Content

About this draft: This is a working draft. It is incomplete. The chapter contains placeholders for some figures and tables. Much of the data is missing. Full discussion of some topics may be incomplete. This is the second of several drafts to be circulated in 2008 before the public review draft is distributed in December.

Subgroup: Improve Operational Efficiency and Transfers

Chapter [#] Conveyance

Conveyance provides for the movement of water. Conveyance infrastructure includes natural watercourses as well as constructed facilities like canals and pipelines, including control structures such as weirs. Examples of natural watercourses include streams, rivers, and groundwater aquifers. Conveyance facilities range in size from small local end-user distribution systems to the large systems that deliver water to, or drain, areas as large as multiple hydrologic regions. Conveyance facilities also require associated infrastructure such as pumping plants and power supply, diversion structures, fish ladders, and fish screens.

Conveyance in California

An extensive system of regional and interregional conveyance facilities in the state moves water from a source location to an area where it is needed and/or conveys excess water safely to protect existing resources. Common water management objectives and evaluations do not consistently show preference for either regional or interregional options. Determinations must be made at the project level.

Sacramento-San Joaquin Delta Conveyance. The Delta, located at the confluence of the Sacramento and San Joaquin rivers, is a critical element of both regional and interregional conveyance systems. It is composed of natural streams and sloughs as well as artificial channels. A network of levees and hundreds of miles of interconnected waterways, the Delta naturally carries water westward from the upstream water drainage basins to the bays connected to the Pacific Ocean. Also relying on the Delta's waterways are in-Delta diversions for agriculture, industrial, and municipal use and the south-of-Delta export facilities pulling large quantities of water in the southern Delta for the similar beneficial uses in the San Francisco Bay Area and Southern California. This anthropogenic conveyance system, now a network of constructed islands protected by levees moving mostly water through the Delta from the Sacramento and San Joaquin rivers, has altered the natural structure, source water mixture, and salinity intrusion throughout the Delta, affecting water quality and habitat.

Interregional Conveyance. An extensive system of conveyance facilities moves water with the use of natural and constructed waterways in the state. The two longest interregional conveyance projects in California are the State Water Project (SWP) and the Central Valley Project (CVP). Both the SWP and the CVP use natural rivers, such as the Sacramento River, and constructed conveyances, such as the California Aqueduct, to deliver water from storage reservoirs in Northern California to a broad array of agricultural water agencies in Northern California and the San Joaquin Valley, as well as urban water agencies in the Sacramento Valley, San Francisco Bay Area, Central Coast, and urban Southern California. Levees along major rivers and levees in the Delta serve to convey floodflows, but also convey water for water supply.

Local agencies have developed a number of interregional conveyances. For example, East Bay Municipal Utility District and the San Francisco Public Utilities Commission have developed major conveyance systems that transport water from Sierra Nevada rivers directly to their service areas. The Los Angeles Department of Water and Power developed the Los Angeles Aqueduct to convey water from the Owens Valley to Los Angeles. A major source of water in Southern California continues to be diversion and distribution of Colorado River water via the All American Canal serving the Imperial Irrigation District, the Coachella Canal serving the Coachella Valley, and the Colorado River Aqueduct delivering water to urban Southern California. Each of these conveyance systems is a major contributor to each region's water supplies and overall water supply reliability.

The existing network of interregional conveyance systems would not be capable of producing benefits if not for the ability of local water agencies to use conveyance to distribute imported, or locally produced, water to the end users, such as treated drinking water to residential or industrial users or irrigation water to agricultural users. In fact, conveyance is necessary in order for benefits to occur with virtually every other facet of local water management, such as desalination, recycling, use efficiency, and storage projects.

Regional Conveyance. At the local level, water is distributed from locally developed sources to the end users. Existing regional, multi-agency conveyance projects in the Bay Area already include the North Bay and South Bay aqueducts and emergency interconnects between various agencies.

Potential Benefits of Conveyance

Regional and interregional conveyance facilities provide flood management, consumptive and non-consumptive environmental uses, water quality improvement, recreation, operational flexibility, and urban and agricultural water management.

The main benefits of conveyance to the urban, agricultural, and environmental water-use sectors are in maintaining or increasing water supply reliability, protecting water quality, augmenting current water supplies, and providing water system operational flexibility. An improvement, for example, in the conveyance for conjunctive use will enhance the capabilities of groundwater recharge using available surface water from surplus or exchange water. For the environmental sector, benefits include in-stream flows, appropriate temperatures, and water quality for aquatic and riparian habitat. It is important to recognize that, in some cases, improving water supply reliability through operational flexibility is just as valuable as increasing overall supply.

Conveyance capacity improvements can enhance reliability without augmenting supplies by increasing operational flexibility. For example, more constraints have been put upon conveyance system operators reducing the opportunities for moving water across the Delta and the reliability of those supplies. Increasing conveyance capacity would allow for greater exports during times when water is available and for larger reductions in exports during fish-sensitive periods while maintaining overall exported water supply. Another possibility would be to add a pumping facility at a location that could be used when existing facilities have an unacceptable effect on Delta fish.

Other specific benefits are:

- Conveyance is necessary for many of the other resource management strategies.

Conveyance is needed to move water in water transfers between sellers and buyers. In order for water to be developed by new groundwater or offstream surface storage, diversion facilities must be capable of filling the storage. Also, facilities must then be in place to convey the storage releases to the users at the right times and flow rates.

Conveyance can improve water quality by moving more water when water quality conditions are better or less impacted by the movement of water, or by moving more water to improve water quality (that is, decrease salinity in the Delta).

- Given the high-intensity, short duration characteristics of California's hydrology, improved conveyance capacities combined with adequate surface water or groundwater storage can enable diversions of more water during high flow, less competitive periods, and consequently reduce the pressure to divert water during low flow, highly competitive periods.
- Conveyance improvements can provide the operational flexibility to divert and move water at times that are less harmful to fisheries.

Other benefits of conveyance improvements generally include:

- Enlarged and enhanced conveyance systems will increase flood control capability with higher and more controlled flow through the river basins while increased surface storage retention ponds will decrease the magnitude of peak storm event outflows.
- Enhanced monitoring and distribution of brackish effluent water, such as agricultural returns, storm water runoff and wastewater outfall, through the natural conveyance systems will increase water quality reliability for beneficial uses such as municipal water supply and recreational activity in storage reservoirs.
- Conveyance management practices that slow overland storm event outflows will increase retention and thereby enhance groundwater recharge processes that have been hindered with sprawling impervious urbanization.
- Effective incorporation of Best Management Practices for storm water runoff, storm water retention basins, and grassy swales, for example, can decrease burdens on management for system conveyance, flood control, and water quality by reducing peak flows, contributing to groundwater recharge, and filtering out nonpoint source pollutions such as sediments and heavy metals. Reducing peak discharge from heavy precipitation events in particular will decrease the demand on the conveyance system.
- Increases in water use efficiency decreases the water demand for a given region and also decreases the return flow from the region. This decreases the interregional conveyance demand and therefore reduces the burden on statewide water conveyance systems thus adding to system-wide reliability.
- Increases in resiliency to extreme events. Interconnected conveyance systems can provide some redundancy to ensure continuation of services during a long-term drought or following a catastrophic event such as an earthquake.
- Reductions in operating costs. Larger conveyance will allow pumping of water at optimal times to decrease the energy requirements at peak California energy demand periods.
- Improvements to instream and riparian habitat. Enlarged streams and channels for flood passage can incorporate habitat improvements that are designed with varying hydrology (including climate change) and operations.

Potential Costs of Conveyance

Potential costs for conveyance can include both facility and operating costs which can be a significant portion of the costs in a water management system. These costs depend on the local circumstances, how far and when the water needs to be conveyed and topography (for example, pumping vs. gravity flow). For example, it costs less to convey water from Oroville Dam to the Delta, all gravity flow through largely natural systems as opposed to constructed facilities, than to convey water from the Delta to the South Coast Hydrologic Region, requiring a large anthropogenic conveyance system with canals and pumps. Conveying water through the Delta and over the Tehachapi Mountains increases water costs due to construction, operation, and maintenance costs for canals, pipelines, and pumping plant facilities. With additional conveyance capacity, flexible management strategies control cost, such as moving water during off-peak energy demand periods when power costs are lower.

DWR prepared "An Initial Assessment of Dual Delta Water Conveyance" for the Delta Vision Blue Ribbon Task Force. This report identified a range of costs for through-Delta improvements from $1.2 billion to $8.6 billion. The estimated costs for an isolated facility ranged from $4.2 billion to $7.4 billion for an eastern or western alignment, respectively. A combination of an isolated facility with through-Delta improvements ranged from $5.4 billion to $17.2 billion depending on alignment and degree of levee improvements selected for the through-Delta.

The Contra Costa Water District (CCWD) is constructing a screened intake on Victoria Canal that would relocate some of CCWD's diversions to obtain better source water quality and shift diversion from an unscreened intake on Rock Slough. The total project cost, including planning, design and construction, is estimated at $100 million.

The Freeport Regional Water Project (FRWP) is a cooperative effort of Sacramento County Water Authority (SCWA) and East Bay Municipal Utility District (EBMUD) of Oakland to supply surface water from the Sacramento River to customers in central Sacramento County and the East Bay of California. Construction of the project is scheduled for completion in 2009 at a total cost of $903 million.

Major Issues Facing Conveyance

Managing California's water conveyance necessitates persistent efforts to address chronic issues, such as maintenance of an aging infrastructure, while simultaneously addressing new issues, such as decreased Delta smelt population. Current Bay-Delta planning efforts to address Delta Conveyance issues such as Delta Vision, the CALFED Science Program, and the Bay-Delta Conservation Plan include plans to meet the needs of water supply for consumptive use as well as the needs of the Delta ecosystems. Additional efforts to protect the Delta conveyance system also involve emergency planning for flood events, levee maintenance to increase levee integrity, and climate change impact assessment to better predict future conveyance infrastructure needs.

Maintenance

It is essential, at a minimum, to maintain the current level of conveyance capacity for both natural and constructed facilities. Substantial reinvestment will be required just to maintain the current level of benefits due to aging infrastructure, as well as, diminishing conveyance capacity in natural watercourses. This is most critical from both a water supply and flood passage standpoint for channels in the Delta. Diminishing conveyance capacity is also a problem for flood management facilities such as bypasses that over time fill with silt, debris and plant growth that reduce the effectiveness for passing flood waters. In addition, rivers and streams depend upon a

watershed that is in good condition. This is likely to take on very significant importance over time due to the increasingly higher costs of maintenance and the increasing demands of a growing population.

Watersheds provide the critical functions of snowpack storage, runoff, and water filtration in groundwater. Therefore, watershed management activities will also require investment in maintenance as part of the natural infrastructure of the state's water system. As California's population increases and precipitation patterns fluctuate a higher demand will be placed upon the conveyance system to move water to meet these needs for protected source water and dispersed water use with urban sprawl.

Science and Planning

Water managers, planners, and biologists continue to work to identify and understand the relationships between hydrodynamics, flow timing, fish timing and movement, water temperature, geomorphology, water quality, environmental responses, global climate change, and other conveyance-related considerations so they can optimally plan, develop, operate, and maintain natural and constructed conveyance infrastructure. Various CALFED programs have been studying these factors and expect to develop plans to improve the operation of the state's conveyance systems with a balanced approach to meeting the needs of its people and the environment. These studies are most evident in the Delta where export demands must be met, flood control improvements are needed, water quality improvements are being sought, and Delta fisheries and their habitat must be protected.

The purpose of the Bay-Delta Conservation Plan (BDCP) is to create a stable regulatory framework to conserve and recover at-risk native species and natural communities in the Delta and provide water supply reliability. A joint Habitat Conservation Plan/Natural Community Conservation Plan is being developed through a collaborative process with water users, state and federal agencies, and non-governmental organizations. The BDCP will examine how to improve the design and operation of the state and federal water projects over both the short term and the long term and implement a major program for restoring and managing habitats within the Delta. The BDCP is being closely coordinated with the Governor's Delta Vision Task Force and receives technical support from the CALFED Ecosystem Restoration Program (ERP) to ensure consistency between BDCP and ERP planning activities.

The CALFED Storage Program is studying increases in upstream-of-Delta reservoir storage to increase management and statewide system flexibility. This flexibility will contribute to increase survival of anadromous fish and improve Delta water quality, ecosystem restoration, and water supply reliability. To ensure the increased water storage is delivered to meet these needs, a reliable conveyance system will be needed. The projects within the CALFED Conveyance Program are based upon a through-Delta-only conveyance approach and include the evaluation of a through-Delta facility, Delta Cross Channel Re-operation, Franks Tract Project, permanent operable gates in the South Delta, south of Delta SWP/CVP aqueduct intertie, and CCWD Alternative Intake Project. These projects will also be evaluated assuming the possibility of a dual-conveyance system (through and around the Delta) for the Delta.

The beneficial uses of dredged materials along with contamination characterization of sediments being evaluated through the US Army Corps of Engineer's Long-term Management Strategy for dredging and levee maintenance work needed for conveyance in the Delta. DWR's Delta Risk Management Strategy will establish levee standards for the Delta to increase through-Delta water supply reliability.

Regulatory Compliance

Operation of conveyance facilities must comply with various laws, regulatory processes, and statutes such as Public Trust Doctrine, Area of Origin statutes, California Environmental Quality Act, National Environmental Protection Act, the Clean Water Act, and the Endangered Species Acts. Additional construction and operation of new facilities must also comply with these regulations.

Water Supply Reliability

Existing conveyance facilities do not provide long-term reliability to meet current and projected needs. Improvements to existing facilities in the form of updating aging infrastructure, upgrading existing capacities, and constructing additional facilities are needed to meet needs under changing conditions.

Greater interconnections are needed to help improve water supply reliability. Each water system has its own level of water supply reliability, based largely on storage and conveyance systems, hydrology, and level of demand. Operational flexibility, particularly during emergency conditions is a primary benefit of greater interconnection of independent water systems, as demonstrated during previous drought conditions. Conveying water through the Delta in times of drought is especially challenging considering the various demand from agriculture, municipalities, and environmental needs.

Water supply reliability related to Delta water withdrawals depends on the ability to meet water quality standards for Delta water users, flow requirements for Delta fish, and other requirements to protect endangered fish. The Delta water quality conditions and supply to the Delta network will fluctuate with seawater intrusion, the quality and quantity of river and stream flows into the Delta, in-Delta water management operations, and export pumping operations. The required supply to the in-Delta ecosystem will also depend on indigenous species population counts and invasive species management actions. In-Delta supply must also meet the demand of the Delta consumptive use to benefit such activities as agriculture and local municipalities.

Area of Origin Interest

Interregional movement of water is sometimes opposed by the source-water counties. In addition to struggling to augment local water supplies to meet growing demands, area of origin interests often feel that the downstream water users could or should be more committed to assisting in managing the natural infrastructure, such as watersheds, from which their imported water originates.

Climate Change

The potential for climate change will be a challenge as precipitation patterns may change as well as future water needs. Predicted for climate change are warmer air temperatures, diminishing snowpacks, increased evaporation, and seasonal changes in water availability. Warmer temperatures will reduce dissolved oxygen levels, hindering the health of sensitive species such as salmon. This will also promote algal blooms and microbial growth affecting drinking water quality. Less precipitation is estimated to fall in the colder winter season reducing contributions to the snowpack, and more precipitation is estimated to fall later into a warmer spring season resulting in increased frequency and intensity of rainfall. This scenario would require larger

conveyance capacity and reservoir storage to successfully manage water for flood prevention and long-term water use. Further demands upon conveyance operations would arise from a prediction of a wider range of extremes of water year types. Wetter years will be wetter and drier years will be drier than those in recent record. In the Delta, a combination of higher outflow in wet years with projected sea level rise would increase the burden on levees. A sea level rise in a drier year would increase salinity intrusion into the Delta and thus impact in-Delta water quality and water supply reliability.

Delta Conveyance

Over the past several decades, increasing demand for the Delta's resources have increased the conflict between the needs of water users and efforts to sustain the estuary's aquatic ecosystem and support recovery of State and federally listed fish. These conflicts have led to a crisis regarding the ability to protect Delta fisheries, maintain water quality, and meet the needs of both in-Delta and export area agricultural and municipal water users. This situation has resulted in the need to address these competing beneficial uses, as well as, sustainability concerns.

The major issues pertaining to reliability of water supply transferred through the Delta include the following items.

- The health of the Delta ecosystem is paramount in consideration of water-related activities within the Delta. Continuing declines in some native species populations migrating through or living in the Delta, such as the Delta smelt and salmon runs, highlight the increasing influence of the Delta ecosystem on water supply reliability. Any activity proposed for Delta conveyance will need to consider the restoration and preservation of native habitat to benefit pelagic organisms and other native species.
- The integrity of more than 385 miles of Project levees and over 730 miles of non-Project levees throughout the Delta is continually undermined by such elements as storm events creating floods and seawater surges, island subsidence, natural levee erosion, poor quality peat soils used to build the original levees, seismic activity, burrowing animals, and sea level rise. This infrastructure weakness undermines the sustainability of using the Delta as a conveyance corridor. DWR's Delta Risk Management Strategy Phase II report will establish levee standards for the Delta to increase through-Delta water supply reliability. Also, DWR has developed an emergency response plan that has put in place tools to protect the Delta.
- Maintaining optimal water quality within the Delta for both drinking water and for native species habitat will be a challenge. Some of the major constituents of concern are salinity, organic carbon, nutrients, dissolved oxygen, temperature, and turbidity. Control of water quality in a tidal estuary with fluctuating hydrology from season to season and year to year will require well understood and fully inclusive strategies. As water quality requirements can vary and at times conflict among users, the challenge will be to agree upon the implementation strategy.
- Maintenance of in-Delta projects for beneficial uses such as recreational boating and swimming, sport fishing, shipping, agriculture, industrial, and drinking water supply will continue to be an ongoing management challenge for resources and balance as political and fiscal climates evolve.
- Implementation of major conveyance facilities and improvements within the Delta will be costly. The federal, State, and local water agencies will need to combine their efforts to agree on project goals, plans, benefit/cost analysis, and finally fiscal resources such as bonds and user fees.

Recommendations to Promote Conveyance

The following recommendations apply to federal, State, and local water agencies:

1. Improved conveyance. This could take the form of improving the aging infrastructure, increasing existing capacities, or adding new conveyance facilities.
2. Upgrade aging distribution systems that could provide reduced energy needs through improved efficiency and also provide improved water quality by eliminating sources of pollution from degraded pipelines.
3. Promote development of more extensive interconnections among water resources systems such as, and in addition to, the SWP/CVP aqueduct intertie or improved connectivity within the Bay Area. It is likely that leadership and funding on this will be at the local level. Agreements must be solidified in advance to avoid reaching critical impasses during extreme droughts or catastrophic events.
4. Establish performance measures for specific measurable metrics such as quantity of deliveries for agricultural and urban users and miles of rehabilitated conveyance facilities to qualitative indicators such as resiliency of conveyance to earthquakes and fewer regulatory conflicts.
5. Assure adequate resources to maintain existing constructed and natural conveyance facilities and capacity and condition. This may include development of a strategy to maintain channel capacity in areas of the Delta and in flood management facilities. Financially support regional, interregional, and Delta conveyance improvements.

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