VOLUME 3 - RESOURCE MANAGEMENT STRATEGIES

CHAPTER 6

Conveyance — Regional/Local

Alameda County. This intertie project connects the Delta-Mendota Canal and the California Aqueduct via a new pipeline and pumping plant to restore the Delta-Mendota Canal conveyance to 4,600 cubic feet per second to achieve multiple benefits.

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Conveyance provides for the movement of water, geographically connecting the supply to the demand. Conveyance infrastructure includes natural watercourses as well as human-made facilities like canals, pipelines, and flood bypasses. Examples of natural watercourses include streams, rivers, floodplains, and groundwater aquifers. Conveyance facilities range in size from small, local, end-user distribution systems to the large systems that move water to and from distant areas. Conveyance facilities also require associated infrastructure such as pumping plants, diversion structures, fish ladders, and fish screens. Regional and local water supply conveyance is discussed in this chapter. For a discussion of flood conveyance systems and integrated flood management, see Chapter 4, "Flood Management," of this volume.

Conveyance in California

Most of California's precipitation occurs in Northern California, and most of the demand is in Southern California. Delivering the supply to meet the demand requires some of the largest water conveyance systems in the nation. An extensive system of regional and interregional conveyance facilities in the state moves water from a source location to an area where it is used and conveys excess flood flows safely to protect existing resources.

Sacramento-San Joaquin Delta Conveyance

The Sacramento-San Joaquin Delta (Delta), located at the confluence of the Sacramento and San Joaquin rivers, is a critical element of both regional and interregional conveyance systems. The Delta's waterways are interconnected natural streams, sloughs, and constructed canals. The Delta waterways serve as a hub to move water from the drainage basins of the Sacramento and San Joaquin rivers to bays eventually leading out to the Pacific Ocean. The Delta is heavily relied upon to convey water for in-Delta diversions as well as exports for use in the San Francisco Bay area, the San Joaquin Valley, Central Coast, and Southern California. A more thorough discussion of Delta conveyance issues is in Chapter 5 of this volume.

Interregional Conveyance

California has an extensive system of conveyance facilities that move water throughout the state by a combination of natural waterways and constructed facilities. The two largest interregional conveyance projects in California are the State Water Project (SWP) and the federal Central Valley Project (CVP). Both the SWP and the CVP use natural rivers such as the Sacramento, San Joaquin, and Feather as well as the Delta for conveyance. In addition, they rely upon entirely human-made conveyances such as the California Aqueduct, the Delta-Mendota Canal, the Friant-Kern Canal, and the Madera Canal. These natural and human-made conveyances deliver water 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 Southern California. For a map that shows the extensive conveyance systems throughout the state, see Chapter 7, Figure 7-1, "Location of Local, State, and Federal Water Projects."

Local agencies have also developed a number of interregional conveyance systems. For example, the 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 and operates the Los Angeles Aqueduct to convey water from the Owens Valley to Los Angeles. A major Southern California water source continues to be Colorado River water which is diverted and distributed via the All-American Canal, the Coachella Canal, the Palo Verde Canal, and Metropolitan Water District's Colorado River Aqueduct. Each of these conveyance systems is a major distributor of California's water supplies and plays a key role in maintaining California's overall water supply reliability.

Regional Conveyance

At the local level, water is distributed from locally developed sources to the end users located within the same watershed or river system. Existing regional, multi-agency conveyance projects exist in all urban regions of California, particularly the San Francisco Bay area and the Southern California regions surrounding the Los Angeles and San Diego areas. These systems often include emergency interconnects between various agencies, which can be used in events such as earthquakes and fires to transport water when the normal pipelines are inadequate to meet emergency needs or when one delivery system has been taken out of service.

Conveyance systems are necessary to achieve benefits from virtually every other facet of local and regional water management such as desalination, recycling, and water transfers as well as both surface and groundwater storage. Water supplies are of no use without an extensive network of interregional conveyance systems to distribute imported or locally produced water to the end users for immediate use or to storage for future use.

Potential Benefits

Regional and interregional conveyance facilities can provide benefits to flood management, consumptive and non-consumptive environmental uses, water quality improvement, recreation, operational flexibility, groundwater basin conjunctive uses, and both 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. Improvements in system conveyance capacity can be achieved by locating and widening bottlenecks that constrict the movement of water. For example, improved conveyance capacity can increase the amount of available surplus water or exchange water that can be transported for immediate use or stored in a local conjunctive use project, which will enhance the capabilities of groundwater recharge. See Chapter 9 of this volume for a comprehensive discussion of various types of conjunctive water use projects and concepts in California. For the environmental sector, benefits from improved conveyance capacity can be integrated into project design in order to support stream restoration goals such as improved in-stream flows, appropriate water temperatures for fish, channel maintenance, and water quality for aquatic and riparian habitat.

In some cases, improving the reliability of existing water supplies can be just as valuable as increasing overall supply. A system is unreliable when it cannot provide the water when and where it is needed. Conveyance capacity improvements can enhance reliability without augmenting supplies by increasing operational flexibility to move water between storage locations and points of use. For example, water agencies in the Los Angeles, San Diego, and the San Francisco Bay regions have been constructing alternative pipeline transmission facilities between reservoirs in different locations to provide system flexibility and prevent stranded service areas in an earthquake emergency.

Other types of benefits from improved conveyance include:

- Facilitating the movement of water for storage and ultimately to the end users. In order for water to be developed from new groundwater conjunctive use or off-stream surface storage, diversion facilities must have adequate conveyance capacity to fill the storage. Also, facilities must then be in place to convey the water releases from storage to the users at the right times and flow rates.
- Improving water quality by transporting more river water when water quality conditions are high (minimal turbidity and contaminants) and reducing water diversions when water quality is poor.
- Enabling diversions of more water during high river flows with less competitive use periods, and consequently reducing the pressure to divert water during low flow, highly competitive use periods. Given the high-intensity, short duration characteristics of California's hydrology, improved conveyance capacities combined with adequate surface water or groundwater storage make beneficial diversions possible for metered release later in the year. This concept is sometimes referred to as the gulp and sip strategy.
- Providing the operational flexibility to divert and move water at times that are less harmful to fisheries.

Other specific benefits of conveyance improvements are listed below.

- Enlarged and enhanced conveyance systems can 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.
- Conveyance management practices such as spreading basins that slow overland storm event outflows can increase retention and thereby enhance groundwater recharge processes that have been hindered by sprawling impervious surfaces characteristic of urbanization.
- Effective incorporation of best management practices for storm water runoff, storm water retention basins, and grassy swales, for example, can reduce peak flows, contribute to groundwater recharge, and filter out non-point-source pollutants such as sediments and heavy metals. This, in turn, decreases the burdens on management for system conveyance, flood control, and water quality. Reducing peak discharge from heavy precipitation events in particular will decrease the demand on the conveyance system.
- Increases in resiliency to extreme events by employing 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 results from enlarged conveyance capacity that allows 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

Potential conveyance costs vary significantly and can include both facility and operating costs which can be a significant portion of the costs in a water management system. These costs generally depend on how far the water needs to be conveyed, timing, and topography (for example, pumping vs. gravity flow). It costs less to convey water from DWR's Oroville Dam to the Delta via gravity flow through largely natural systems than to convey water from the Delta to Southern California through a constructed conveyance system with canals and pumps. With additional conveyance capacity, flexible management strategies can help control costs, for example, by moving water during off-peak energy demand periods when power costs are lower. Below are examples of significant conveyance projects and their costs.

- In 2010, the Contra Costa Water District (CCWD) finished construction of a screened intake on Victoria Canal in the Delta that would relocate some of CCWD's diversions to obtain better source water quality and shift diversions from a then unscreened Rock Slough intake. The total project cost, including planning, design and construction, was just less than $100 million.
- In 2011, the U.S. Bureau of Reclamation constructed a fish screen at Rock Slough which allows more use of the intake during high-flow, good water quality conditions rather than the more expensive CCWD Old and Middle River diversions. Water from the Delta is diverted at Rock Slough for the Contra Costa Canal which is CCWD's major water supply and delivery system. Rock Slough was one of the largest unscreened Delta diversions. Cost of the fish screen structure was about $26 million.
- The Freeport Regional Water Project (FRWP) was completed in 2010 settling a 40-year debate over East Bay Municipal Utility District's (EBMUD's) federal contract for American River water rights. The project is a cooperative effort between the Sacramento County Water Authority (SCWA) and EBMUD to supply surface water from the Sacramento River to customers in central Sacramento County and the East Bay in Alameda and Contra Costa County. SCWA and EBMUD share a screened intake capacity of 185 million gallons per day (mgd). SCWA will receive 85 mgd. EBMUD will receive 100 mgd in dry years to supply its customers in the San Francisco Bay area. The intake, fish screen, pumps, canals, and 17-mile pipeline connecting to EBMUD's Mokelumne Aqueducts cost approximately $1 billion.
- The CVP/SWP intertie project connects the Delta-Mendota Canal and the California Aqueduct via a new pipeline and pumping plant to restore the Delta-Mendota Canal conveyance to 4,600 cubic feet per second (cfs) which improves CVP water deliveries to south of Delta contractors, provides capability to more frequently fill CVP San Luis earlier in the water year, allows for maintenance and repair activities, and provides the flexibility to respond to CVP and SWP emergency water operations. The project went online in the spring of 2012 at a cost of $20 million.
- In an effort to increase water delivery flexibility, the Cross Valley Canal (CVC) was constructed in 1975 to deliver State Water Project (SWP) water from the California Aqueduct to urban Bakersfield. The delivered water is then used for agricultural, municipal, and water recharge purposes. The Kern County Water Agency contracted with various water districts for CVC construction and operation. The first 17 miles of its 21.5-mile length are concrete-lined to minimize water losses while the remaining section is unlined to facilitate ongoing

percolation (recharge) to the aquifer. In 2005, the CVC Expansion Project began in an effort to increase the ability to accept imported water from the SWP. This represents incredible infrastructure, with the CVC connecting to the California Aqueduct, local groundwater banking projects, Kern County Water Agency's Henry C. Garnett Water Purification Plant, and the Friant-Kern Canal. The expansion was completed in January 2012 at a cost of approximately $78 million.

- The Red Bluff Fish Passage Project was completed in the winter of 2012 and consists of a screened replacement intake on the Sacramento River for the Tehama-Colusa and Corning canals. The screens replace the operation of the Red Bluff Diversion Dam, which was an impediment to several salmonid species and green sturgeon recently listed under the Endangered Species Act. The screened pumping plant improves fish passage conditions while ensuring continued water deliveries to 150,000 acres of high-value cropland. New project features include construction of a flat-plate fish screen, intake channel, 2,500 cfs capacity pumping plant, access bridge, and discharge conduit to divert water from the Sacramento River into the Tehama-Colusa and Corning canals. These new features maintain and ensure conveyance capacity into the future. This joint project between the U.S. Bureau of Reclamation and the Tehama-Colusa Canal Authority cost approximately $190 million.

Major Implementation Issues

Managing California's water conveyance systems requires persistent efforts to address chronic issues, such as maintenance of an aging infrastructure, while simultaneously addressing new issues, such as direct and cumulative impacts to fish, wildlife, and environmental habitat (refer to Chapter 8, "Water Transfers," under the heading "Recommendations for Water Transfers" for more information). Along natural waterways and rivers, significant issues involve flooding impacts to adjacent lands and levee maintenance.

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 and diminishing conveyance capacity in natural watercourses. 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 floodwaters. The cost of maintenance is likely to become more significant over time due to the increasingly higher costs and the increasing ecosystem and population demands.

Science and Planning

Water managers, planners, and biologists continue to identify and understand the relationships among hydrodynamics, flow timing, species response, water temperature, geomorphology, water quality, environmental responses, global climate change, and other conveyance-related considerations so that they can optimally plan, develop, operate, and maintain natural and constructed conveyance infrastructure. The Bay Delta Conservation Plan and the Delta Stewardship Council's Delta Plan processes have been studying these factors to develop plans to improve the operation of the state's conveyance systems with a balanced approach to meet the needs of its people and the environment. In addition to the Delta, these studies include regions where export demands must be met, flood control improvements are needed, water quality improvements are being sought, and in-stream fisheries and their habitat must be protected and restored.

The U.S. Army Corps of Engineers' Long-Term Management Strategy outlines dredging and levee maintenance work needed to maintain conveyance in the Delta. DWR's Delta Risk Management Strategy seeks to establish Delta levee standards in order to increase through-Delta water supply reliability by decreasing the chance of levee failures and subsequent conveyance impacts.

Regulatory Compliance

Operation of conveyance facilities must comply with various laws, regulatory processes and statutes such as the Public Trust Doctrine, Area of Origin statutes, California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), the Clean Water Act, and the Endangered Species Act. Proposed new conveyance projects must comply with the above regulations, especially the required CEQA and NEPA environmental evaluation and disclosure requirements.

Emergency Water Supply Reliability

Existing conveyance facilities do not provide long-term reliability to meet current and projected needs. To meet needs under changing conditions, improvements such as updating aging infrastructure, upgrading existing capacities, and constructing additional facilities must be made.

Greater interconnections are needed to help improve water supply reliability. Each water system has its own water supply reliability level based largely on storage and conveyance systems, hydrology, and the demand schedule timing and magnitude. Operational flexibility, particularly during emergency conditions, is a primary benefit of greater water system interconnections, as demonstrated during previous droughts.

Area of Origin Interests

Interregional movement of water is sometimes opposed by the water users or agencies located in the watershed where the water supply originates. Area of origin interests, like interests in the export areas, need to augment local supplies to meet growing demands. Downstream water users could derive multiple benefits (water quality, water quantity, flood control) from investing in projects and programs in the upper watersheds from which their water originates.

Ultimately, it is important for all interests to strike a balance that provides for the needs of all of California.

Climate Change

Climate models project that average temperatures are expected to continue to rise several degrees by the end of this century. With warmer temperatures, the state can expect more precipitation to fall as rain instead of snow leading to a reduction in snowpack, which serves as a natural form of storage. In the past decade we have seen a gradual shift in snowpack and runoff timing in California, where runoff is occurring earlier in the year than expected. Although climate temperature models have a higher degree of certainty, it isn't fully understood how total precipitation will be affected by climate change. Climate precipitation models project little change in precipitation in California before 2050; projections after 2050 suggest even more uncertainty with either more or less precipitation; however, projections estimate that flood magnitudes will increase by the end of the century. Additionally, with global temperature rise, corresponding sea level rise is projected to impact low-lying areas in the Delta.

Mitigation

Energy intensity for regional/local conveyance ranges from low to high depending on whether water is distributed with the infrastructure system using extensive energy. For example, some local conveyance uses gravity to distribute water, which may have the benefit of using very low energy or perhaps generating electricity. Improving conveyance system efficiency will have benefits for climate change mitigation. Local conveyance management strategies discussed in this chapter provide new opportunities to reduce energy use and greenhouse gas emissions:

1. Improving conveyance system efficiency by (a) upgrading the aging infrastructure to reduce water leakage and related loss will improve infrastructure and energy efficiency to reduce energy uses and related greenhouse gas emissions; and (b) increasing existing capacities, or adding new conveyance facilities, could increase capacities of local water supplies, thereby reducing the need for more energy-intensive water supplies, especially in Southern California. However, there could be tradeoffs in energy usage with increasing existing capacities, or adding new conveyance facilities at specific locations, if water is then distributed using energy intensive pumping without using gravity.

2. Upgrading aging water distribution systems to improve energy efficiency and water quality by eliminating sources of pollution from degraded pipelines to save energy from water treatment, could also provide greenhouse gas (GHG) mitigation benefits by reducing energy use.

3. Promoting development of more extensive interconnections among water resources systems also enhances efficiency of conveyance systems with possible energy efficiency, which could have GHG mitigation potential.

4. Ensuring adequate resources, establishing performance metrics, and creating energy efficiency measures could provide energy reduction and GHG mitigation potential for local conveyance systems.

Adaptation

Anticipated effects of climate change including changes in flow timing, altered precipitation patterns, and increased flooding have the potential to dramatically impact existing conveyance. Infrastructure improvements and efficiency enhancements will not only benefit present-day operation and resilience of the systems but will also reduce vulnerabilities to prepare for an uncertain hydrologic future.

Development of adaptation strategies to a changing climate is dependent upon identifying conveyance system vulnerabilities. Vulnerabilities mentioned in this chapter include aging facilities and lack of resilience and redundancy to respond to natural disasters such as earthquakes and floods. Changing climate and hydrology have the potential to intensify existing vulnerabilities, for example, increased magnitude or changes in timing of peak flood flows.

Potential dual-purpose or no-regrets strategies outlined in this chapter should be considered by planners to address both existing and climate induced vulnerabilities:

- Improving infrastructure and increasing capacity for enhanced flood control capability and beneficial water transfer.
- Management practices that enhance groundwater recharge and quantify conveyance efficiency.
- More interconnections between conveyance systems for future operational flexibility and redundancy.

Recommendations

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

1. Improve conveyance systems. This could take the form of improving the aging infrastructure, increasing existing capacities, or adding new conveyance facilities. New conveyance could increase opportunities for further conjunctive water use in areas with depleted groundwater. Installation of state-of-the-art fish screens also improves supply reliability by reducing ecosystem constraints on the water system.

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 and Southern California. It is likely that leadership and funding on this will be at the local level. Agreements should be solidified in advance to avoid critical impasses during extreme droughts or catastrophes.

4. Establish performance metrics for quantitative indicators, such as quantity of deliveries for agricultural and urban users and miles of rehabilitated conveyance facilities, and qualitative indicators, such as resiliency of conveyance to earthquakes and fewer regulatory conflicts.

5. Assure adequate resources to maintain the condition and capacity of existing constructed and natural conveyance facilities. 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.

Other Resource Management Strategies

This chapter, "Conveyance — Regional/Local," is closely related to:

- Chapter 2, "Agricultural Water Use Efficiency."
- Chapter 3, "Urban Water Use Efficiency."
- Chapter 7, "System Reoperation."
- Chapter 8, "Water Transfers."
- Chapter 12, "Municipal Recycled Water."
- Chapter 13, "Surface Storage — CALFED."

This chapter, "Conveyance — Regional/Local" is also related to:

- Chapter 4, "Flood Management."
- Chapter 24, "Land Use Planning and Management."

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