State Water Resources Control Board Priorities for Public Benefits of Water Supply Projects

Background

Section 79743 of the Safe, Clean, and Reliable Drinking Water Supply Act of 2010 (Act)[1] charges the California Water Commission (Commission) with responsibility for developing a set of methods for quantifying public benefits associated with water supply projects for the purposes of allocating $3 billion in potential General Obligation Bond funding. These funds will only become available if the larger $11.4 billion water bond measure, currently scheduled for the November 2012 ballot, is passed by the voters.

The Act requires the Commission to adopt the methods by regulation, and to consult with the Department of Fish and Game (DFG) and the State Water Resources Control Board (State Water Board) in the development of these regulations. The regulations adopted by the Commission must also include the priorities and relative environmental value of ecosystem benefits as provided by the DFG, and the priorities and relative environmental value of water quality benefits as provided by the State Water Board.

For purposes of developing the regulations, water supply projects eligible for funding include:

(a) CALFED surface storage projects;
(b) Groundwater storage projects;
(c) Conjunctive use and reservoir reoperation projects; and
(d) Local and regional surface storage projects that improve the operation of water systems in the State and provide public benefits.

Projects receiving funding must provide measurable improvements to the Delta ecosystem or to the tributaries to the Delta, and funds cannot be used for the costs of environmental mitigation or meeting compliance obligations except for those associated with providing public benefits. Additionally, funds may only be used for the following public benefits associated with water storage projects:

(1) Ecosystem improvements, including changing the timing of water diversions, improvement in flow conditions, temperature, or other benefits that contribute to restoration of aquatic ecosystems and native fish and wildlife, including those ecosystems and fish and wildlife in the Delta.

(2) Water quality improvements in the Delta, or in other river systems, that provide significant public trust resources, or that clean up and restore groundwater resources.

(3) Flood control benefits, including, but not limited to, increases in flood reservation space in existing reservoirs by exchange for existing or increased water storage capacity in response to the effects of changing hydrology and decreasing snowpack on California's water and flood management system.

(4) Emergency response, including, but not limited to, securing emergency water supplies and flows for dilution and salinity repulsion following a natural disaster or act of terrorism.

[1] Senate Bill x7-2.

(5) Recreational purposes, including, but not limited to, those recreational pursuits generally associated with the outdoors.

The funding for proposed public benefits is limited to 50 percent of the proposed cost of the associated water supply project and at least 50 percent of the public benefits funding provided for any project must be attributed to ecosystem improvements, as described in (1) above.

Methods for Quantifying Public Benefits

The California Department of Water Resources (DWR), on behalf of the Commission, hired a consultant (CH2M Hill) to assist in developing methods for quantification of public benefits. Under DWR's direction, and with input from the DFG and the State Water Board, CH2M Hill has prepared a draft report[2] that identifies and reviews the available tools and methods for quantifying benefits. The report includes recommendations for methods that could be used to quantify different categories of public benefits. The recommended methods primarily include economic models that can be used to monetize environmental benefits and, thus, provide a common denominator by which projects can be compared to one another and across benefit categories (i.e., the relative benefits of different projects). Converting public benefits to economic value also provides a mechanism for determining how much money should be awarded to priority projects and the cost effectiveness of proposed projects, and for ensuring that the cost share requirements are met. In most cases, however, the physical benefits of a project (e.g., acres of wetlands restored, stream miles meeting temperature objectives, etc.) will need to be quantified to reliably assign an economic benefit. The Commission may consider and incorporate the recommended methods into their regulations.

In addition to public benefit quantification methods, the Act also requires the Commission to include in the regulations the priorities and relative environmental value ecosystem and water quality benefits as provided by the DFG and the State Water Board, respectively. Therefore, funding decisions presumably will be based on a combination of the economic value of public benefits and the priorities provided by the DFG and the State Water Board.

Priorities and Relative Environmental Value of Water Quality Benefits

Detrimental water quality and ecosystem impacts of water supply projects are well documented and can include adverse chemical, physical, and biological changes to water and habitat. For example, diversion of water can reduce in-stream flows to the point where aquatic habitat and aquatic life is reduced or eliminated. Impounding water in a reservoir can result in increased water temperature and decreased oxygen content, direct elimination of riverine habitat, undesirable changes in water column nutrient chemistry, and other impacts. New water supply projects can be designed to minimize water quality and ecosystem impacts, and even be designed to rectify these impacts where they have historically

[2] DWR Draft Report: Description and Screening of Potential Tools and Methods to Quantify Public Benefits of Water Storage Projects. Prepared by CH2MHill. Available at: http://cwc.ca.gov/cwc/docs/Methods_Tools_Quantification_PublicBenefits.pdf

occurred. However, development of new water supplies for consumptive use has the potential to adversely affect water quality and ecosystems at and downstream of the source of supply. The State Water Board, therefore, encourages the Commission to adopt methods that define the net water quality and ecosystem benefits, taking into consideration the water quality and ecosystem "costs" incurred by proposed projects, as well as the benefits.

The Water Board's highest priorities for funding of water quality benefits associated with water supply projects, as defined in the Act, include projects that:

1. Improve water temperature conditions in water bodies on California's Clean Water Act (CWA) Section 303(d) list that are impaired for temperature;
2. Improve dissolved oxygen conditions in water bodies on California's CWA 303(d) list that are impaired for dissolved oxygen;
3. Mitigate or control mercury in water bodies on California's CWA 303(d) list that are impaired for mercury;
4. Reduce salinity concentrations in water bodies on California's CWA 303(d) list that are impaired for sodium, total dissolved solids, chloride, or specific conductance/electrical conductivity;
5. Result in Delta tributary stream flows that more closely mimic natural hydrograph patterns or other flow regimes that have been demonstrated to improve conditions for aquatic life;
6. Create additional supply capacity south of the Delta, and offset/reduce the current or future water demand from the Delta and its tributaries; and
7. Clean up or restore groundwater resources in high use basins.

These priorities are not listed in order of priority since the State Water Board cannot evaluate the relative environmental benefits of prospective projects or generally elevate the importance of one water quality benefit over another without information on the specific merits of the projects or the ability to evaluate tradeoffs. Additionally, the listed priorities do not necessarily reflect the State Water Board's overall priorities for water quality improvement and protection; rather, they reflect high priority water quality issues that could be positively influenced by water supply projects as defined by the Act.

Following is additional information on each of the above-listed priorities:

<u>Improve Temperature</u>

Water temperature influences physical, chemical, and biological processes of an aquatic ecosystem. For example, temperature affects the toxicity of chemicals, physical habitat, and the life cycle, growth rate, and survival of aquatic life. The temperatures of water bodies, which generally vary seasonally, determine the type of species that are present. Reservoirs often result in creating habitats that induce a shift from coldwater species to warmwater species, and can further impact coldwater species through increased predation (e.g., bass prey on salmon smolts).

Impounding water impacts temperature regimes within the reservoir itself and downstream of the dam. While free-flowing streams tend to have homogenous temperatures, due to relatively shallow depths and mixing, water in reservoirs are warmer at the top, where the surface is exposed to sunlight, and

colder at the bottom. These conditions often cause the reservoir to be become temperature-stratified. A reservoir influences the temperature of the stream immediately below the dam by changing the natural flow regime, both in quantity and quality. These effects depend on the means in which water is released from the reservoir, which may be for hydropower, water supply, flood control, or fish passage. Water temperature, as well as the amount of nutrients present, also affects the amount of dissolved oxygen in the water (dissolved oxygen impacts are described in the next section). When a reservoir is stratified, water released from the surface will be warm, and tends to be oxygen-rich and nutrient-depleted. Water released from the bottom will be cold, and tends to be oxygen-depleted and nutrient-rich (this is especially true for newer reservoirs where large quantities of flooded vegetation decay over a period of time). Such extremes, compared to the natural temperatures to which aquatic species evolved, can adversely impact native aquatic life.

Among the 71 water bodies (rivers and streams) currently on California's CWA 303(d) list of impaired water bodies that are listed for temperature impairment, 41 water bodies are downstream of reservoirs (Attachment 1). While stream temperature can be impacted by factors other than those related to water storage (e.g., removal of riparian vegetation, agricultural return flows, water diversions), about 40 percent of the 41 temperature-impaired water bodies downstream of reservoirs may be impacted by dam construction, upstream impoundment, and/or flow regulation/modification. The State Water Board supports funding of projects that provide quantifiable improvements in temperature levels to reduce or eliminate exceedances of water quality objectives for temperature in waters downstream from reservoirs. Effective temperature improvements involve the design and operation of reservoirs so the manner of releasing water, both physically and temporally, more closely mimics, to the extent feasible, the natural temperature regime of the downstream waters prior to the project.

Improve Dissolved Oxygen Levels

Almost all aquatic life depends on oxygen dissolved in the water for their health and survival. As with temperature, dissolved oxygen in a reservoir may become stratified. As mentioned in the discussion on temperature above, the extent and duration of reservoir stratification is affected by its depth, shape, and other factors. Waters at the surface become warmed by sunlight, and cooler, denser waters remain near the bottom. Although cooler water can hold more dissolved oxygen, the surface waters of a reservoir may be well-oxygenated, while water at the bottom may become deoxygenated and not able to support life. This is especially true for new reservoirs, which can become anoxic due to decaying vegetation and microbes that deplete the water of oxygen, as well as for reservoirs that receive high levels of nutrients from human or animal wastes, including fertilizers. Water releases located deeper in a reservoir generally contain lower dissolved oxygen levels, which may alter aquatic habitat and harm aquatic species. At the other extreme, water that passes over a spillway and plunges into a pool at the base of the dam can cause too much air to be in the water creating a supersaturated condition that can be lethal to some fish species (gas bubble disease).

Whether the reservoir releases are from near the top or the bottom of a dam (i.e., higher temperatures and dissolved oxygen versus lower temperatures and dissolved oxygen), the downstream habitat and aquatic life are often subjected to conditions that are inconsistent with those of a free-flowing stream.

There are currently 139 water bodies on California's 303(d) list of impaired water bodies that are listed for dissolved oxygen impairment (Attachment 2). Seven of those water bodies are reservoirs, and 75 are water bodies downstream of a reservoir. Although agricultural discharges and other nonpoint sources are common causes of lowered dissolved oxygen levels, upstream impoundment, dam construction, and flow regulation/modification are identified as potential sources of dissolved oxygen impairment in Northern California. Therefore, the State Water Board supports funding of projects that provide quantifiable improvements in dissolved oxygen levels so that water quality objectives for dissolved oxygen are met in and downstream of reservoirs. Like temperature considerations, effective dissolved oxygen improvements involve the design and operation of reservoirs so the manner of releasing water, both physically and seasonally, more closely mimics, to the extent feasible, the natural regime of the downstream waters prior to the project. Many of the design and operation factors that address dissolved oxygen impairment will also improve temperature levels.

Control and Mitigate Methylmercury

Methylmercury is a neurotoxin that poses health risks to humans and wildlife. The primary route of exposure is through consumption of fish, and most fish contain at least some concentration of methylmercury. This has prompted the Food and Drug Administration and the California Office of Environmental Health Hazard Assessment to recommend that sensitive populations (women of child-bearing age and children) limit or avoid fish consumption. Approximately 65 percent of California's reservoirs have been predicted to contain fish with methylmercury levels high enough to warrant a mercury control program.[3]

Mercury enters the water column through a variety of sources, including erosion of rock and soil containing natural mercury, atmospheric deposition, and past and present waste discharges (e.g., mining waste, municipal wastewater, storm water, etc.). Particle-bound inorganic mercury settles out in reservoirs and other depositional areas where bacteria in the sediment convert it to methymercury, the form that is biologically available and can bioaccumulate in higher trophic level organism. Reservoirs, therefore, have the potential to amplify the adverse effects of mercury in the aquatic environment. Furthermore, the rate of methylation and the toxicity of mercury to aquatic life are affected by water temperature, dissolved oxygen, and salinity, among other factors.

There are currently 184 water bodies on California's 303(d) list of impaired water bodies that are listed for mercury impairment (Attachment 3). Among those water bodies, 74 are reservoirs and 86 are water bodies downstream of reservoirs. The number of listings is expected to double in the 2012 listing cycle as a result of applying a more stringent numeric listing criterion. Mercury control in reservoirs and other water bodies is, therefore, a high priority for the State Water Board. The State and Regional Water Boards are in the process of developing a statewide water quality control program for mercury. The mercury control program, once developed, may include a statewide reservoir mercury Total Maximum Daily Load ("TMDL") and control program to address mercury-impaired reservoirs. Accordingly, mercury

[3] Chris Foe, Central Valley Regional Water Quality Control Board. Personal Communication, December 20, 2011. Preliminary forecast based on Surface Water Ambient Monitoring Program data from 184 lakes.

controls incorporated into new or existing water supply projects would create significant public benefits and should be a priority for funding.

Reservoir management strategies to control mercury accumulation may include reducing the source of mercury before flooding, fisheries management, capping and dredging bottom sediment, aerating anoxic bottom sediment and waters, water level management, changing the timing and location of reservoir discharges, and limiting the extent of flooded areas.

Reduce Salinity Concentrations

Elevated salinity in California's surface water and groundwater can damage crops, degrade drinking water, and damage industrial equipment. High concentrations of salt in supply water also inhibit the ability to recycle water. Salts are naturally occurring in the environment, and water quality concerns are generally related to transport and concentration of salts associated with human activity. The primary sources of salinity include agricultural drainage, wastewater, and seawater intrusion to both surface water and groundwater. The economic impacts from salinity have been estimated to be in the millions of dollars with cost predicted to exceed one billion dollars by 2030 in the Central Valley alone.[4]

California's CWA 303(d) list of impaired water bodies currently lists 137 water bodies as impaired for salinity, measured as chloride, sodium, electrical conductivity/specific conductance, and/or total dissolved solids (Attachment 4). Among those water bodies, 68 are water bodies downstream of a reservoir, and two are reservoirs. The other water bodies listed for salinity impairment are saline lakes, wetlands, and the Delta estuary.

Salt in the Delta is derived from tributary sources as well as the Pacific Ocean. Delta watershed hydrology influences salt concentrations because freshwater inflows from the tributaries repel or balance seawater intrusion, which is also affected by tidal influences and water diversions. Changes in hydraulic and hydrologic patterns caused, in part, by the construction and operation of reservoirs, the influence of the Delta export pumps, and modification of Delta channels has resulted in changes in salinity. The State Water Board has established salinity water quality objectives for key locations in the Delta. The State Water Board is currently in the process of reviewing the southern Delta salinity and the San Joaquin River flow objectives contained in the Bay-Delta Plan (the existing objectives have been exceeded on numerous occasions in the past). The State Water Board supports funding of projects that provide quantifiable improvements in Delta or San Joaquin River salinity, or reduce or eliminate exceedances of the water quality objectives for these water bodies. Effective salinity improvements may involve the release of stored water to meet salinity objectives, operational or physical changes at the Delta export pumps, operational or physical changes to Delta channels, agricultural drainage treatment or re-use, and re-operations of agricultural drainage (e.g., real time salinity management).

Given that some salinity impairment is caused or exacerbated by flow regulation/modification, and can be mitigated by manner, volume, and timing of reservoir releases, the State Water Board supports

[4] Howitt, R. et al. (2009) The Economic Impacts of Central Valley Salinity. Final report to the State Water Resources Control Board. Contract 05-417-150-0 (University of California Davis).

funding of projects that provide quantifiable improvements in salinity levels to reduce or eliminate exceedances of water quality objectives for salinity in waters downstream from reservoirs.

Restore Flow/Hydrograph Variability in Delta Tributaries

Hydrology of the Delta watershed has been highly regulated by water diversion, storage, and use, and, as a result, flows have become more homogenous. Native aquatic species, which have evolved to take advantage of flow and habitat variability, have been adversely affected by physical and flow-related habitat simplification, which often favors exotic species over native species. This concept, and the supporting science, is described and incorporated in the State Water Board report entitled "Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem"[5], which includes flow criteria expressed as a percentage of the unimpaired hydrograph rather than as static numbers. The report indicates that Delta "inflows should generally be provided from tributaries to the Delta watershed in proportion to their contribution to unimpaired flow unless otherwise indicated."

Water supply projects typically result in net decreases to in-stream flows due to consumptive use, but new and existing projects can be operated in a manner that mimics natural unimpaired hydrographs to the benefit of native species and their habitats. For example, pulse flows can be incorporated into reservoir operating regimes to maintain channel function, enhance outmigration, or trigger ocean entry of fishes. Water supply projects resulting in Delta flows or Delta tributary stream flows that replicate natural hydrograph patterns or have been demonstrated to improve conditions for native aquatic life, should be given high priority for funding. Specifically, projects that improve flow for the Sacramento-San Joaquin Delta Ecosystem are a high priority for the Water Boards.

In December 2010, the State Water Board also completed a prioritized schedule and cost estimate to complete instream flow studies for Delta tributaries[6]. The report includes a detailed list (Schedule 1) of Sacramento River and Delta tributaries that are high priorities for conducting instream flow analyses and for development of instream flow criteria. Projects that implement instream flow criteria established for rivers and streams identified as "Priority 1" in Schedule 1 of the report should also be considered a priority for funding.

We also encourage the commission to prioritize projects designed to divert and store (in surface impoundments or groundwater basins) high flows that exceed established instream flow criteria caps or other levels that are demonstrated to exceed flows needed for aquatic habitat or cause human or environmental harm.

Reducing Current or Future Water Demand on the Delta Watershed by Developing Local Water Supplies

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[5] State Water Resources Control Board (2010). Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem. Available at: http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/docs/final_rpt080310.pdf

[6] State Water Resources Control Board (2010). Instream Flow Studies for the Protection of Public Trust Resources: A Prioritized Schedule and Estimate of Costs. http://www.waterboards.ca.gov/publications_forms/publications/legislative/docs/2011/instream_flow2010.pdf

As stated above, water supply projects are typically associated with a net depletion of in-stream flow. Incremental improvement to in-stream flow conditions and water quality can potentially be achieved locally in the Delta watershed by increasing local water supplies south of the Delta. Developing local water supplies in southern California, for example, could reduce reliance on imported Delta water and/or create additional flexibility in the timing of diversions from the Delta or its tributaries. Developing additional water supply capacity south of the Delta would also result in a more diverse and potentially more reliable source of supply in light of regulatory uncertainty associated with diverting water from the Delta and predictions of future reductions in the Sierra snowpack due to climate change. Additionally, increasing south of Delta supplies could result in a reduction in the greenhouse gas emissions associated with the energy requirements to convey water from the Delta to southern California.

The State Water Board's highest priorities for increasing reliable local water supplies south of the Delta include: (1) projects that maximize the use of recycled water, linked to groundwater or surface water storage for consistency with the Act; (2) conjunctive use or other groundwater storage projects that result in measurable improvements to Delta flows or flow variability conducive to enhancing conditions for native aquatic life; and (3) storm water capture and reuse projects emphasizing the use of low impact development and green infrastructure technologies.

Restore Groundwater in High-Use Basins

Groundwater represents a large and growing portion of the State's water supply portfolio. Groundwater is particularly vulnerable, however, to contamination and must be maintained at a quality that is sufficient for its intended use to provide a water supply benefit. Discharge of pollutants, over-pumping, and land use practices are adversely affecting groundwater quality, supply, and availability in the State. Contamination from salts, nitrates, and industrial chemicals, such as solvents and fuels, has reduced the suitability of groundwater as a drinking water source in some areas. Seawater intrusion is occurring in some coastal aquifers as a result of groundwater pumping. Once groundwater becomes contaminated it is difficult and costly to clean-up, so prevention is key. Unmanaged groundwater pumping can result in depletion of groundwater resources and land subsidence (in some cases a permanent loss of storage capacity). While at the same time urbanization and other land use changes are reducing opportunities for water to percolate and recharge groundwater.

The State Water Board's 2008 Strategic Plan identifies protecting and restoring groundwater in high-use basins as one of the Board's primary goals. The Act itself specifically defines prevention or remediation of groundwater contamination that provides water storage benefits as actions that are fundable as water supply projects. The State Water Board strongly supports funding for projects incorporating efforts to prevent groundwater contamination, clean up contamination that already exists, or restore water supply in over-drafted aquifers. The State Water Board's specific priorities related to groundwater protection and remediation efforts include:

1. Development of Salt and Nutrient Management Plans as specified in the State Water Board's Recycled Water Policy[7].
2. Establishing or enhancing local groundwater management efforts, including Integrated Regional Water Management planning, that include performance standards for maintaining groundwater quality and quantity.
3. Funding of large-scale groundwater cleanup where no readily identifiable or viable responsible party has been identified.
4. Projects that increase the percolation of low-nitrate/low-salt waters, including low impact development (LID) projects designed to infiltrate storm water for purposes of restoring groundwater levels in high use or over drafted basins.
5. Projects that incorporate the use of recycled water as a way to offset groundwater overdraft.
6. Construction and use of barrier wells to reduce seawater intrusion.

Through its Groundwater Ambient Monitoring and Assessment (GAMA) Program, the State Water Board has identified priority basins (Attachments 5a and 5b) that include 116 of the 472 DWR-defined groundwater basins. These priority basins account for 95 percent of public supply wells, 99 percent of municipal pumping, 90 percent of agricultural pumping, 90 percent of leaky underground tanks, 90 percent of pesticide applications, and 60 percent of the land area in California. In response to Executive Order D-5-99, the State Water Board has also mapped the locations where published hydrogeologic information indicates conditions that are more vulnerable to groundwater contamination (Attachment 6a). These locations are termed "Hydrogeologically Vulnerable Areas" (Attachment 6b). This information should be considered in decisions on where to fund groundwater cleanup and protection projects, with projects located in priority basins and/or hydrogeologically vulnerable areas receiving the highest priority.

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[7] State Water Board Resolution No. 2009-0011.