their original spawning ranges significantly curtailed with the construction of today's existing dams. High elevation storage, however, are proposed to be situated in locations well above existing dams and, in many cases, above a series of already existing impoundments. Fish passage is not an issue. To be sure, programs such as the Interagency Fish Passage Steering Committee are looking at re-introducing listed species above the terminal reservoirs, but again, in many areas, several existing impoundments already exist before we get to those high elevation areas.

A prescient question today is - are new reservoirs even possible? To answer that query, I typically ask a very fundamental question; does the watershed experience uncontrolled releases or surplus flow conditions at any time of the year? Typically, the answer is yes. It is that yield that I propose to capture with new high elevation storage facilities.

Taking California as an example, it is not difficult to see why this makes sense. On average, we receive about 200 MAF of precipitation each year. Of that, we "manage" about 40% or 80 MAF. By "manage" I am referring to water that is allocated and prescribed for beneficial use – it is our "dedicated yield. This includes urban, residential, M&I, and Ag water as well as that water prescribed for environmental flows purposes – including instream flows, Wild & Scenic Rivers, and managed wetlands and wildlife refuges.

That leaves the majority, or 120 MAF that is unavailable or lost. While much of that loss is uncontrollable, namely through direct evaporative or transpirative loss and deep percolation to the salt sinks, a large portion is also lost as outflow to the Pacific.

As we all can appreciate, all rivers must maintain a minimum baseflow condition. There has to some water in the rivers – we cannot store all of it. But therein lies the test, how much water is appropriate in rivers in order to maintain all of the instream functions necessary to serve natural ecosystem and societal needs? On the one extreme of course is the flood season when most reservoirs are evacuating large quantities of water both before and during rain events. This is water that, but for perhaps 4 or 5 months, changes from a threat to an absolute necessity.

This is where, in my view, there must be a concerted effort to "close the flood control and water supply gap". It is an irrefutable edict of hydrology that says you cannot have a flood control and water supply issue in the same water year unless, the infrastructure is inadequate. That certainly seems to be the case today as we commonly experience flood control issues in mid-winter, only to turn around and cut water contractor deliveries several months later because our reservoir carryover storage is too low.
The inconvenient truth is that we are today still relying on 20th century infrastructure and the assumptions attached to those early facility designs and yet are faced with 21st century issues.

The population of California back in the early 1940's when many of the federal water projects in the State were being planned and designed for example was less than 9 million. Today, 70 years later, our population exceeds 38 million. Leaving aside the increase in consumptive demands, original design capacities could not account for the growing and complex yield needs that have evolved over time; those of endangered species, wildlife refuges, and water quality control. All of this has led to an overall diminishment of available water supplies to water users since the total available yield has not changed, only its apportionment across a wider array of uses.

Add in the hydrologic timing shifts associated with climate change, and it becomes essential that we look at water yield management with new eyes – ones that take seriously the reality that our static (and aging) infrastructure is increasingly being asked to accommodate changing hydrologic conditions and provide water to an ever increasing number of uses and increasingly complex timing modes. We have a continually migrating environmental baseline – yet our infrastructure has remained static. This goes against the widely accepted and fundamental hydrologic principle that states – stationarity is dead. In other words, we cannot rely on fixed infrastructure or historical assumptions given the rapidly changing and dynamic nature of our environment.

In my view, I feel that we have emerged, perhaps by necessity, into a new era of water storage development. In fact, I have never seen such interest in new storage development as I am seeing today. Federal, State, and local/regional initiatives as well as urban water purveyors, power interests, and Ag districts are increasingly supporting the need to new water storage. That, together with a new player; private investor interests are making new storage a dynamic new reality.

A growing number of Americans are slowly realizing the value of water, the increasing need to serve multiple beneficial uses, and the urgent need to move away from entrenched 20th century dogma regarding water infrastructure functionality – and take a refreshing new look at how we manage water under these rapidly changing circumstances. Closing the flood control – water supply gap is the first step towards this new charter – and high elevation storage is an effective means of accomplishing these new objectives.

Mr. Chairman, let me close by saying that there are indeed many continuing challenges ahead. But never has there been a more pressing need for new storage than what exists today. Its ability to proactively meet the growing demands and concerns associated with water supply security, the need for clean energy, fish habitat enhancement, instream thermal refugia for listed fish species, downstream water quality protection, including protection against saline intrusion associated with SLR, improved flood control, and source area adaptation to the effects of climate change in our mountain regions are just some of our growing contemporary needs. In fact, for once, there almost appears to be bi-partisan acceptance between environmental and water development interests - one that did not exist even a few years ago, but now seem jointly accepting of this vital necessity for long-term societal health. High elevation storage is emerging as a critical facet in future water sustainability and an inimitable prerequisite for any national economic recovery mandate.

New high elevation storage across the western and mountain States can help provide many of those benefits.

I want to thank you Mr. Chairman and the Subcommittee members for your time today. Hopefully, I have been able to shed light on some of the contemporary thinking in water resources management and am more than happy to answer any questions.

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