Volume 2

Chapter 12 Matching Water Quality to Water Use

Matching water quality to water use is a management strategy that recognizes that not all water uses require the same quality water. This tomato processing plant near Williams does not require the same quality of water as a computer chip plant. (DWR photo)

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Matching water quality to water use is a management strategy that recognizes that not all water uses require the same quality water. One common measure of water quality is its suitability for an intended use, and a water quality constituent is often only considered a contaminant when that constituent adversely affects the intended use of the water. High quality water sources can be used for drinking and industrial purposes that benefit from higher quality water, and lesser quality water can be adequate for some uses, such as riparian streams with plant materials benefiting fish. Further, some new water supplies, such as recycled water, can be treated to a wide range of purities that can be matched to different uses. The use of other water sources, again, like recycled water, can serve as a new source of water that substitutes for uses not requiring potable water quality.

Status of Water Quality Matching in California

SWRCB has identified 23 beneficial use categories of water, for mostly human and in-stream uses. Human uses can be categorized as consumptive, such as municipal, agricultural, and industrial supplies, and non-consumptive, such as navigation, hydropower generation, and recreation. Matching water quality to most of these uses is important because, except for municipal and industrial uses, water is generally used as-is, without treatment.

Farmers currently match crops to the available water quality. In general, irrigation water should contain levels of constituents such as salinity and boron that will not inhibit the yields of some crops. Conversely, agricultural water supplies that have low levels of salts may require adding gypsum to improve percolation. Agricultural water supplies may require filtration to remove particulate matter that could clog low pressure irrigation systems and reduce soil infiltration rates. As an extreme case, Imperial Irrigation District runs all water that it diverts from the Colorado River at Imperial Dam through siltation basins to remove suspended particulate before the water is released into the All American Canal.

Alternatively, ambient, in-stream water must be suitable to support a wide range of aquatic habitats and conditions. Thus, water quality for in-stream uses generally must be free of a variety of contaminants, not just a few. One particular pollutant that greatly affects fisheries is temperature. An example of an effort made to match water quality to an environmental use for that particular pollutant is the Temperature Control Device at Shasta Dam, which was built to better match water temperature to the reproductive needs of salmonid fish downstream.

For drinking water supplies, it is important to start with the highest quality source water possible. Historically, California's urban coastal communities, Los Angeles, San Francisco, Oakland and Berkeley, constructed major aqueducts to such sources as Hetch Hetchy, Owens Valley, and the Mokelumne River. Later, water supplies of lesser quality, such as the Sacramento-San Joaquin Delta and the Colorado River, were also tapped for domestic water supplies. In response, many utilities already manage water quality by blending higher quality water supplies with those of lower quality, as well as matching treatment process to source water quality, as required by regulation. For example, Metropolitan Water District of Southern California (MWD) dilutes high salinity Colorado River water with lower salinity water from the Bay-Delta, which improves public acceptance of tap water, as well as facilitates groundwater recharge and wastewater recycling projects. In turn, MWD dilutes the higher bromide and organic carbon levels in Delta water with Colorado River water, to help reduce disinfection by-products in treated water. In Solano County, higher quality, less variable Lake Berryessa water is blended with lower quality, highly variable North Bay Aqueduct water from the Delta. Likewise, many water suppliers have the capability to blend groundwater, local surface water, and imported supplies to achieve a desired water quality, although some utilities may instead choose to use water supplies based upon cost minimization or water rights considerations. Some water agencies even blend water (and water quality) from different levels of the same reservoir, by using different intake levels. Many water management actions, such as conjunctive use, water banking, water use efficiency, and water transfers, intentionally or unintentionally, result in one type of water quality traded for, or blended with, another.

Business also matches water quality to use. Water used in high-technology applications is often purer than that used for drinking. For instance, Silicon Valley manufacturers and other businesses in the San Francisco Bay Area prefer higher quality Hetch Hetchy water to Delta or groundwater supplies that are also available in the region. For other uses, lower quality waters can be used. Cooling water used in production is often of a lower quality than that used for drinking. The Central and West Basin Municipal Water Districts offer different qualities of recycled water — at different costs — tailored to different uses, including process water for petroleum refining. At least one concrete plant in San Francisco captures and reuses its low quality stormwater runoff for concrete production.

CALFED identified two potential water quality exchange projects, the San Joaquin Valley-Southern California Water Quality Exchange Program, and the Bay Area Water Quality and Supply Reliability Program, to improve water quality and water supply reliability — as well as disaster preparedness — on a regional basis. These programs could promote matching water quality to water use, with potentially no degradation to the ultimate use of the water. For instance, in the Bay Area, a local water agency with access to a water supply of relatively lower water quality could fund water recycling or water conservation projects in another agency's service area that has a higher quality water supply, in exchange for the higher quality water saved by those projects. Under the San Joaquin Valley-Southern California Water Quality Exchange Program, MWD is working with both the Friant Water Users Authority and the Kings River Water Association to investigate the feasibility of exchanging water supplies. MWD is interested in these exchanges to secure higher quality Sierra water supplies that could result in treatment cost savings and an increased ability to meet more stringent drinking water quality regulations. In return for participating in the water quality exchange, Friant and Kings are interested in securing infrastructure improvements, financed by MWD, which will increase water supply reliability for their members.

Potential Benefits

For agricultural and in-stream uses, water quality matching is an integral part of water quality management, because there is generally no treatment of these water supplies prior to their use. For drinking water, appropriately matching high quality source waters can reduce the levels of pollutants and pollutant precursors that cause health concerns in drinking water. In addition, less costly treatment options can be used when water utilities start with higher quality source waters, and water supply reliability can simultaneously be enhanced.

For municipal and industrial customers, using water high in salinity can cause economic costs through damages to plumbing and fixtures and water-using devices and equipment. One study, conducted in 1998 by the U.S. Department of the Interior and the MWD, found that for every 100 mg/L decrease in salinity, there is an economic benefit of $95 million annually to MWD's customers.

Improved treated water quality and water supply reliability are also potential benefits of water quality matching for those agencies that have access to a diverse water supply portfolio. One example is the Santa Clara Valley Water District, its retail agencies, and other water suppliers along the South Bay Aqueduct, which have access to Delta water, Hetch Hetchy, local surface water, and groundwater. During droughts, seawater intrusion increases the level of salinity in Delta water supplies, including bromide. In such an event, agencies and regions with water source flexibility could use more groundwater or local surface water, if available, both of which are relatively bromide-free and thus do not create bromate, a potential carcinogen, upon disinfection with ozone.

Potential Costs

Water that contains lower levels of salinity is a better match for domestic water quality uses and for irrigating salt-intolerant crops such as strawberries and avocados. As noted, some agencies blend water supplies to achieve a desired water quality, including salinity. If low salinity water supplies are unavailable, water utilities may instead have to treat high salinity water supplies to achieve a desired water quality. In the Chino Basin, utilities already demineralize (desalt) water for domestic use, and Zone 7 Water Agency and Alameda County Water District have similar plans. At ACWD, for example, the capital costs alone of its new groundwater desalting project in Newark were $1.3 million per acre-foot per day of capacity, with operations and maintenance costs of $500 per acre-foot. In some cases, costs for matching water quality to use will also include new conveyance systems to connect different source waters.

CALFED estimates that it will spend just under $100 million (in 2004 dollars) on water quality exchanges during Stage 1 implementation. The primary costs of water quality exchanges are: infrastructure, conveyance (such as energy, capacity, and hydraulic losses), and incentive payments for participants (i.e., the incentive driving the Friant/Kings-MWD programs is MWD's willingness to invest in local infrastructure that will benefit the exchange partner). In 2003, however, a "no-cost" water quality exchange was implemented between the Environmental Water Account (EWA), Kern Water Bank, and MWD. Under the exchange, EWA had purchased groundwater in Kern Water Bank and was seeking to avoid a storage fee for leaving the purchased water in the bank. MWD offered to receive EWA's purchased water in exchange for providing the EWA with a surface water supply later in the year when EWA could use the water. MWD benefited from the exchange because it received groundwater supplies with low total organic carbon and bromide levels during a period when MWD was unable to blend total organic carbon levels down with Colorado River supplies. Other "no cost" exchanges are being explored that are similar to this arrangement. One example is for an urban water user to provide agricultural water users with surface supplies during the peak agricultural water demand period, when agricultural users are forced to use groundwater and may be facing pumping constraints. In return, the agricultural user would return a like amount of pumped groundwater during the fall-winter period when there is excess groundwater pumping capacity and bromide and total dissolved solids in Bay-Delta supplies are higher. In addition to water supply benefits, use of Delta water in groundwater recharge and banking operations may also provide water quality benefits as well by substantially reducing levels of turbidity, pathogens, and organic carbon upon withdrawal.

Major Issues

Many of the issues of matching water quality to use are integrally connected to pollution prevention.

Water Transfers

Water quality exchanges face similar regulatory, institutional, and third-party impact issues that water supply transfers face (please see the Water Transfers narrative for a discussion of those issues). In particular, water supplies are generally governed by place-of-use restrictions that must be addressed when exchanging water supplies. Moreover, water quality exchanges could have adverse third-party impacts, such as increasing the salinity of local groundwater, reducing the availiability of higher quality in-stream water needed for fisheries, and limiting agriculture to salt-tolerant crops. For drinking water, an exchange could also trade bromide and organic carbon, precursors to contaminants with probable risks, for arsenic, one of the few known carcinogens regulated in drinking water.

Unusable Water

There is often a high cost incurred by water supplies that become either unsuitable for certain uses, or very expensive to use, because of contamination. One specific example, cited in a recent study by the Environment California Research and Policy Center, is the contamination by methyl tertiary-butyl ether (MTBE, a gasoline additive that may cause cancer), which initially closed 80 percent of Santa Monica's drinking water wells, in turn forcing that city to increase its dependence on imported water sources, and later to install treatment to reduce MTBE levels. More generally, nitrate has closed more public water supply wells in California than any other contaminant, often permanently redirecting the use of such contaminated water to irrigation.[1]

Salinity

Agricultural drainage, imported Colorado River water, and seawater intrusion in the Delta and coastal aquifers all contribute to increasing salinity in all types of water supplies, which can adversely affect many beneficial uses, including irrigation, fish and wildlife, and domestic use. The primary tool to reduce salinity impacts is matching water quality to use, because many sources of salinity, such as seawater intrusion, are natural, and treatment to remove salinity is relatively expensive. Further, water supplies that are high in salinity increase the cost of recycling or recharging these supplies in aquifers for subsequent reuse.

Operations Criteria for Storage and Conveyance

Water quality currently plays a relatively minor role in the operation of most local, State, and federal water projects. Most reservoirs and other projects, such as water transfers and the Environmental Water Account, are operated to achieve goals and objectives related to water supply, power production, flood control, fish and wildlife protection, and even recreation—but not water quality. In the Delta, the only water quality standards for project operations are for salinity,

[1] For a fuller discussion, please see the Aquifer Remediation narrative.

to protect agricultural, in-stream, and municipal and industrial uses. However, these ambient water quality standards do not reflect water user demand for lower salinity water supplies. Moreover, other parameters of concern for domestic uses, such as pathogens and organic carbon, do not have operating criteria and, further, do not have objectives in basin plans or discharge requirements in NPDES permits.

Upstream and Downstream Partnerships

Presently, few partnerships exist between upstream source water areas, downstream water users, and the water users in between that affect water quality, resulting in a critical disconnect in the overall system. Such partnerships could lead to pollution prevention or trading opportunities that could result in more efficient water quality protection.

Ecosystem Restoration and Drinking Water Supplies

Some ecosystem restoration projects, such as wetlands restoration, may improve habitat and even some aspects of water quality, but at the same time, may degrade other aspects of water quality, such as mercury or organic carbon (from a drinking water perspective). The CALFED Bay-Delta Program is actively investigating this potential conflict in matching water quality to use (see Ecosystem Restoration narrative).

Recommendations to Improve Water Quality Matching

1. The State, local water agencies, and regional planning efforts should manage water supplies to optimize and match water quality to intended uses and available and appropriate treatment technology.
2. Consistent with the watershed-based source-to-tap strategy recommended in the Pollution Prevention narrative, the State should help facilitate system-wide partnerships between upstream watershed communities and downstream users along the flow path, in order to seek ways to better match water quality to use.[2]
3. The State should facilitate and streamline water quality exchanges that are tailored to better match water quality to use, while mitigating any adverse third-party impacts of such transfers, as well as ensure that place-of-use issues are addressed in a manner that protects an exchange participant's water rights.
4. The State and local agencies should better incorporate water quality into reservoir, Delta, and local water supply operations, as well as facility re-operation and construction. For example, the timing of diversions from the Delta, and thereby the concentrations of salinity and organic carbon in those waters, could be better matched to domestic, agricultural, and environmental uses. Alternatively, the timing and location of urban and agricultural discharges to water sources, including the Delta, could also be coordinated with the eventual use of water conveyed by potentially impacted diversions. Facilities conveying municipal and industrial water could also be separated from those conveying water for irrigation.
5. To facilitate water reuse downstream, the State should encourage upstream users to minimize the impacts of non-point urban and agricultural runoff and treated wastewater discharges.

Selected References

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Sacramento River Watershed Program

Alameda County Water District

[2] More information on this watershed-based approach can be found in the Pollution Prevention and Watershed Management narratives.