CAP – ADD Water Project Support

Phase 1: Final Draft Report
Water Resources Allocation Case Studies
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1. EXECUTIVE SUMMARY

In May of 2007, the Central Arizona Project (CAP) launched a stakeholder participation process called Project ADD Water. The focus question for the ADD Water Stakeholder Process is:

> Assuming CAP is to be the primary entity that acquires, develops and delivers new water supplies for its three county service area, how should the water be shared and paid for?

As part of this process, stakeholders were asked what information they needed to answer the focus question. In response, stakeholders produced nearly 90 data requests. CAP staff, in response to these requests, contracted with the Arizona Water Institute (AWI) through the Global Institute for Sustainability (GIOS) at Arizona State University (ASU) to conduct case studies of regional water authorities and to provide related technical assistance. This report presents the findings of these case studies.

CAP staff asked that the case studies focus on entities from the Southwest U.S., but also consider entities elsewhere in the US, in other arid regions of world, and elsewhere as relevant. ADD Water Project Team leaders and stakeholders articulated 12 questions they wished to see addressed in the case studies:

1. Legal basis and organizational structure of the entity.
2. Types of end users: municipal, industrial, agricultural or a combination.
3. Types or service: wholesale, retail or a combination.
4. Quality of water delivered: raw water, treated water or a combination.
5. Sources of water: surface, effluent, desalinated groundwater.
6. Basis of delivery volumes: baseline, peaking or supplemental, as in drought supplies.
7. Basis of end users' entitlement to water deliveries: formal allocation, legal contract, annual order submittal or other.
8. Water rights/entitlements: held by individual end users, held by delivery entity or other.
9. Significant 'sidebars' on delivery: direct delivery into treatment plants; prior use of other available supplies.
10. Method of allocating water acquisition costs among end users.
11. Method of allocating infrastructure/development costs among end users.
12. Method of allocating variable delivery costs among end users.

In particular, participants in the CAP ADD Water discussions were interested in examples of how new water supplies developed by regional entities have been apportioned among local water providers and how costs were allocated between the local water providers and water users.

The remainder of this executive summary provides a very brief overview of the thirteen case studies and the various mechanisms for apportioning supplies and costs. A table briefly

summarizing the thirteen case studies is attached. Finally, the remainder of this report contains more detailed case study descriptions and references.

I. Regional water management entities

Regional approaches to acquiring new supplies are sometimes viewed as a way to share the costs of new water supply and infrastructure development. Regional approaches may also reduce competition for water, but this is only effective if individual water providers and decision makers believe a water authority will protect their interests and be able to use its purchasing and negotiating power and cost sharing potential to reduce costs. Successful regional efforts must also balance the differing needs and jurisdictional autonomy of their members. The thirteen regional water management efforts considered in this report represent a range of approaches.

Six of the case studies focused on a particular regional entity, five of the cases addressed a particular water transfer and two of the cases looked at both the entity and a particular transfer. All but one of the case studies looked at municipal water deliveries, about half of the cases involved municipal and industrial deliveries only and half also served agricultural customers. The majority of the entities examined only provided wholesale water, but two also served significant retail uses and one only served retail customers. Treated drinking water was delivered by four of the entities, eight delivered only raw water to their wholesale customers and one delivered both. In most cases, eight of the thirteen, the regional entity held any water rights involved. In three cases the customers themselves held the right. Two of the cases focused on temporary water transfers where the water right remained with the leasor. Finally, the case studies were equally divided between those that were serving a base water supply, those serving supplement supplies or supplies for new growth, and those entities meeting both types of demand.

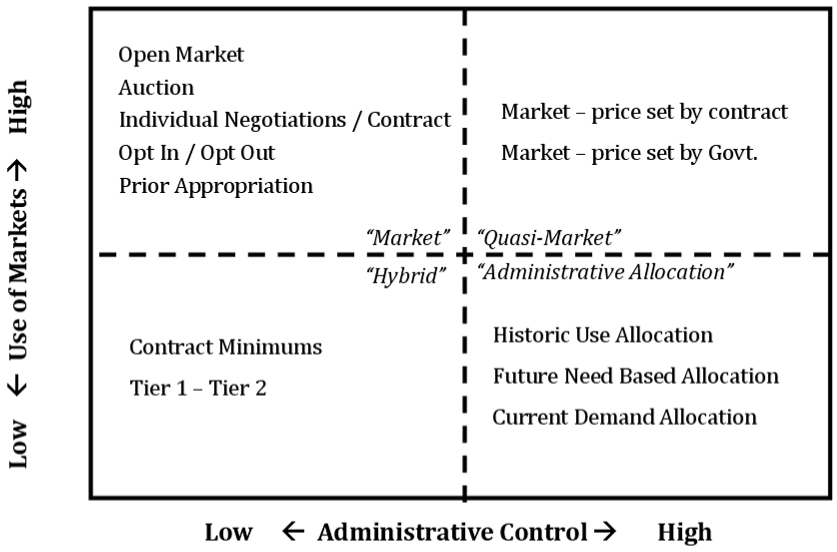
II. Apportioning new water

Figure 1 identifies supply apportionment mechanisms, some of which are represented in the case studies. Among the many ways such mechanisms could be characterized, this diagram focuses on two distinct continuums. First, to what degree are markets utilized. Open market transactions between a willing buyer and willing seller, where there are sufficient participants in the market so that no one entity can determine the price, where information is freely available and the costs of actually making a water transaction are low; is an example of a pure market approach. Although examples of such open markets are rare for water, various mechanisms contain at least some market components. The second continuum looks at the degree of administrative control over the apportionment of water supplies. The original CAP allocations, done by state and federal agencies based on estimates of unmet future water demand, are a high level of administrative control example. Numerous other apportionment mechanisms are arrayed in the diagram along these continuums. The exact positioning of individual mechanisms can certainly be debated and additional mechanisms could be added, but it is hoped this figure helps to illuminate the case studies and the options available.

Figure 1

Water Supplies: Who Gets The Water

Supply Apportionment Mechanisms



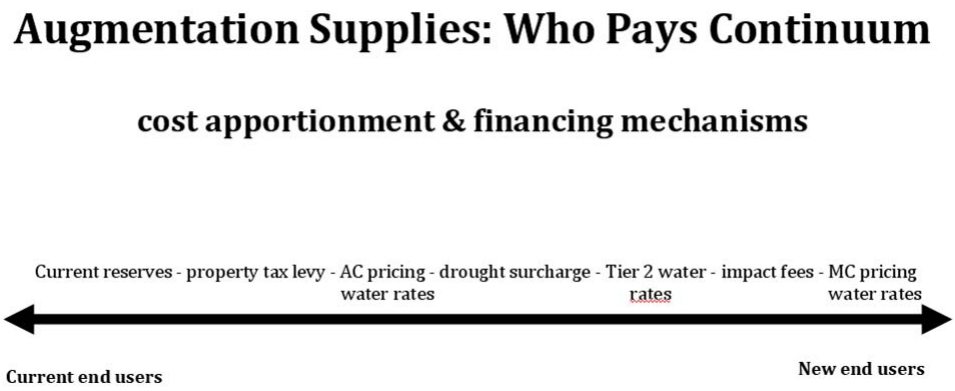
Several of the Project ADD Water participants were particularly interested in examples where market mechanisms were used to distribute and price water. Five of the cases are principally market based. Another five are categorized as "quasi-market" meaning that being a willing buyer, rather than an agency allocation, determined the supply available to the member, but the price was set by a non-market mechanism. Finally, in three of these cases historic water rights or agency allocations were utilized.

III. Apportioning the costs of new water acquisition and infrastructure

Figure 2 illustrates a number of different mechanisms for apportioning the cost of supply augmentation. These mechanisms are arrayed along a continuum of who pays. At the far left, current customers pay the full cost, with current cash reserves being used to pay all augmentation costs up front. At the far right, marginal cost pricing is applied, whereby the incremental and typically higher cost for developing and delivering new supplies would be completely covered through water rates charged to those generating the new demand. Other financing mechanisms, some based on water rates, others on taxes and impact fees are arrayed along this continuum. The case studies illustrate many of these options.

In two of the case studies, the CA Drought Bank and the North Texas Municipal Water District, marginal cost pricing mechanisms were used. For four of the cases, average cost, melded or what are often called postage stamp water rates, were utilized. Seven of the cases utilized a mix of these approaches.

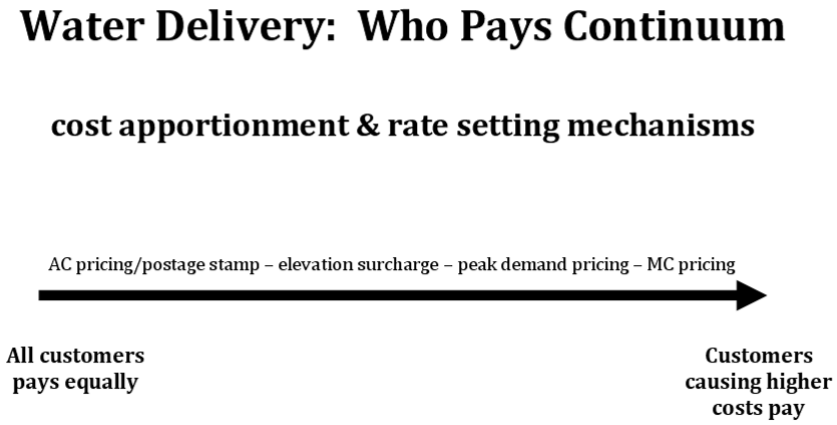
Figure 2



IV. Apportioning the costs of treatment and delivery

Figure 3 provides a similar continuum for mechanisms to set water delivery rates. In this case, the continuum goes from the far left where all water users pay equally to the far right where costs are attributed to and recovered from the customers whose use actually generates the higher costs. As indicated in the previous section, the case studies provide evidence on the use of several of these mechanisms

Figure 3



2. NATIONAL CASE STUDIES

I. Arizona case studies

A. Central Arizona Water Conservation District

1. Background, legal basis and organizational structure

The Central Arizona Water Conservation District (CAWCD) is a multi-county water conservation district created pursuant to Arizona law, A.R.S. § 48-3701 *et seq*. It was formed by Maricopa, Pima and Pinal counties in 1972 for the purpose of contracting with the Secretary of the Interior to repay the reimbursable costs of constructing the Central Arizona Project (CAP) and to deliver the project's water supply. CAWCD also operates and maintains the Central Arizona Project (CAP).

CAWCD is governed by a 15-member Board of Directors popularly elected by voters in each of its three counties. There are 10 members from Maricopa County, 4 from Pima County and 1 from Pinal County.

2. Types of end users: municipal, industrial, agricultural or a combination

CAWCD's customers are a combination of: (1) municipal and industrial (M&I) users, such as cities, towns, and private water companies; (2) non-Indian agricultural (NIA) users, primarily irrigation districts organized under Arizona law; and (3) Indian tribes.

3. Types or service: wholesale, retail or a combination

CAWCD provides wholesale water service to its three-county service area. Most of CAWCD's customers are municipal providers, Indian communities or agricultural districts, but CAWCD also provides water to some individual agricultural and industrial users, including golf courses, power plants and nurseries.

4. Quality of water delivered: raw water, treated water or a combination

CAWCD sells raw water to its customers. It offers no water treatment services.

5. Sources of water: surface, effluent, desalinated groundwater.

The water delivered by CAWCD is primarily surface water from the Colorado River. CAP may also recover surface water that was previously stored underground. From time to time, CAWCD gets a small amount of surface water from the Agua Fria River, which is captured in Lake Pleasant behind New Waddell Dam.

6. Basis of delivery volumes: baseline, peaking or supplemental, as in drought supplies

The use of CAP water varies by customer. For some, CAP is their primary, if not sole, water supply. Most CAP customers also rely on groundwater to some extent, as permitted under state law. A few have additional sources of water available, such as from the Salt River Project. For those users, CAP water may be used as a partial drought supply—e.g., those customers may increase their CAP deliveries to make up for shortfalls in other supplies.

For the most part, CAP water is a base supply. But CAP water is used to meet some peaking demands in the hot summer months. Agricultural deliveries, in particular, are significantly higher in the summer.

7. *Basis of end users' entitlement to water deliveries: formal allocation, legal contract, annual order submittal or other*

Under section 5 of the Boulder Canyon Project Act of 1928 and the U.S. Supreme Court decree in Arizona v. California, 376 U.S. 340 (1964), Colorado River water may only be used pursuant to a contract with the U.S. Secretary of the Interior. All such contracts must be for permanent service. CAWCD holds the master contract with the Secretary of the Interior for the CAP water supply.

In 1983, the Secretary of the Interior allocated the long-term CAP supply to various water users in central Arizona.[1] The Secretarial allocations to M&I and NIA water users were based on the recommendations of the Arizona Department of Water Resources (ADWR). In developing its recommendations for municipal allocations, ADWR started with population projections for each provider's service area, assumed a common rate of usage (gallons per capita day, gpcd), then subtracted the dependable supply available to each provider from sources other than CAP.

Following the allocations, CAWCD and the Secretary of the Interior, acting through the Bureau of Reclamation (Reclamation), entered into subcontracts with M&I and NIA water users for the delivery of CAP water. The Secretary of the Interior contracted directly with Indian tribes for the delivery of CAP water. Under its master water delivery contract, CAWCD is obligated to delivery water to Indian tribes pursuant to their contracts with the Secretary.

CAP water users submit annual water orders to CAWCD up to the limit of the entitlement specified in the individual CAP contracts and subcontracts.

8. *Water rights/entitlements: held by individual end users, held by delivery entity or other*

As noted above, CAWCD holds the master contract with the Secretary of the Interior for the delivery of Colorado River water through the CAP. Individual CAP contracts and subcontracts entitle water users to take a specific maximum amount of CAP water annually. Most CAP contractors and subcontractors are water providers themselves: municipal providers treat and deliver CAP water to homes and businesses in their service areas; irrigation districts deliver untreated water to individual farms; Indian communities deliver treated or untreated water to tribal members.

9. *Significant 'sidebars' on delivery: direct delivery into treatment plants; prior use of other available supplies*

There are a number of conditions on CAP water deliveries:

[1] There have been many CAP allocation decisions over the years, but the key decision is that of Secretary Watt published in the Federal Register on March 24, 1983, which defined the allocations to M&I water users that are reflected in the current long-term M&I water service subcontracts.

- Use of CAP water must be consistent with Arizona water law and federal law applicable to the CAP;
- The system through which CAP water is conveyed after delivery to the contractor or subcontractor must be maintained with linings adequate to prevent excessive conveyance losses;
- Subcontractors are prohibited from pumping groundwater from within their service area for use outside their service area;
- Non-Indian subcontractors may not sell, lease, exchange, forbear or otherwise transfer CAP water, except under certain narrow circumstances. Indian contractors may lease their CAP entitlements only if expressly authorized in a water rights settlement agreement approved by Congress; and
- Plans for use of CAP water are subject to environmental review by Reclamation.

Furthermore, all CAP water deliveries are subject to the availability of Colorado River water in any year. CAP shares the junior priority among all water users in the Lower Colorado River basin.

10. Method of allocating water acquisition costs among end users

Under its master contract, CAWCD must pay the United States $0.25 for each acre-foot of Colorado River water diverted for M&I use. The total annual cost is insignificant and is paid by CAWCD from water sales and tax revenues.

11. Method of allocating infrastructure/development costs among end users

CAP is a multipurpose project constructed by Reclamation. CAWCD is obligated under its master contract to repay the costs of CAP construction allocated to commercial power and non-Indian water supply. The amount of CAWCD's repayment obligation was the subject of federal litigation, which was eventually settled. Under the settlement, CAWCD's repayment obligation for the CAP is approximately $1.65 billion. The majority of that obligation will be repaid with proceeds from the sale of surplus project power. A portion will be repaid by M&I subcontractors through a capital charge. The M&I subcontracts require annual payment of a capital charge, established by CAWCD, for each acre-foot of CAP entitlement, regardless of how much CAP water is actually used by the subcontractor in that year. The remainder of CAWCD's repayment obligation will be repaid using ad valorem tax revenues collected by CAWCD.

12. Method of allocating variable delivery costs among end users

CAP contractors and subcontractors pay both a fixed operation, maintenance and replacement (OM&R) charge and a pumping energy charge. The fixed OM&R charge is determined by dividing all fixed O&M costs by the projected total water volumes for that year and adding a component to fund capital replacements. This amount is collected on all ordered water whether delivered or not. The pumping energy charge is determined by dividing net pumping energy costs by projected deliveries. This amount is collected only for water actually delivered as opposed to scheduled.

B. Central Arizona Groundwater Replenishment District

1. Legal basis and organizational structure of the entity

The Central Arizona Groundwater Replenishment District (CAGRD) is the name by which the replenishment authorities given to the Central Arizona Water Conservation District (CAWCD) are referred. In 1993, CAWCD's authorities were expanded to include replenishment services within its three-county service area. These authorities are defined in A.R.S. Title 48, Chapter 22, Article 4 (§ 48-3771 *et seq*.). The CAGRD operates as a department within CAWCD. However, all costs associated with replenishment services are segregated from other CAWCD costs and must be paid exclusively by CAGRD members.

2. Types of end users: municipal, industrial, agricultural or a combination

CAGRD provides replenishment services for two types of members: Member Lands (individual subdivisions) and Member Service Areas (the entire service area of a city, town, domestic water improvement district or private water company). Thus, CAGRD's end users are primarily municipal, industrial and commercial in nature. Membership in the CAGRD is voluntary and is attained when a representative of the subdivision (the developer or landowner) or service area (the municipal water provider) complies with qualification requirements outlined in statute. Under current law, CAGRD cannot deny membership if statutory requirements are satisfied.

3. Types or service: wholesale, retail or a combination

CAGRD does not actually deliver water to its members. Instead, membership in the CAGRD expands its members' ability to use groundwater legally. This expanded groundwater use must be replenished by the CAGRD. The replenishment service for Member Lands is paid directly by the property owner as an assessment that is included as part of its annual County property tax bill. Property owners within Member Service Areas do not pay an assessment directly to CAGRD. Instead, the municipal provider serving the service area pays a replenishment tax to CAGRD and, generally, passes the cost on to individual property owners in its water rates.

4. Quality of water delivered: raw water, treated water or a combination

As indicated above, CAGRD does not deliver water directly to its members. Instead, it delivers water to replenishment facilities. To date, CAGRD has used raw CAP water to meet its replenishment obligations. In the future, CAGRD will contract for other water supplies (e.g., effluent) that must be treated prior to replenishment.

5. Sources of water: surface, effluent, desalinated groundwater

CAGRD has the authority to use virtually all types of water to meet its replenishment obligations except groundwater withdrawn from within an Active Management Area. To date, CAGRD has used primarily CAP water for replenishment. However, a small portion of its obligations have been met using credits accrued with treated effluent. CAGRD's current Plan of Operation identifies a portfolio of water supplies that are potentially available to CAGRD and includes Colorado River water (both CAP and non-CAP), effluent, and imported groundwater.

6. Basis of delivery volumes: baseline, peaking or supplemental, as in drought supplies

As indicated above, CAGRD does not deliver water directly to its members. Instead, it replenishes excess groundwater used by its members. Depending on the member, the use of excess groundwater can be as a baseline supply, a peaking supply or a supplemental supply. The volume

of excess groundwater use by a member (and CAGRD's corresponding replenishment obligation) could also be affected by drought. For example, if a member generally relies on a volume of surface water that is reduced due to drought, the member's use of excess groundwater may increase. In any case, CAGRD must satisfy its replenishment obligation within three years of incurring the obligation.

7. Basis of end users' entitlement to water deliveries: formal allocation, legal contract, annual order submittal or other

Enrollment in the CAGRD is a de facto allocation of water supplies. CAGRD members' entitlement to water is generally based on their legal right to use groundwater and the limitations identified in the State's Assured Water Supply Rules. Enrollment of a parcel of land or a service area in the CAGRD proves consistency with the management goal of the AMA in which the member is located. Providing this proof, along with proof that groundwater is physically available to serve the subdivision/service area, allows the member to receive a Certificate or Designation of Assured Water Supply from the Arizona Department of Water Resources, effectively increasing the volume of groundwater that can be used for the subdivision/service area. Once enrolled, when the member begins using Excess Groundwater, CAGRD is required by law to acquire a renewable water supply and replenish the Excess Groundwater used by the member. In 2001, CAGRD began including, in its Member Service Area agreements, a limit on the volume of groundwater use that a Member Service Area can report as excess groundwater in any year. If the member wants to increase that limit, it must receive approval from the CAWCD Board of Directors.

8. Water rights/entitlements: held by individual end users, held by delivery entity or other

As indicated above, individual members maintain their own rights to groundwater. The water that CAGRD uses to meet its replenishment obligations will be used pursuant to water rights held by CAGRD, not by individual members.

9. Significant 'sidebars' on delivery: direct delivery into treatment plants; prior use of other available supplies

The only significant sidebar on CAGRD replenishment services is the limit on reported excess groundwater use that is included in all Member Service Area agreements executed since 2001. Other than that, CAGRD has no control on the volume of excess groundwater use by its members (and, consequently, on the volume of renewable water supplies that it must acquire to meet its replenishment obligations).

10. Method of allocating water acquisition costs among end users

Water acquisition costs are paid through a combination of uniform fees and assessments. The majority of the costs (60-70%) are paid through a uniform annual "per-acre-foot" assessment rate collected from all members based on the volume of Excess Groundwater use reported for the prior year. In addition, a uniform "per-residential-housing-unit" Enrollment Fee is collected when Member Lands apply for enrollment in the CAGRD. Enrollment Fees are designed to cover 5-15% of the water acquisition costs. Finally, a uniform "per-residential-housing-unit" Activation Fee is collected when a subdivision located within a CAGRD Member Land or Member Service Area applies with the Arizona Department of Real Estate for a Public Report allowing the marketing of

parcels within the subdivision. Activation Fees are designed to cover 20-30% of the water acquisition costs.

11. Method of allocating infrastructure/development costs among end users

Infrastructure/development costs are paid through the same combination of uniform fees and assessments as described above for water acquisition costs.

12. Method of allocating variable delivery costs among end users

For CAGRD, variable delivery costs are those costs associated with transporting water from its origin to a replenishment facility. The costs include all losses associated with generating a replenishment credit that can be used to offset CAGRD's replenishment obligation. The costs are allocated uniformly within each AMA based on the costs to satisfy the replenishment obligation within that AMA. Members pay an annual "per-acre-foot" assessment based on the volume of Excess Groundwater used in the prior year.

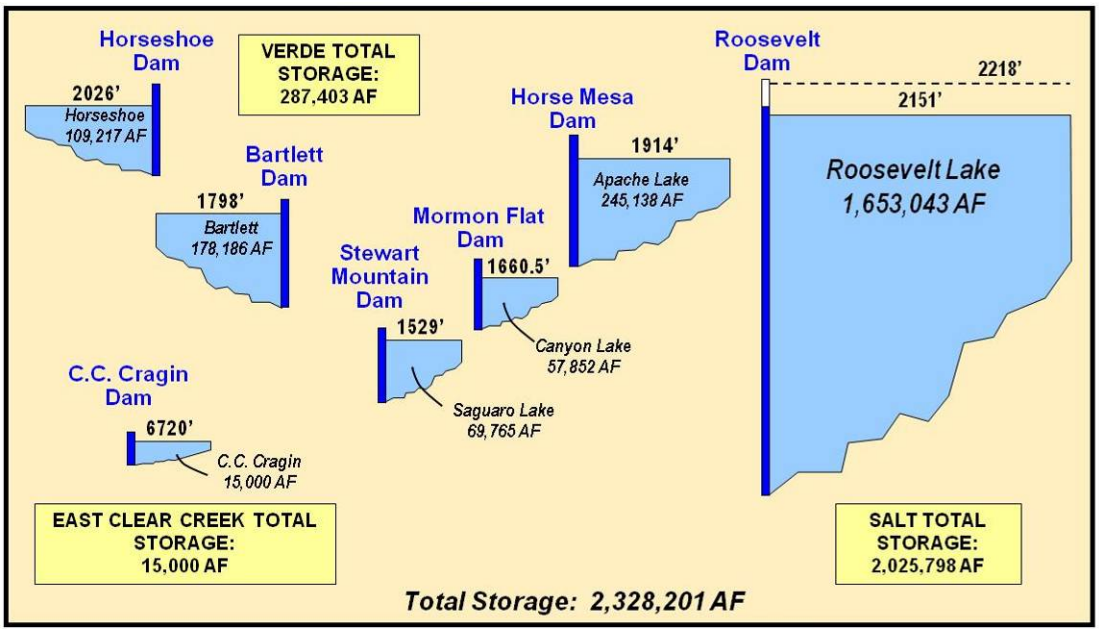
C. Salt River Project

1. Background, legal basis and organizational structure

SRP was established in 1903 as the nation's first multipurpose federal reclamation project. SRP is made up of two organizations: the Salt River Valley Water Users' Association (Association) and the Salt River Project Agricultural Improvement and Power District (District).

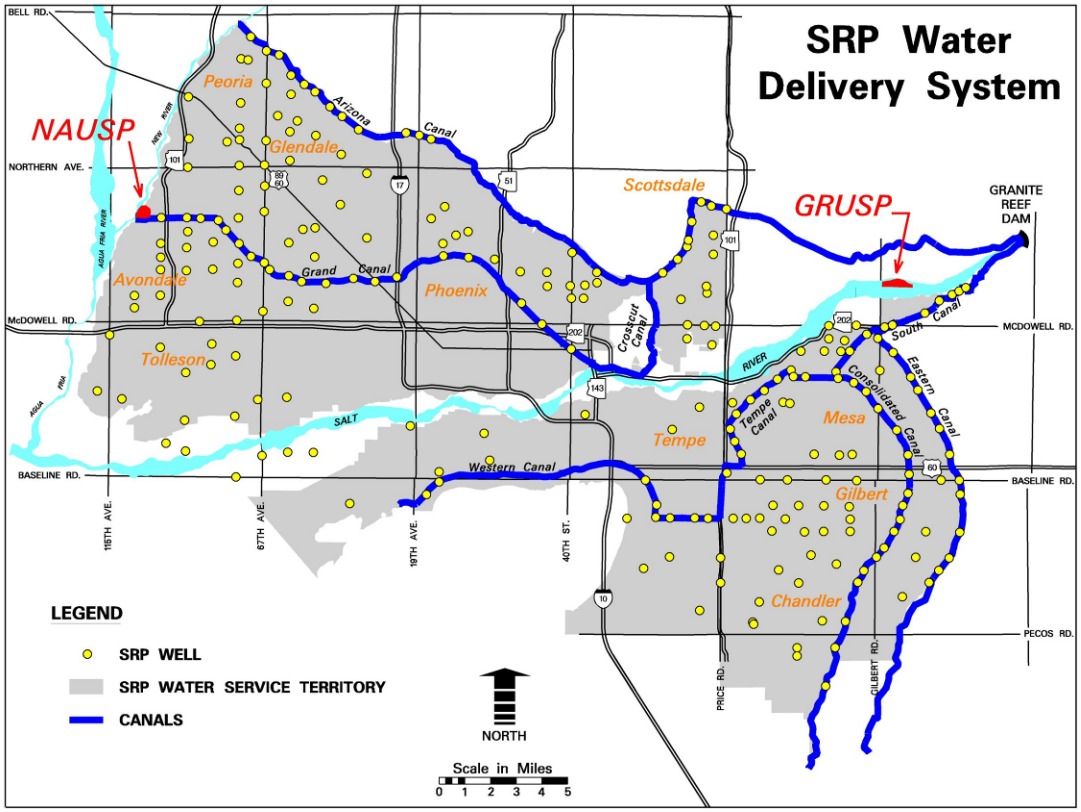
Certain lands within the Association's water service area have rights to the waters of the Salt and Verde rivers (and other resources), and the Association is responsible for the delivery of water developed, controlled, or stored by the Association (see Figure 1) for the benefit of such lands (see Figure 2).

Figure 1: SRP Reservoir System Capacities (acre feet)



For illustrative purposes only. Subject to change.

Figure 2: SRP Water Delivery System/Water Service Area



For illustrative purposes only. Subject to change.

Depending on current and projected reservoir levels, watershed conditions, and demand, the Association delivers up to 1 million acre feet per year.

2. *Types of end users*

Domestic, municipal, agricultural, recreation, power, and other beneficial uses.

3. *Types of service*

The Association is a raw water provider to those lands having water rights described above.

4. *Quality of delivered water*

Since the Association delivers raw water, the quality of the water is dependent on the sources being utilized (e.g., Salt River, Verde River, groundwater, etc.).

5. *Sources of water*

Salt River, Verde River, and groundwater. Excess CAP water is also used for reservoir management (drought mitigation), power generation, and agricultural purposes under the terms of the excess CAP water agreements with CAWCD.

6. *Basis of delivery volumes*

Water delivery amounts vary depending on reservoir levels, water demand, and other factors.

7. *Basis of end users' entitlements*

In general, end-user entitlements (allocations) are established (1) by the Association's Board of Governors for those lands (Member Lands) within the Association's water service area pursuant to the Association's Articles of Incorporation and By-Laws, and federal reclamation law; and (2) pursuant to contractual or decreed arrangements.

For example, contingent on approval by the Association's Board of Governors, the allocation for Member Lands is expected to be 3 acre feet per acre (all surface [stored] water) during calendar year 2009.

8. *Water rights/entitlements*

See paragraph 7 above.

9. *Significant 'sidebars' on delivery*

Water Delivery Limitations: As provided in the Association's Articles of Incorporation and federal reclamation law, water delivered by the Association must be used on the lands to which the appurtenant water rights are attached, unless pursuant to a lawful water exchange.

Municipal Deliveries: The majority of Association deliveries are to the ten municipalities located within the Association's water service area (see Figure 2). Such deliveries are administered under the Water Delivery and Use Agreement (WDUA) with each municipality.

In general, the WDUA establishes the "agency" relationship between the municipality and those lands having water rights within the Association's water service area (Eligible Lands; includes Member Lands), and governs the municipality's receipt and delivery of such water to Eligible

Lands (via water treatment plants, etc.). The WDUA also provides for water exchanges between the municipality and the Association (subject to Association approval).

10. Method of allocating water acquisition costs among end users

The Association's Board of Governors establishes the rates (assessments, fees, and other charges) for Member Lands. Rates and fees for lands covered under contracts or decrees are as provided in such contracts or decrees.

11. Method of allocating infrastructure/development costs among end users

See paragraph 10 above.

12. Method of allocating variable delivery costs among end users

See paragraph 10 above.

II. California case studies

A. Metropolitan Water District of Southern California-Palo Verde Irrigation District water transfer

1. Background, legal basis and organizational structure

The Metropolitan Water District of Southern California (MWD) has a federal contract for the "delivery of the following quantities of Colorado River water: (1) A fourth priority for beneficial consumptive use on the Coastal Plain of Southern California of 550,000 AFY and (2) a fifth priority for beneficial consumptive use on the Coastal Plain of Southern California of 662,000 AFY" (PVID, 2004:1). MWD also has the right to divert any unused portion of California's Colorado River entitlement, essentially unused by Californian agriculture, and any unused portion of Arizona's and Nevada's entitlements. The 2003 Quantification Settlement Agreement and increased use in Arizona and Nevada means that available supplies to MWD are declining. To mitigate the risk posed by reduced supplies and drought on MWD's low priority entitlements, MWD has entered into a long-term water transfer contract with the Palo Verde Irrigation District (PVID). PVID has a right to irrigate 104,500 acres with Priority 1 Water and additional water rights to Priority 3 Water (PVID, 2004a:1-2): the agreement transfers Priority 1 Water. The PVID-MWD Forbearance and Fallowing Program arrangement was finalized on August 16, 2004. The program will be operational for 35 years unless MWD terminates the agreement with five year notice on or after July 31, 2010 (PVID, 2004b:1). Participating acreage will range from a minimum 13,250 acres to a "full subscription" of 26,500 acres. "Under full subscription, a base load area of approximately 6,000 acres will be fallowed each of the 35 years (and) up to a maximum 24,000 acres will be fallowed in any 25 years and up to a maximum 26,500 acres in any 10 years…. (such years need not be consecutive" (PVID, 2004b:1). "Landowners will grant PVID and Metropolitan a fallowing easement on owned land equivalent in acreage to the landowner's maximum fallowing commitment" (PVID, 2004b:2). The transfer agreement will provide MWD with additional Colorado River water supplies of between 29,500 af and 118,000 af per year for 35 years for a total supply augmentation of between 1.9 million to 3.9 million af over the life of the program (MWD 2008a).

2. Types of end users

MWD is a water wholesaler providing water to "26 cities and water districts" (MWD 2008b). MWD supplies raw and treated water to retail, predominantly municipal, water providers in "parts of Los Angeles, Orange, San Diego, Riverside, San Bernardino and Ventura counties" which serve 18 million residents (MWD 2008b).

3. Types of service

MWD supplies both wholesale and retail water to its consortium members.

4. Quality of delivered water

The PVID transferred water is Colorado River water as such it is the same quality as MWD's other contracted Colorado River water supplies (MWD also receives supplies from northern California). The agreement involves the direct transfer of PVID's Colorado River entitlement to MWD as such it is untreated water.

5. Sources of water

The water transferred through the Palo Verde Land Management, Crop Rotation and Water Supply Program is Colorado River water. The water is made available to transfer to MWD through the fallowing of PVID fields.

6. Basis of delivery volumes

MWD determines fallowing acreage, within the restrictions of the program: a minimum of 7 percent and a maximum of 28 percent of land (MWD 2008a), using "fallowing calls." A call cannot be "rescinded or diminished" and it is the responsibility of MWD to "manage its calls such that, at full subscriptions, the average fallowed land over the 35 years will equal at least 12,000 acres per year (approximately 13 percent of irrigated valley lands) (PVID, 2004b:1-2). MWD, not it's member agencies, determines the calls based on its estimates of total District-wide water demand and the availability of MWD's other water supplies.

7. Basis of end users' entitlements

MWD has a 35 year contractual agreement with PVID that specifies maximum transfer volumes and costs. MWD has the contract for this transferred water. The agreement increases and diversifies the water portfolio of the District indirectly benefiting its member agencies.

8. Water rights/entitlements

PVID retains its Colorado River entitlements – the agreement provides for a temporary transfer of PVID's allocation over a 35 year contractual period. Dennis B. Underwood, Metropolitan vice president for Colorado River resources commented that "there's no change in land ownership or water rights" (MWD, 2004b).

9. Significant 'sidebars' on delivery

There are no sidebars on delivery. MWD receives the PVID water as it does other Colorado River water for which it has entitlements via the 242 mile Colorado River Aqueduct. However, more generally MWD is developing a plan for coping with shortage. In February 2008, Metropolitan's

board approved the framework for a Water Supply Allocation Plan in the event Metropolitan does not have adequate supplies to meet 100% of firm demands (MWD 2008c). The mechanism for allocating a regional shortage to member agencies is not based on across-the-board sharing. Rather, the formula would determine an agency's need for wholesale water supplies using the historic demand (previous three-year average) and adjusting for growth and changes in local supplies. Then those agencies that are dependent on MWD would receive additional allocations and those agencies that have implemented conservation measures would also receive allocation credits. Delivery restrictions "shall be enforced through a penalty rate structure (with) a lower penalty for minor overuse of allocations, and a higher penalty for major overuse of allocations" (MWD 2008c). Namely agencies would pay Tier 1 prices if they comply, 3 x Tier 2 rates for use above the agency's shortage allocation but less than or equal to 110 percent of this allocation and 5 x Tier 2 rates for use above 110 percent of its allocation. Penalties will be reduced for those agencies that have paid a larger share of MWD's capital and operating expenses (MWD 2008c).

10. Method of allocating water acquisition costs among end users

MWD is a wholesale water provider of both raw and treated water. The PVID water transfer deal increases MWD's water supplies of untreated Colorado River water but the marginal cost of this water supply is higher than the cost of its federally contracted Colorado River water supplies. To ensure that

> "the cost of maintaining existing supplies and developing additional supplies are recovered [MWD utilizes] .. a two-tiered pricing approach. The higher Tier 2 Supply Rate is set at Metropolitan's cost of developing supply… it provides a price signal to encourage cost effective conservation and local resources development….[it] also recovers a greater proportion of the cost of developing additional supplies from member agencies that have increasing demands on Metropolitan's system. Therefore, the Tier 2 Supply Rate partially addresses customer equity issues between member agencies that are not increasing their demands on the system and member agencies that continue to need additional imported water supplies. The Tier 2 Supply Rate will be charged to all firm water sales above 60 percent of a member agency's base demand, unless the member agency elected to execute a Purchase Order. If a member agency executed a Purchase Order, its initial base demand is calculated as the maximum annual firm demand for the 13 years ending June 30, 2002. If a member agency submits a Purchase Order it will pay the Tier 2 Supply Rate for all firm demands that exceed 90 percent of its base demand." (MWD 2008d:61-62).

Note that a Purchase Order is a voluntary contractual commitment made by a member agency to purchase a minimum volume of water over a ten-year term that is equivalent to at least 60 percent of its highest firm demand in the period 1989-99 through 2001-02 multiplied by ten. The member agency pays for this contracted water whether or not it takes full delivery of the contracted volume. Water purchased under a Purchase Order, up to an amount equivalent to 90 percent of its base demand, is preferentially priced at the Tier 1 rate. Note that those "agencies who have growing demands, or who lose local supplies, will end up purchasing water at Tier 2" (pers comm. June Skillman, MWD). See the table below which shows the MWD Tier 1 and Tier 2

Water Supply Rates in the period 2003 through 2009 and provides a breakdown on how much water MWD sold at each rate (2008 and 2009 are estimates).[2]

Calendar Year	2003	2004	2005	2006	2007	2008	2009
Tier 1 Rate, $/af	73	73	73	73	73	73	109
Tier 2 Rate, $/af	154	154	154	169	169	171	250
Water Supply Surcharge, $/af							25
MWD deliveries, af							
Tier 1	1,835,067	1,850,772	1,603,664	1,621,483	1,832,415	1,810,000	1,842,653
Tier 2	89,373	212,494	39,979	70,050	283,577	191,850	282,069
Tier 2 as % of total deliveries	4.6%	10.3%	2.4%	4.1%	13.4%	9.6%	13.3%

MWD through this two-tiered rate structure practices a form of marginal cost pricing; those member agencies that are growing fastest pay higher water costs to cover the cost of developing new supplies.[3] MWD's two-tier all-inclusive rate structure for 2009/10 is $579 and $695 per af[4] for Tier 1 and Tier 2 treated water, respectively, and $412 and $528 per af for Tier 1 and Tier 2 untreated water, respectively (MWD 2008e).

11. Method of allocating infrastructure/development costs among end users

MWD's rates include "tiered pricing for supply, a capacity charge and a financial commitment from Metropolitan's member agencies in the form of a purchase order designed to improve regional water resources management and accommodate a water transfer market" (MWD 2007: 22). The Capacity Reservation Charge is another way that MWD ensures that those member agencies which are growing the fastest and therefore putting most pressure on the conveyance and treatment systems pay proportionately more. "It recovers the cost of providing peak capacity within the distribution system, and is designed to encourage member agencies to shift demands

[2] This information was provided by June Skillman, Finance Contact for Rates and Charges, MWD on September 18, 2008.

[3] For example, the costs of the transferred PVID water include upfront costs and costs that vary with the acre feet of water transferred. MWD paid a one-time sign up payment to landowners of $3,170 per water toll acre enrolled for a total $73.5 million (MWD 2008a). When an option is exercised MWD pays an additional $602 per acre fallowed. Annual payments are adjusted by 2.5% per year for the first ten years then by between 2.5% and a maximum 5% in all subsequent years based on the Southern California CPI. In addition MWD is responsible for reimbursing PVID all "Reimbursable Costs" associated with the development and management of the program (PVID, 2004a:21). MWD also has spent $3.5 million on "program environmental documentation and implementation" and $6 million for "local community improvement programs" (MWD 2008a). In 2006 and 2007 the upfront costs for participation rights in the PVID-IID program were $82.4 million and $80.2 million, respectively. "These costs are being amortized using the straight-line method over 35 years. Amortization expense totaled $2,313,000 and $2,045,000 in fiscal years 2007 and 2006, respectively" (MWD 2007:33).

[4] For example, the $695 per af Tier 2 treated water rate consists of: Tier 2 Water Supply Rate $250 per af + System Access Rate $143 per af + Water Stewardship Rate $25 per af + System Power Rate $110 per af +Treatment Surcharge $167 per af = $695 per af. These charges and rates are to cover variable costs MWD also has fixed cost components, namely the Capacity Reservation Charge and the Readiness-to-Serve Charge.

and avoid placing large daily peaks on the MWD system during the summer months. (It is based on) daily flow measured between May 1 and September 30" (SDCWA 2008d). The charge is based on peak flow it is a fixed charge levied on the maximum per day demand placed on MWD's system by each member agency. It "recovers the cost of providing peak capacity within the distribution system" (MWD 2008e). Effective January 1, 2008, the Capacity Charge is $6,800 per cubic foot per second of maximum daily flow requested. Those member agencies that are growing fastest and do not contain peak summer demand will pay more to MWD in Capacity Reservation Charges this is fair because it is peak demand that requires MWD to invest in facility and conveyance infrastructure upgrades.

12. Method of allocating variable delivery costs among end users

The breakdown of MWD rate structure for FY2007 reflects changes introduced in 2003 "to provide separate rates for supply, treatment, power, access, and demand management. The rate structure also provides tiered pricing for supply, a capacity charge, and a financial commitment from customers in the form of a purchase order" (MWD 2007:68). Variable cost charges are all set in dollars per af and include charges for treatment, energy, water supply, etc (see footnote 3 above). The water rate information indicates that variable delivery costs are shared between member agencies by a postage stamp rate (MWD 2007:68). Under the old rate structure, prior to 2003, wheeling rates were a set dollar amount per af in 1998 and then in the period 1999-2002 were set "subject to available capacity, rate determined on a case by case basis" (MWD 2007:69).

Evaluation

The costs of the PVID augmentation water are not shared equally among member agencies because MWD practices a form of marginal cost pricing for water supplies. It has a two tier pricing structure for both untreated and treated water. The 'surcharge' for Tier 2 water is around $120 per af and it is set to recover the costs of developing new supplies. Those member agencies whose demand is growing fastest pay more on average for their total MWD water supplies because more of their water falls into the Tier 2 rate. Furthermore, the costs of upgrading infrastructure to keep pace with peak demand is proportionate to each member agencies peak load.

B. <u>San Diego County Water Authority-Imperial Irrigation District water transfer</u>

1. Background, legal basis and organizational structure

The San Diego County Water Authority (SDCWA) is a water wholesaler established by the California State Legislature in 1944. It is also a member of the Metropolitan Water District of Southern California (SDCWA 2008a). SDCWA has a goal to reduce its dependence on imports from MWD. In 2007 almost a quarter of SDCWA's water supplies were non-MWD imported water, this compares to just 5 percent in 1991 (SDCWA 2007). The water transfer agreement developed with the Imperial Irrigation District (IID) is an example of one of its largest projects designed to meet this objective.

In 2003 SDCWA and IID agreed to restructure their 1998 water transfer agreement. "A pivotal feature of the restructured first 15 years is the Water Authority's offer to provide $130 million in

up-front funding to pay for development of on-farm and system improvements, economic and job stimulus programs and environmental mitigation" (SDCWA, 2002:1). The program will transfer up to 200,000 afy of water (from "year 19 and thereafter"), an equivalent volume to the 1998 agreement. The agreement has "an initial term of 45 years and a renewal term of 30 years… (it) represents a new supply of 12.9 million acre-feet of water over the 75-year term of the agreement" (SDCWA, 2003b:2). A portion of this water is set aside for Salton Sea environmental mitigation.

2. Types of end users

As a water wholesale SDCWA supplies 90 percent of San Diego's water. The end users are the 24 Water Authority member agencies, essentially water and irrigation districts, served by the Authority. The profile of each member agency's customers varies but customers are predominately municipal with some industrial, commercial and agricultural users (SDCWA 2005). In FY 2007 of the 741,893 af delivered 55 percent was for residential customers, 23 percent for commercial and industrial, 15 percent for agriculture and 7 percent for public and other customers (SDCWA 2007).

3. Types of service

SDCWA is a wholesale water provider. Its agreement with the IID increases water supplies available in San Diego County: it does not directly supply customers.

4. Quality of delivered water

The IID transferred water is part of California's Colorado River water entitlement. Therefore the transferred water quality is akin to other Colorado River water supplies that SDCWA imports from the Metropolitan Water District of Southern California. SDCWA also has entitlements to other types of imported and locally sourced water supplies.

5. Sources of water

All the water transferred from IID to SDCWA is Colorado River water. The mechanism by which the IID frees up water to transfer will transition from a temporary 15-year fallowing program to water conserved on-farm and in system conservation (IID, 2007). The schedule of fallowing over the life of the program is as follows: Year 1 (2003) fallow to conserve 15,000 af, with conserved water rising by 15,000 af per year until Year 11 (2013) when conserved water from fallowing peaks at 150,000 afy for five years (until 2017). After 2017 fallowing ceases and efficiency improvements take over water conservation (IID, 2004a:6). "During the peak years of the fallowing period under the restructured proposal, approximately 10 percent of farmland in Imperial Valley would participate in a voluntary, temporary and rotational fallowing program" (SDCWA, 2003b:2).

6. Basis of delivery volumes

The IID-SDCWA water transfer agreement sets out by contract year the maximum volume of water that will be transferred from the IID to SDCWA, this volume ramps up until it reaches 200,000 afy by Year 19 in 2021. The agreement also specifies the source of the transferred water: fallowing vs. on-farm and system conservation. There is no contractual agreement on how SDCWA's member agencies will share the augmentation water.

7. Basis of end users' entitlements

The IID transfers water to SDCWA as per their 2003 water transfer agreement. The contract specifies water volumes by year, fixed and variable costs paid by SDCWA, price escalators and payments to mitigate third party costs and administrative costs. The water entitlements remain with the IID.

8. Water rights/entitlements

The IID was concerned about the implications of this fallowing program on their water rights but language in the Fallow Program materials clearly states the "Fallowing Party acknowledges that IID retains all water rights to the Colorado River in its name and control as a trustee under the California Irrigation District Law, and no water rights or other rights to water are created by this Agreement" (IID, 2004b). The agreement also includes a "no chase" clause, meaning no water agency or person would be able to request any additional fallowing by IID. Only IID would be able to initiate any future fallowing agreements. The legislation also protects IID against reasonable and beneficial use challenges during the term of the agreement" (SDCWA, 2002:4).

9. Significant 'sidebars' on delivery

There are no significant sidebars on delivery. SDCWA has contracted for the transferred water and has incorporated compensation mechanisms in the agreement for the Salton Sea and local third party economic impacts.

10. Method of allocating water acquisition costs among end users[5]

The restructured agreement provides additional imported water supplies to the SDCWA this water will be sold to Member Agencies. Note that IID water is not purchased for one of member agencies in particular but rather increases the supplies available to the Authority. The costs of the agreement water include both upfront agreement related costs and costs which are paid to individual irrigators or the IID on a per acre or per acre foot basis.[6] Other upfront costs include a $50 million environmental fund to mitigate environmental impacts attributable to the transfer. The program also incorporates an up to $40 M fund to offset third party economic effects. The program started with a $5 M lump sum and a "community benefits escrow account funded at the equivalent of $100 per acre per year of enrolled land fallowed under the temporary fallowing program" (SDCWA, 2002:3). Finally SDCWA by agreement will compensate IID during the first 15 years of the agreement for "lost water sales and power (hydroelectric generation) revenues and

[5] Dan Denham, Principal Water Resources Specialist, San Diego County Water Authority provided information for this section.

[6] "Farmers electing to participate in the program would receive a one-time sign-up incentive of $700 per acre (payable in 2003), plus annual payments of $550 per acre (2002 dollars compounded annually at 2.5 percent) beginning in 2008. Payments (by SDCWA) for transferred water start at $258 per acre-foot and increase each year to a set price schedule" (SDCWA, 2003b:2). Note that the IID does not receive this contract price - the IID has an agreement with the State of California to sell it water at $175 per acre-foot in 2003 which it in turn sells to SDCWA. The difference between the $175 and the contract price of $258 generates state funds to pay for the Salton Sea restoration (SDCWA, 2003a). In addition the IID makes available additional water to the state for direct use by the Salton Sea at a lower price – payments to the IID for water delivered to the Salton Sea were $93 per acre-foot in 2004 rising to $96 per acre-foot the following year (Sunding, Mitchell and Kubota, 2004).

administrative costs of $25 per acre-foot of water produced for transfer" (SDCWA, 2002). Overall the marginal costs of this water to SDCWA are higher than the costs of water from the MWD.

In order to allocate these costs between SDCWA Member Agencies SDCWA melds the costs of its various M&I supplies and charges this melded rate to its customers. The Authority's Melded Supply Rate is a weighted average cost of water. IID water is a separate line item in the accounts which in CY2009 is anticipated to cost the Authority $35.1 million for the transfer of 60,000 af. The IID water is "melded" into the Authority's larger supply portfolio and sold at the "melded" rate. In CY 2009 IID transfer water cost $588 per af. This high cost marginal supply raises the melded untreated M&I supply rate. The cost per af without the IID water would be $440 per af not $463 per af. The SDCWA accounting means that all member agencies pay for marginal supplies from the IID in higher water rates. See Table 2 for an illustration of how this melded rate was calculated for FY2008-2009. Note that a large proportion of the melded rate is tied to MWD's untreated Tier 1 water rate for which SDCWA will pay $412 per af in CY2009. The cost of the IID water is $643 per af (water purchase cost plus IID socioeconomic payment). In this way all member agencies pay for augmentation water. The melded rate means that all member agencies pay for the costs of augmentation water: the "melded supply rate .. recovers the cost of water supply incurred by the Water Authority. These costs include the purchase of water from MWD, the IID, the Coachella and All American Canal, costs of MWD wheeling for non-MWD supplies, and certain costs associated with the Quantification Settlement Agreement" (SDCWA 2008d).

Melded Untreated M&I Supply Rate Calculation

Acre foot sales ('000s)	**CY 2009**
MWD Tier 1	399.0
IID	60.0
Canal Water Delivery Costs	38.0
Supplemental Supply Purchases – CY 2009	25.0
TOTAL AF SALES	**522.0**
Water Purchase Cost (in millions $)	
MWD Tier 1 Water Purchases	164.4
IID Water Purchases	35.3
Canal Water Purchases	10.8
Supplemental Supply – Purchases CY 2009	13.2
Supplemental Supply – Purchases CY 2008	2.8
Supplemental Supply – Storage Costs	3.8
Subtotal Water Purchases	**$230.3**
Additional Costs (in Millions)	
Canal Cost Differential and Operating Budget Costs	4.4
IID Socioeconomic Payment	3.3
Prior Year Cost of Sales Recovery (2003 & 2004)	1.3
QSA Environmental	2.4
Subtotal Other Costs	11.4
TOTAL SUPPLY COST	**$241.7**
A/F RATE (Total Supply Cost/Total A/F Sales)	**$463**

Source: SDCWA 2008b: 283

Part of the SDCWA's Customer Service Charge is set to "recover costs .. to support the functioning of the Water Authority (including) research, development and planning costs associated with new supplies" (SDCWA 2008d). This charge is set at $16 million for CY2009. It "is allocated among the member agencies on the basis of each agency's three-year rolling average of all deliveries" (SDCWA 2008d) which means that those member agencies whose demand is growing fastest pay proportionately more because it is their demand which is driving the need to develop new supplies.

In years when SDCWA exceeds its MWD Tier 1 allocation it must pay MWD's higher untreated Tier 2 rate. SDCWA passes these higher costs on to its member agencies. "The Tier 2 Supply Rate is designed to reflect MWD's costs of acquiring new supplies" (SDCWA 2008c). The Tier 2 rate for untreated water in CY 2009 is $528 per af. Member agencies "exceeding their Tier 1 allocation pay the MWD bundled Tier 2 Supply Rate… instead of the M&I Melded Supply Rate" (SDCWA 2008d). The Authority as a whole exceeded its MWD Tier I allocation by 8,869 af in CY 2007, largely due to storage purchases, but in general it does not typically exceed it. Furthermore, as the PVID water transfer and lining of the All American Canal water savings ramp up, the likelihood of exceeding the MWD Tier I allowance is reduced.

11. Method of allocating infrastructure/development costs among end users

In 1998 SDCWA adopted the Infrastructure Access Charge (IAC) "as an additional source of fixed revenue to improve coverage of the Water Authority's projected fixed expenditures. The IAC is levied on all retail water meters within the Water Authority's service area .. for the purpose of maintaining a minimum ratio of projected fixed revenues to projected fixed expenditures of 25% on any future fiscal year" (SDCWA 2008d). This charge was $1.56 per meter equivalent (ME) in CY2007, $1.70 per ME in CY 2008 and will be $1.90 per ME in CY 2009. It is expected to raise $20.58 million in CY2009 of which The City of San Diego will pay $8.82 million. The Authority also levies property taxes which are projected to raise $19.9 million in FY2008-09. To put these charges in perspective SDCWA's total operating revenues from water sales were $343.08 million in 2007 (SDCWA 2007). To the extent that these charges are used to cover the costs of new infrastructure incumbent water users would be subsidizing new growth.

For MWD supplies, which account for three-quarters of all SDCWA supplies, the SDCWA passes on MWD rates which have elements of marginal cost pricing. For example, the MWD Capacity Charge is set at $6,800 per cubic foot second of maximum daily flow requested by SDCWA during the three previous fiscal years. SDCWA recovers this charge "proportionally based on a five-year rolling average of member agency flows during coincident peak weeks" (May 1 through September 30) (SDCWA 2008d). For example in CY2009 The City of San Diego will pay $2.80 million of the total $8.81 million capacity charge based on its deliveries during coincident peak weeks in the period 2003-2007 inclusive which accounted for a 31.74 percent share of total SDCWA peak demand in that period. In addition MWD's Readiness-to-Serve Charge "recover(s) costs associated with standby and peak conveyance capacity and system emergency storage capacity. (It is) allocated among MWD member agencies on the basis of each agency's ten-year rolling average of firm demands (including water transfers and exchanges conveyed through

system capacity). This allocation (is) revised each year. … (The SDCWA Board has directed that this charge) will be passed through proportionally to member agencies on the basis of each agency's ten-year rolling average of firm demands (including water transfers and exchanges conveyed through system capacity) (SDCWA 2008d).

12. Method of allocating variable delivery costs among end users

For SDCWA water the variable costs of delivery are shared proportionately by its member agencies. Wheeling rates are not based on acre feet per mile delivered but on acre feet delivered i.e. postage stamp rates. "The Transportation Rate is a uniform rate set to recover capital, operating and maintenance costs of the Water Authority's aqueduct system including all facilities used to physically transport the water to member agency meters. ... The Transportation Rate is levied on each acre-foot of water as delivered by the Water Authority through its facilities" (SDCWA 2008d). The recommended Transportation Rate for CY2009 is $64 per af. Furthermore treatment costs are also standard; the Melded M&I Treatment Rate for CY2009 is $168 per af. A Storage Charge is also "allocated among the member agencies using a pro rata share of each agency's three-year rolling average of non-agricultural deliveries" the total charge in CY2009 is set at $23 million (SDCWA 2008d).

Evaluation

The SDCWA-IID fallowing program like the MWD-PVID program is not based on bids but rather a set price for fallowed water. This likely results in higher prices for SDCWA. SDCWA's accounting procedures divide up the costs of M&I deliveries by the acre feet delivered therefore all member agencies pay a share of the costs of new water supply development. The Authority also raises significant revenues from property taxes and an Infrastructure Access Charge. To the extent that these revenues pay for new infrastructure or augmentation supplies incumbent water users are subsidizing growth. But the two tiered pricing structure for MWD supplied water ensures that those member agencies that exceed their Tier 1 allocation pay higher prices to cover the costs of augmentation supplies. In this way the Authority passes on a form of marginal cost pricing to its member agencies. In addition the Authority passes through MWD's Capacity Reservation Charge, which is a fixed charge levied on peak demand flow. This charge is passed through proportionally based on its' member agencies peak demand.

C. California Drought Water Bank, 1991-1994

1. Background, legal basis and organizational structure

Drought conditions that began in 1987 reached a critical level by 1991 and prompted the Governor of California to charge the Californian Department of Water Resources (CDWR) to create the California Drought Water Bank. The aim was to facilitate the voluntary transfer of water in order to forestall "stringent urban water rationing, severe cutbacks in agricultural water availability, and critical conditions for fish and wildlife". The CDWR formed a "Water Purchase Committee … to negotiate the terms and conditions of a model contract for buying water for the Bank" (Israel and Lund, 1995:3). The California State Legislature and Governor passed three enabling pieces of legislation that guaranteed the rights of water rights holders and enabled the

temporary transfer of water outside their service area (Israel and Lund, 1995:3). The state-sponsored Bank operated in 1991, 1992 and 1994 (CDWR, 2000:18).

2. Types of end users

The Drought Bank facilitated the temporary, compensated transfer of water from northern Californian irrigators to southern California cities and irrigators. The volumes of water purchased and offered in each year of the drought bank's operation are shown in Table 1.

Table 1: California Drought Water Bank Purchases and Allocations (1,000 af)

	1991	1992	1994
Supply			
Purchases	821	193	222
Delta and instream	(165)	(34)	(48)
Net supply	656	159	174
Allocation			
Urban	307	39	24
Agricultural	83	95	150
Environmental		25	
Carryover	266		
Total allocation	656	159	174
Selling price ($/af)	**175**	**72**	**68**

Source: CDWR, 2000:21. Note selling price does not include transportation charges which ranged from $15 to $200 per af.

A breakdown of sellers and the volumes of water transferred and purchased in the 1991 and 1992 Drought Water Banks can be found in CDWR, 2000: 20, the 1991 buyers are listed in Table 2. In 1991 a total 389,970 af was purchased by 12 buyers, the largest buyer was the Metropolitan Water District of Southern California (MWD), which purchased 55% of the total Bank water. Some water was also transferred between agricultural uses. Given the high cost of water, the agricultural purchases were likely for high value "fruit, vegetable and nut crops" (Howitt, 1994:359). Because demand fell short of water sold to the bank, a total 265,558 af was set aside for carryover storage paid for by the state (Israel and Lund, 1995:6).

Table 2: 1991 Drought Water Bank allocations

Location	Amount allocated	Percent of total
Alameda Co. Flood Control & Water Con. District	500	0.1
Alameda Co. Water District	14,800	3.8
American Canyon Co. Water District	370	0.1
City of San Francisco	50,000	12.8
Contra Costa Water District	6,717	1.7
Crestline-Lake Arrowhead Water Agency	236	0.1
Dudley Ridge Water District	13,805	3.5
Kern County Water Agency	53,997	13.8
Oak Flat Water District	975	0.3
Santa Clara Valley Water District	19,750	5.1
Metropolitan Water District of Southern Ca.	215,000	55.2
Westlands Water District	13,820	3.5
TOTAL	**389,970**	**100.0**

Source: Israel and Lund, 1995:22.

Because of issues with the fallowing program, for the 1992 program the CDWR did not accept any fallowing contracts relying instead on groundwater substitution and stored water. This change resulted in lower prices for purchased water and shifted the composition of the water purchasers. A total 61 percent of all water transferred in 1992 was delivered to agriculture accounting for 12 of the 16 contracts signed. Urban buyers purchased just a quarter of the total supplies and the remainder was purchased to support fish and wildlife. Another reason suggested for the shift in demand is that urban water providers discovered that some conservation measures had comparable costs to Bank water inclusive of water conveyance costs (Howitt, 1994:361).

3. Types of service

The type of water available for purchase through the Drought Bank was akin to the type of water typically delivered to these end users, i.e. wholesale water. The buyer was responsible for conveyance and treatment costs.

4. Quality of delivered water

The water available through the Drought Bank was raw, untreated water.

5. Sources of water

The state-sponsored Bank temporarily permitted the transfer of riparian rights through fallowing "allowing the water to stay in the rivers and channels. In doing so, the additional water retained in the Delta channels enable(d) the SWP and CVP to decrease releases from upstream storage, making more available for other water demands" (Israel and Lund, 1995:6). In 1991 transferred water came from three sources: 50 percent from fallowing, 30 percent from groundwater substitution and 20 percent from reservoir storage in the north of the state (CDWR, 2000:18). Out of the 820,665 af obtained through 348 contracts, 325 were fallowing contracts which released 414,743 af to the bank (Israel and Lund, 1995:4). This transfer resulted in the fallowing of 166,094 acres. "The acreage fallowed for the Water Bank was about ten percent of the field and vegetable

acreage of the major counties participating in the program" (Israel and Lund, 1995:4). Only that land which had been farmed during 1990, or was set aside under the federal Farm Commodity program and had been slated to return to active farming in 1991, was eligible for the program.

The land fallowing component of the Bank was so controversial that it was abandoned in the 1992 Bank. "Only water acquired through ground water exchange and stored surface water contracts were accepted. This helped procedurally, environmentally, and politically. However, had demand been higher in 1992, (February 1992 rains eased demand) it is likely a land fallowing program would have been needed" (Israel and Lund, 1995:9). The 1992 Bank secured 80 percent of its water from groundwater substitution and 20 percent from storage: no fallowing contracts were signed.

6. Basis of delivery volumes

Water purchased for the Drought Bank was a supplemental drought supply. The drought conditions and endangered species compliance meant that the state was faced with the prospect of reducing supplies to municipalities to meet the requirements of the environment. Entities with junior water entitlements had incentives to purchase drought supplies from more senior entitlement holders or risk being unable to supply their customers or irrigate their high-value, drought-vulnerable vine and tree crops.

7. Basis of end users' entitlements

There was no formal allocation of Drought Bank water or contracts between the lessor and lessee. Rather those end users who were willing to pay $175 per acre foot contracted with the Drought Bank, paid conveyance charges and received the drought supplies. Because the Drought Bank received more water from sellers than was demanded from buyers it was not necessary to ration supplies through any mechanism, such as critical needs, first come first served, or price. Taxpayers ultimately paid approximately $45 million for the carryover storage. Howitt et al., (1992) conclude that "the over-acquisition of water was an unavoidable consequence of the lack of negotiated agreements before the drought emergency and an understandable lack of knowledge about the supply and demand for Bank water." In the 1992 Bank the CDWR "behaved as a true broker, matching supply to real demands" (Israel and Lund, 1995:9).

8. Water rights/entitlements

Entitlement holders temporarily leased water to the Drought Bank which in turn allocated water to entities that were willing to pay $175 per acre foot. There were no direct leases between buyers and sellers – the state facilitated the water transfers, paid the lessors and received payment from the end users.

9. Significant 'sidebars' on delivery

On the supply side the Drought Bank accepted all bids at $125 per acre foot. On the demand side the "allocation of Bank water by DWR was prioritized based on 'Critical Needs' to assure participants that the most urgent demands were satisfied first" (Israel and Lund, 1995:5). These priorities were: emergency health and safety needs, municipal and agricultural areas with critical needs, environmental critical needs, areas in jeopardy of sustaining a severe economic shock, and

carryover storage. In addition "before purchasing water, buyers had to demonstrate maximum use of current available water supplies, implementation of a satisfactory water conservation program, and ability to fund their purchases from the Bank" (Israel and Lund, 1995:6). However the priority of these critical priorities was never tested because more water was offered to the Drought Bank than was demanded by end users. This obligation to purchase as much water as was bid at the $125 per acre foot price was a flaw in the program. The state had to pay for the unreimbursed costs (Clifford, Landry, and Larsen-Hayden 2004). One reason for this over-estimation is that when cities were faced with the high price of supplemental water, end users "revised their needs downwards and actual purchases were 11% less than the estimates of "critical needs". Much of this difference was obtained by effective water conservation" (Howitt, 1994:361).

10. Method of allocating water acquisition costs among end users

The Drought Bank negotiated voluntary contracts to purchase water at a fixed price of $125 per af paid to farmers who chose to fallow their land or substitute groundwater for surface water irrigation. "The intent was to offer a price that would yield a net farmer income similar to farming plus an additional amount to encourage participation in the Water Bank." "To ... motivate early seller participation in the Water Bank, purchase contracts contained a price escalator clause" (Israel and Lund, 1995:4 and 3). The CDWR negotiated 351 supply contracts in less than five months (Howitt, 1994: 358), making over 821,000 af of water available to meet the critical needs of the state in 1991. Of this total, 165,137 af were left in-river for the delta and instream fish needs with the remainder available for municipal demand. The Drought Bank demonstrated that large volumes of water could be transferred in a drought. This is unsurprising given that the 1991 $125 per af offer price was around six to seven times the net return per af of water used to grow crops in the areas the Bank targeted (Clifford, Landry, and Larsen-Hayden 2004).

Willing buyers paid a set charge of $175 per af. The difference between the price the buyers paid and the price the sellers received, $50 per af, was an administrative charge levied by the CDWR to cover the costs of brokering the program and "satisfy(ing) outflow requirements for moving water through the Sacramento-San Joaquin Delta" (Israel and Lund, 1995:5). In the second year of the Drought Bank, prices dropped to $50 per af paid to sellers and $72 per af for buyers (Israel and Lund, 1995:8). Unlike in 1991 the 1992 and 1994 Drought Banks did not have any carryover water because the state acted more like a water bank facilitating transfers between willing sellers and buyers only.

The Bank demonstrated that it is possible to purchase large quantities of water in a drought, at a premium, and to move that water around the state. Although the Drought Bank was a rapid response to the drought crisis the timing of the bid period (February through April) was not ideal to secure inexpensive fallowed water. The bid procedure mandated by the Governor did not promote price competition.

11. Method of allocating infrastructure/development costs among end users

The cost of conveyance, most of which was delivered through State Water Project (SWP) infrastructure, was negotiated by the buyer with the SWP and paid for by the buyer.

12. Method of allocating variable delivery costs among end users

Water purchasers were required to pay administrative, conveyance and any treatment costs.

Evaluation

Israel and Lund (1995:10-11) comment that "the experiences of the Drought Water Banks of 1991 and 1992 provide water managers and planners with numerous lessons for the operation of large-scale water banks and for the long-term management of water resources in general…. Centralized water banks have several advantages: they provided a greater chance for successfully completing a transfer for buyers and sellers dealing directly with the Bank … in part due to the relatively straight-forward nature of ... contracting and negotiations, but also the reduced likelihood of third-party interference in Bank transfers supported by state legislation waiving environmental impact review … a State-sponsored bank, can substantially reduce the transaction costs of water transfers. Most of the terms of the transfers were standardized and the transfer process was clear. State funds ... provide(d) initial working capital … (and) the State was able to facilitate coordination of transfers with other water movements in the state." Other observations are: that special legislation may be required to facilitate ease of temporary transfers and to reduce transaction costs, that "transfers can occur between water years", that "all sectors are interested in purchasing water" including some "high-valued and perennial crop" irrigators and that "there is substantial (agricultural) interest in selling water in drought years … however, seller participation is price-sensitive."

The experience with the drought bank was a learning experience for how to better design fallowing program. In response to the controversy surrounding the fallowing component of the 1991 Bank Howitt *et al.* (1992) provided specific "recommendations for future bank operations; several of these were incorporated into the 1992 Water Bank, such as: early notice ... contracting guidelines ... a dual-class system of contracts ... (and) additional recommendations" (Israel and Lund, 1995:7). These four recommendations were designed to: encourage participation by providing irrigators time to plan; improve administrative efficiency and opportunities to participate on fair and transparent terms; generate incentives for early participation by sellers and buyers through the use of option-contracts for early-signed contracts and non-option agreements for late-signed contracts; and to more accurately measure consumptive use savings by crop and irrigation type and limit the percentage of fallowed acreage by region to reduce third party economic impacts.

III. Colorado case studies

A. Aurora, Colorado – Arkansas Valley water transfer

1. Background, legal basis and organizational structure

In March 2003, after two years of negotiation, Reclamation approved a 12,600 af temporary water lease between the City of Aurora, CO and 152 Arkansas Valley farmers (US Water News, 2004). The agreement was reached after drought had severely depleted the city's reservoirs; in 2003 storage was just 26% of capacity rising to 46% of capacity in 2004 (UAWCD, 2004). The

farmers were all shareholders in the High Line Canal Company and hold third and fourth most senior water rights on the Arkansas River (Headwaters, 2004). The Southeastern Colorado Water Conservancy District (SECWCD) and the Upper Arkansas Water Conservancy District (UAWCD) were also involved in the agreement to ensure its passage. The temporary water leases were made possible by changes to Colorado legislation; in 2003 the Colorado General Assembly passed H.B. 1001 and H.B. 1334 to enable cities to sign interruptible supply contracts with irrigators.

2. Types of end users

The end user is the City of Aurora, Colorado.

3. Types of service

The water made available under this contract to the City of Aurora is wholesale water.

4. Quality of delivered water

The water made available to the City of Aurora is untreated Arkansas River water.

5. Sources of water

The renewable three-year lease provides the City of Aurora with an option to pay the High Line Canal Company shareholders to fallow up to 8,200 acres or 36% of canal irrigated land. The water transferred is surface water from the Arkansas River.

6. Basis of delivery volumes

The agreement specifies that the option is for water transfers during drought periods. The trigger mechanisms and necessary actions by the City of Aurora are identified by the UAWCD (2004). Namely: (1) temporary leases can only be effected in years when Aurora's storage capacity is below 60% (90,000 af – annual water use is ~58,000 af) and can only be used to augment storage not for immediate use; (2) implementation of temporary leases requires simultaneous implementation of an "Increasing Block Rate Structure" on the City of Aurora's water users to encourage conservation; and (3) use of the temporary leases requires implementation of mandatory outdoor water restrictions on the city's water users.

7. Basis of end users' entitlements

This was an initial three-year program renewable for up to 40 years.

8. Water rights/entitlements

The water rights remain with the canal shareholders the City of Aurora has an option for temporary compensated transfers only.

9. Significant 'sidebars' on delivery

The UAWCD and SECWCD signed mitigation agreements with the City of Aurora and the High Line Canal Company and the Spurlin-Shaw/Hayden Ranch to prevent injury and preserve and enhance basin resources. The City of Aurora agreed to leave 1,650 af in the basin. In addition the agreement modified the timing and method of water transfer to reduce damage to the native water flow. The City of Aurora also agreed to increase its use of recycled water to meet future

demands and thereby reduce demands on out-of-basin water transfers so it will be allowed to claim water rights in the Arkansas Basin after 2043 when the current agreement expires. (Headwaters, 2004).

Other conditions were placed on the agreement. The City of Aurora is prohibited from purchasing or permanently transferring additional water out of the Arkansas valley for 40 years; (2) Aurora's rights to lease up to 145,200 af of water in the 40 year period were affirmed; (Headwaters, 2004) and (3) a maximum of 54,000 af can be transferred to the city in any single year of which 50% must originate outside the Arkansas Basin. In addition Aurora may only enter into temporary leases for a maximum 10,000 af in any single year and may only exercise such temporary leases in a maximum three years out of each ten year period (UAWCD, 2004).

10. Method of allocating water acquisition costs among end users

The agreement cost $5,280 a share. The total cost of the three year program is $5.5 million resulting in an average cost of $145.50 per af (Headwaters, 2004). To pay for the leases the City of Aurora has introduced a 68¢ drought surcharge per 1,000 gallons metered on its residential customers. All city residents will thus directly pay for this drought supply.

11. Method of allocating infrastructure/development costs among end users

There is only one buyer, in this case, the City of Aurora. The drought surcharge is levied on all water metered for residential use. Those customers with high water demand pay more for the development of this new supply.

12. Method of allocating variable delivery costs among end users

Any additional costs associated with the agreement are covered by the drought surcharge.

Evaluation

No study has yet estimated third party economic impacts for this particular transfer but a recent paper investigates the consequences of block rates, higher prices and watering restrictions in Aurora during the drought (Kenney, et al., 2007). The City of Aurora has instituted a drought surcharge levied on all residential water customers to pay for water development costs.

Subsequent to this agreement seven irrigation ditch companies, including High Line Canal and Bessemer, Oxford, Otero, Holbrook, Catline and Fort Lyon, have proposed to form a monopoly-like entity: a "Super Ditch". The Super Ditch "would combine the water resources of seven canals (and) could bring more than $9 million in payments annually, if seven ditch companies can agree to a framework" (Woodka 2007). The concept behind the Super Ditch is to reduce competition between irrigators in order to raise fallowing revenues. Incidentally this organization is also likely to reduce transaction costs for buyers.

B. South Metro Water Supply Authority, Colorado

1. Background, legal basis and organizational structure

The South Metro Water Supply Authority (SMWSA) was formed in 2004 when the Douglas County Water Resource Authority, the South Metro Water Supply Study Board and "other large water providers requested to work with one regional entity. By taking a unified approach to regional water rights and allocation, SMWSA better serves constituents through its increased negotiating power and support on structural and non-structural projects" (SMWSA 2008a). The SMWSA is located in Denver's south metro area and has 13 Member Agencies of which 12 participated in regional long-term water planning.

2. Types of end users

The end users are thirteen Member water districts and cities which serve 320,000 residents. The Authority also delivers water to agricultural interests (SMWSA 2007a).

3. Types of service

The SMWSA is a wholesale water provider to its thirteen member agencies.

4. Quality of delivered water

Water currently delivered to M&I customers is high quality groundwater.

5. Sources of water

SMWSA's main water source is groundwater: collectively the SMWSA providers have rights to 111,000 af of groundwater (SMSWA 2007b). The Authority also has surface water rights, and water leases with Denver Water and Aurora Water. The Authority is developing new supplies and improving conjunctive management of water resources with the implementation of an aquifer storage and recovery program (SMWSA 2008b).

In 2007 the SMSWA released its Regional Water Master Plan which presents detailed information on regional opportunities for water supply development. The Master Plan has three stages which will assist its members in transitioning from groundwater supplies to renewable supplies. Interim Authority-wide water demand in 2010 is estimated to be 70,300 afy, rising to 90,700 afy in the mid-term 2020 period, and to 102,000 afy in the long-term planning horizon of 2030. The Master Plan at each stage includes additional water for as yet unidentified additional SMWSA members and to cover uncertainties in demand projections. At 'buildout' when demand is forecast to reach 116,700 afy the Authority plans to be using less than 15,000 af of groundwater a year (SMWSA 2007b).

In the first stage the Master Plan envisages the development of "interim renewable [surface water] supplies … [conveyed] through existing interconnections between water providers … without major infrastructure [investment]". Some of the new supplies identified are temporary water leases, purchasing 72,000 af of reservoir storage, and implementation of conservation and

reuse projects (SMWSA 2007a). In the second stage the Authority's goals will be reached through the purchase of "mid-term renewable supplies…, while avoiding the need for major new transmission pipelines" (SMSWA 2007b). The final stage will secure "long-term renewable supplies through the purchase of "additional water rights…[with possible] partnering .. on major water supply development and transmission pipeline investment" (SMSWA 2007b). The Master Plan identifies concrete water supply, treatment and transmission alternatives with associated capital and O&M cost estimates for each project alternative at each stage of the Master Plan.

6. Basis of delivery volumes

The Master Plan uses population projections and gpcd estimates to forecast demand at various time steps for each member agency. However, "the renewable supply components identified in [the] Master Plan can be implemented on an individual "opt in" or "opt out" basis by each SMWSA member." "SMWSA member agencies can make individual decisions based on their water supply goals, operational strategies, and financial capabilities. These and other factors will guide the degree to which each SMWSA provider will participate in interim, mid-term and long-term supply projects" (SMWSA 2007b). That is only those SMWSA providers that participate in a specific supply augmentation project will have contractual rights to the additional water.

7. Basis of end users' entitlements

Each SMWSA participating provider will have an agreement, specifying terms and conditions with the Authority for the proportion of additional water supplies that it helps to finance.

8. Water rights/entitlements

Although not stated directly in the Regional Water Master Plan the opt in/opt out doctrine implies that only SMWSA members who contribute to specific augmentation projects will increase their individual end use entitlements or their proportional share of the Authority's new entitlements.

9. Significant 'sidebars' on delivery

Delivery contracts for augmented water will include contractual terms and conditions.

10. Method of allocating water acquisition costs among end users

The Regional Water Master Plan provides capital cost estimates for interim, mid-term and long-term water supply augmentation projects including treatment and transmission. These estimates do not include cost estimates for water rights acquisition (SMWSA 2007b). The guiding concept of this regional water authority is that SMWSA providers can opt in/opt out of the various water supply options. The implementation of the staged Master Plan will require as a starting point the identification of "SMWSA interim project participants, and [the] determin[ation of] the terms and conditions (quantities, duration of agreement, reliability of supply, terms of operation, etc.) of potential interim raw water and treated water supply projects with each party" (SMWSA 2007b). Each provider will have to evaluate each supply augmentation option for relative cost, water quality and supply reliability, and likely partners and then decide whether or not to proceed with that specific option.

11. Method of allocating infrastructure/development costs among end users

Some of the early interim water projects identified require infrastructure investment or cost sharing agreements, for example negotiating a contract for pipeline capacity with existing providers, purchasing reservoir storage (72,000 af), sharing the costs of reservoir redesign to improve return flow recovery (10,000 af), the construction of a 6,400 af reservoir to better manage flows and return flows, and investment in an aquifer storage and recovery project (SMWSA 2007a). The long-term options involve the joint purchase of water rights, the construction of a regional water treatment facility, the sharing of transmission capacity, and the joint development of terminal storage (either using existing reservoir storage or developing aquifer storage and recovery) to better manage transmission capacity to meet peak demands (SMWSA 2007b). The opt in/opt out doctrine means that only those member agencies that wish to participate will pay for updates to the SMWSA system. Plans may need to be adjusted depending on how many member agencies opt out.

12. Method of allocating variable delivery costs among end users

The Master Plan includes detailed information on the O&M costs of various transmission and water treatment options. The "opt in/opt out" clause would ensure that only those SMWSA providers that participate in specific water augmentation projects would pay a share of the associated variable delivery costs.

Evaluation

The Authority was established as a "regional water-planning entity" (SMWSA 2007a) to develop new *renewable* water sources rather than investing in new well fields (SMWSA 2007b). The rationale of the regional water authority was: (1) to reduce competition between end-users for augmentation supplies and to increase the negotiating power of the Authority; (2) to share the infrastructure costs for the development of these new water sources; and (3) reduce regional groundwater overdraft and develop at the regional level responsible stewardship of "existing groundwater" (SMWSA 2007a). The Master Plan developed water demand forecasts based on population growth rates and gpcd estimates for each member agency. The opt in/opt out doctrine ensures that each SMWSA provider can first evaluate the various water supply augmentation options and chose to participate based on their agency's needs, cost, water quality and supply reliability. However, the more extensive regional augmentation supply options may be difficult to implement if fair cost sharing and water sharing mechanisms are not developed. The Master Plan provides no information on how water and costs will be shared between participating SMWSA providers.

IV. Florida case study

A. Tampa Bay Water Authority, Florida

1. Background, legal basis and organizational structure

The Tampa Bay Water Authority (TBWA) was established in 1998 replacing the "structure and operation of the West Coast Regional Water Supply Authority" (TBWA 2008a). Its creation required new legislation and contracts between the member agencies and the authority. It is a

special district to the State of Florida. The regional water authority was created specifically to end the "water wars", eliminate competition for scarce resources and manage the region's water portfolio for the benefit of the region. A major goal in creating the authority was to "reduce groundwater pumping from 11 long-producing wellfields, develop new water supply sources, end litigation and obtain funding form the Southwest Florida Water Management District" (TBWA 2008b). It has achieved all of these goals.

2. Types of end users

TBWA is the sole wholesale service provider in Hillsborough, Pasco, and Pinellas counties and in the cities of New Port Richey and St. Petersburg. It also serves the City of Tampa. In total TBWA provides wholesale water to members who serve 2.5 million residents in the tri-county region. It has no retail customers.

3. Types of service

The authority is the largest wholesale water provider in Florida. It is the "sole and exclusive wholesale drinking water supplier for all Member Governments" (WCRWSA 1998).

4. Quality of delivered water

TBWA delivers raw water to its member governments this raw water must meet "specified water quality parameters" (TWBA 2008a).

5. Sources of water

In Fiscal Year 2007 (October 2006-September 2007) 74.4% of TBWA's water came from groundwater supplies, 23.2% from surface water and 2.4% from the Tampa Bay Seawater Desalination Plant. The Authority has a goal to reduce reliance on groundwater over time. By Fiscal Year 2011 the goal is to reduce groundwater supplies to 45.5% of the total water delivered, raise surface water supplies to 45.5% and desalinated water to 9% of the total (TBWA 2007a).

6. Basis of delivery volumes

The Interlocal Agreement and Master Water Supply Contract specify that the TBWA has the obligation to sell and deliver water to its Member Governments. "The amount to be delivered shall meet the needs of Member Governments based upon each Member Government's annual report of water requirements as approved or modified by the Authority". "If the Authority fails to supply sufficient water, the Member Governments may purchase water from other source or construct their own water supply facilities, subject to the Authority's option to purchase the facilities at any time" (WCRWSA 1998).

7. Basis of end users' entitlements

Prior to the creation of the TBWA the previous entity the WCRWSA operated "through the various contracts with its Member Governments, the (WCRWSA) .. operated on a "subscription" approach to the development of new water supply sources. The subscription approach to water supply development recovers cost by apportioning the cost of each facility in the system to specific Member Governments that are entitled to receive water from that facility. The history of supply development .. resulted in widely varying water rates and entitlements" (WCRWSA 1998).

This old authority developed few additional supplies in the period 1989 to 1998. Today each member government has a contractual relationship with the authority.

8. Water rights/entitlements

In October 1998 when the Authority was created "each member government transferred its water supply facilities (and most of its ground water rights) to Tampa Bay Water and waived its right to individually develop water supply facilities" (TBWA 2008a). Specific information on transferred facilities and purchase prices paid can be found in the 1998 Interlocal Agreement (TBWA 1998b, Article V). Member Governments are paid credits that can be applied to reduce the cost of purchasing water from the Authority.

Member Governments do retain the water rights to existing wells with a capacity not greater than 1 mgd on average daily basis and continue to supply small amounts of water to remote areas using these existing wells or developing new water supplies with a capacity not greater than 1 mgd because the development "cannot be served on an economically feasible basis .. by the Authority" (TBWA 1998b). A list of the "wells retained by member governments" is provided as Appendix A to the Interlocal Agreement (TBWA 1998b). The Partnership Agreement (The Northern Tampa Bay New Water Supply and Ground Water Withdrawal Reduction Agreement) signed in 1998 by the District, Tampa Bay Water, Hillsborough, Pasco and Pinellas counties and the cities of New Port Richey, St. Petersburg and Tampa immediately cut the "face value of 11 regional wellfield permits .. from 192 million gallons per day (mgd) to 158 mgd. The agreement further required pumping to be reduced .. to 121 mgd .. by Dec. 31,2002….The District agreed to provide up to $183 million in locally collected ad valorem taxes to offset the cost of developing more costly alternative water supply projects" (TBWA 2008c).

The state regulates how much water the agency can withdraw from its water supply sources. "Withdrawals of water are regulated under Water Use Permits issued by the Southwest Florida Water Management District (TBWA 2007b). "The Consolidated Permit, issued by the District in January 1999, regulates withdrawals from 11 of the 13 regional wellfield systems operated by the Agency. …Since January 1, 2004, the 11 wellfields .. are considered a single system for the purpose of measuring compliances with the permitted annual average withdrawal quantity … (which) are limited to 121 million gallons per day (mgd)… (from) December 31, 2007, combined withdrawals from the 11 wellfiels (was) .. limited to 90 mgd .. with the first compliance date being December 31, 2008." "The remaining two regional wellfield systems … are regulated under separate Water Use Permits" meanwhile "withdrawals from the Tampa Bypass Canal are separately permitted and limited to 20 mgd." Finally, two additional surface water sources that allow "the harvesting of high flows" from the Hillsborough and Alafia rivers are also permitted and can be stored in a regional reservoir (TBWA 2007b).

9. Significant 'sidebars' on delivery

In times of "insufficient water .. due to force majeure .. the Authority … shall furnish and deliver to the Member Governments, their pro rate share (or a share that as closely approximates their pro rate share as is reasonable practicable in the circumstances) of available supply, unless otherwise required by law, court order, or appropriate regulatory authorities. Each Member

Government's pro rata share shall be based on the average of the actual amount of Quality Water supplied each month by the Authority to such Member Government over the previous twelve .. month period. The Authority shall use its best efforts to prevent an insufficiency of Quality Water and to remedy any such insufficiency" In times of insufficiency the "Authority may request the Member Governments to implement water use restrictions which shall be applied on a uniform basis among all Member Governments" (TBWA 1998a, Sec 8(B)-(C))

10. Method of allocating water acquisition costs among end users

"Tampa Bay Water was formed as a true regional utility, where all members pay the same price for (wholesale) water and water is provided from a diverse network of source." "The cost of developing new water supplies is shared regionally instead of by those member governments facing proposed reductions in permitted supplies[7] (or rapid population growth" (WCRWSA 1998). A major motivation for creating the Authority was that historic conflicts between member agencies "resulted in protracted and costly legal battles that created no new water" (WCRWSA 1998). Today it takes the Authority between "six to ten years to plan, permit, design and build drinking water facilities" (TBWA 2007b). Investment in new projects includes "effort(s) … to connect previously isolated areas of the region to alternative water supplies. In the past, these areas were separate from the regional system and relied solely on groundwater".

The authority sets a uniform water rate that ensures all member governments share in the cost of developing new supplies. This uniform rate consists of a variable rate and a fixed rate. The fixed rate covers the costs of developing new water supplies including debt service to bonds. Fixed costs are apportioned between member governments based on the proportion of total water delivered by TBWA to each member during the previous year (TBWA 2007b). This formula is a straight forward average cost pricing mechanism per unit of use, where TBWA's fixed costs are estimated for the current year and each member pays a proportion of this total determined by its demand in the previous financial year.

11. Method of allocating infrastructure/development costs among end users

The formation of the Authority required the TBWA to acquire "all regionally significant water supply facilities, transmission mains, well sties, and related equipment from the Member Governments…. The purchase price .. was determined by a uniform methodology .. per acre of land acquisition and … for every 1 mgd of 1996 permitted capacity for wells acquired… The purchase price for the facilities transferred will be paid in the form of an annual credit against payments by the respective Member Governments for water purchased from the Authority" (WCRWSA 1998). That is those member governments that had invested most in water rights and water infrastructure received the most credits which reduce their current water supply costs for a period of 30 years after the conveyance of transferred assets (TBWA 1998b, Sec 3.04(A)(3)).

The uniform rate established by the Authority each year consists of a variable cost rate and a fixed cost rate. "The fixed cost rate is designed to recover Agency expenses incurred for the operation, maintenance, management, security, development and financing of the water system. The fixed cost rate is assessed to Member Governments monthly based on one-twelfth of the

[7] Proposed reductions in ground water pumping for environmental purposes.

total annual fixed cost applied to the ratio of each member's annual water usage during the previous fiscal year divided by such usage of all Member Governments during such year. At the end of the fiscal year each member's share of this fixed cost is recalculated based on the current year's usage" (TBWA 2007b). Fixed costs constitute approximately 82% of the uniform rate (TBWA 2007b).

12. Method of allocating variable delivery costs among end users

The Authority charges a "uniform per-gallon wholesale rate (which includes both the fixed and the variable rate) to Member Governments for the wholesale supply of drinking water" But water delivered by the TBWA to the City of Tampa from the Tampa Bypass Canal is charged a separate rate (TBWA 2007b). "The variable cost rate is designed to recover Agency expenses that are directly related to the quantity of water delivered, primarily chemicals, electric power and water purchased from City of Tampa" (TBWA 2007b). In 2007 the variable costs proportion of the uniform rate was eighteen percent. There is no indication that this rate varies with conveyance distance but credits and debits may be applied "for different levels of treatment of Quality Water" (TBWA 1998a, Sec 13(B)).

Evaluation

The TBWA was created precisely to ensure new water development in the Tampa Bay region; water development that had been delayed by litigation prior to the authority's establishment when individual members competed with each other for new resources. In establishing the authority the member governments signed over their water facilities and rights to the TBWA for which they were compensated. Member governments received credits in accordance to how much they had already invested in water rights and water infrastructure which they use against their annual water charges. Today water augmentation projects are developed regionally for the benefit of the members; and the costs are shared equally. Each member pays the same uniform rate per unit of water demanded. The costs of developing and treating new water sources are generally higher "than the cost of traditional groundwater production and treatment" (TBWA 2007b). These higher marginal costs of developing new supplies are passed through to all members through higher uniform rates. This system replaces the previous system in which water rates varied considerably throughout the Tampa Bay region based on the type of water rights and facilities each retail provider had entitlements to.

V. Nevada case study

A. Southern Nevada Water Authority

1. Background, legal basis and organizational structure

The Southern Nevada Water Authority (SNWA) is a political subdivision of the State of Nevada created in 1991. In 1990 water resource concerns persuaded its predecessor organizations, "municipal water providers in Southern Nevada (to begin) a comprehensive analysis of water resources and facilities". This became known as the "WRMI Process" (SNWA 2008a). This process utilized population projections and current usage rates to estimate future water demands. The outcome of this exercise was a realization that: (1) regional water users needed to increase

conservation efforts; and (2) that new water resources would be required to sustain future growth. This reality was made real to those in the Las Vegas Valley when the largest water provider, the Las Vegas Valley Water District (LVVWD), "stopped accepting new applications for water service in February 1991. Upon completion of its (water supply/demand) analysis, the LVVWD instituted a more formalized water commitment process with the City of Las Vegas and Clark County. Henderson and North Las Vegas also instituted more formal commitment processes. Perhaps more than any other event, it was the temporary cessation of water commitments that awakened the community to the gravity of the water situation. This elevated awareness contributed in large part to the subsequent success of regional water management initiatives" (SNWA 2008a) and the formation of a regional water authority.

In July 1991 SNWA, a regional water authority, was created through a cooperative agreement among the seven agencies: Big Bend Water District, City of Henderson, City of Las Vegas, City of North Los Vegas, Boulder City, Clark County Water Reclamation District and the Las Vegas Valley Water District (Temple and Cunningham). "The SNWA was formed by these seven entities for the purpose of acquiring and managing water resources for Southern Nevada, constructing and managing regional water facilities, and promoting responsible water use" (SNWA 2008a).

Beginning in 1994, the SNWA began "an integrated resource planning process to identify the appropriate combination of resources, facilities and conservation programs to meet future water demands in Southern Nevada" (SNWA 2008a). The recommendations from this process included seeking long-term water supplies and utilizing all available supplies, such as unused Colorado River entitlements, leases and groundwater development. "The recommendations also supported the "phasing in" of new regional facilities to meet future water demands" and "as part of a subsequent planning phase in 1996, recommendations were developed on how to pay for the new regional water facilities" (SNWA 2008a).

2. *Type of end users*

The SNWA supplies water providers in the Las Vegas Valley, Boulder City and Henderson which predominately serve municipal users. In FY 2007 SNWA delivered 483,300 af of water to its purveyor members.

3. *Type of service*

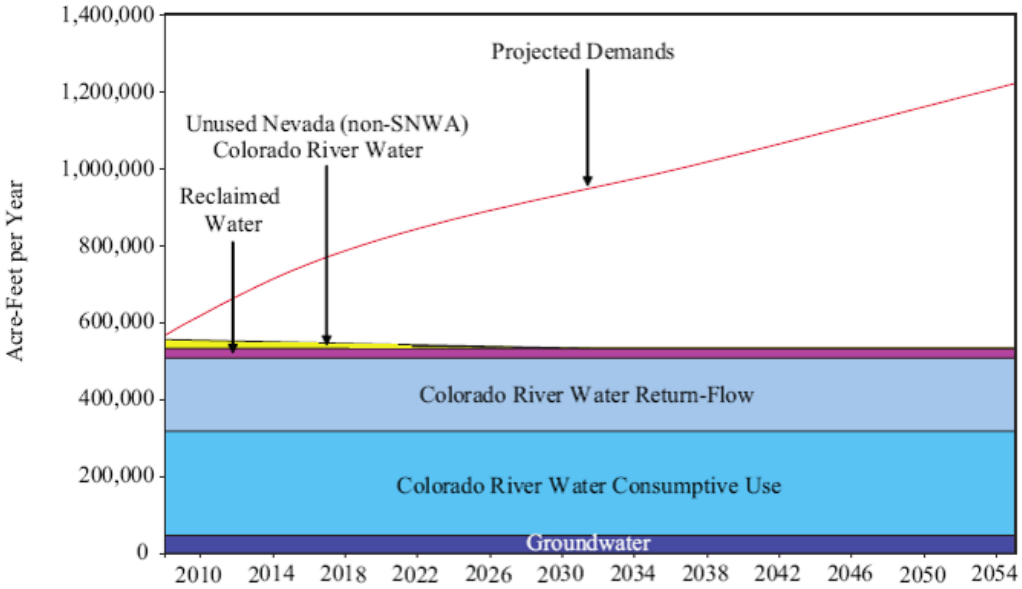
The SNWA is the wholesale water provider to municipal water agencies in the Las Vegas Valley, Boulder City and Henderson. "The SNWA has no retail customers of its own" (SNWA 2006).

4. *Quality of delivered water*

SNWA supplies treated wholesale water to its purveyor members except to Boulder City which receives delivery of raw water for use on golf courses.

5. *Source of water*

SNWA's current supplies consist mostly of Colorado River entitlements including return-flow credits. See chart below for current water sources and projected future demand.



Source: SNWA 2008c.

The Authority is developing additional supplies that include in-state groundwater resources, surface water rights on the Virgin River and Muddy River, and Colorado River system efficiency water, for example SNWA will receive approximately 400,000 af in Intentionally Created Surplus credits from 2011 through 2036, with a maximum annual delivery of 40,000 af, in return for the partial financing of the Colorado River Drop 2 Reservoir (SNWA 2008c).

6. Basis of delivery volume

The 1995 Cooperative Agreement as Amended provides a breakdown of the allocation of (Colorado River) water supplies as follows: Boulder City 8,918 afy; Henderson 27,021 afy; LVVWD 232,426 afy; and North Las Vegas 26,635 afy (the Southern Nevada Water Supply, SNWS Purveyor Members). However for flexibility, "any such Water Supplies which will not be used in a given year by the SNWS Purveyor Member to which they are allocated by this subarticle 8(b) shall be made available in such year to any other SNWS Purveyor Member requesting such Water Supplies" (SNWA 1995, Agreement 8(b)). In 1992 the SNWA also obtained the right to the remainder of Nevada's Colorado River apportionment that becomes "available by reason of reduction, expiration, or termination of an entitlement for use within Nevada" (SNWA 1995, Recital J(i)). "The first 123,000 AFY of Water Supplies to which the Authority obtained a right … shall be allocated as follows: Big Bend 5,352 AFY, Boulder City 3,948 AFY, Henderson 19,858 AFY, LVVWD 78,799 AFY and North Las Vegas 15,043 AFY" (SNWA 1995, Agreement 8(c)). Again this water and other water supplies mentioned in Agreement 8(d-e) that are not utilized by a Purveyor Member are available to another Purveyor Member that requests such water supplies (SNWA 1995, Agreement 8(f)).

The allocation of new water supplies obtained by the Authority and water supplies available for reallocation when another purveyor member does not use it's full entitlement is based on the principle of need where need is defined by the member's water budget (SNWA 1995, Agreement 8(g)). The Authority annually reviews a water resource plan and water budgets. Each purveyor member's water budget takes into account water supplies available to SNWA and separately to

each member, demand within each member's service area, reuse and peaking capacity (SNWA 1995, Agreement 5(j)).

7. Basis of end user's entitlement

The formation of the regional authority meant that individual entitlements to Colorado River water were transferred to the SNWA. In turn under the Cooperative Agreement SNWA has an obligation to "deliver Water Supplies available to the Purveyor Members" (SNWA 1995, Agreement 5(h)). The Cooperative Agreement specifies water delivery volumes to the members (see #6 above).

8. Water rights/entitlement

SNWA holds Nevada's entitlements to the Colorado River and acquired LVVWD's water rights (SNWA 1995, Recital L and Agreement 5(b)). It also has the power to "purchase, sell, exchange, perfect, or otherwise acquire or dispose of any interest in Water Supplies and Water Rights within or without the State of Nevada (SNWA 1995, Agreement 6(a)).

9. Significant 'sidebars' on delivery

In the event of a Colorado River shortage the Authority will share the shortage according to any shortage plan adopted by the Authority or in the absence of such a plan the purveyor members will allocate the shortage based on "the principle of a shared common priority, each such entity shall bear a reduction in the delivery of Colorado River water appropriately taking into account the entity's then existing demand and the quantity of water then being used or reliably available to the entity from all sources" (SNWA 1995, Agreement 8(i)). Thus some member's may take a larger proportional cut in their Colorado River contracted water if they are currently not using their full 'allocation' or have reliable alternative water sources.

In cases of capacity constraints SNWA has a priority schedule to first deliver potable supplies over deliveries that can be satisfied with non-potable water, second to deliver water for ground water recharge where it is used to replace ground water delivered to customers within that calendar year, and the third and fourth priorities are for other ground water recharge (SNWA 1999, Sec 3.5.1). Essentially lower priority deliveries will only be permitted when they do not affect higher priority deliveries (ibid Sec 3.5.2). Furthermore, member purveyors are restricted on taking delivery of water for water banking when "such recharge reduces return flow credits" (SNWA 1995, Agreement 10).

10. Method of allocating water acquisition costs among end users

The principles for allocating new water supplies are stated in Article 8(g) of the 1995 Cooperative Agreement whereby "such water shall be allocated to those Purveyor Members which first experience need in their service areas as identified in the water budget". Furthermore "in the event Water Supplies covered by this subarticle involve a cost to the Authority, the Authority may equitably allocate such cost among those Purveyor Members obtaining such Water Supplies". That is those members who place new demands on the system pay more.

"The SNWA currently receives 10 percent of revenues generated from the sale of federal land in the Las Vegas Valley under the Southern Nevada Public Land Management Act (SNPLMA). Revenues can be used for regional water facilities and programs that generate additional water resources, such as conservation" (SNWA 2005). Conservation is a big part of the 'new' water portfolio which is also funded by connection charges. SNWA has goals to reduce current gallons per capita day (gpcd) water consumption from 272 to 250 gpcd by 2010 and to 245 gpcd by 2035 (SNWA 2008d). "The centerpiece of Southern Nevada's conservation is the SNWA's Water Smart Landscapes Program. With revenues derived from local connection charges paid by new development, the SNWA operates the world's largest incentive program for conversion to water-efficient landscape – more than 100 million square feet of turf has been replaced under the program to date, saving an estimated 5.7 billion gallons of water each year" (SNWA 2008a). The financing of this program means that new development pays for incumbent users to reduce water use and the conserved water can then be used to support new development. The current rebate is $1.50 per square foot of grass removed and replaced with xeriscape, there is no cap but a minimum 400 sf must be replaced (SNWA 2008e). To ensure fairness "SNWA's member agencies share common drought response and conservation goals … (namely they have) adopted similar conservation and landscape watering ordinances, tiered water rates and development code restrictions" (SNWA 2008a). SNWA's Integrated Water Planning Committee also views tiered water rates as another primary tool for water conservation (SNWA 2005).

11. Method of allocating infrastructure/development costs among end users

In 1995 by agreement with the federal government SNWA took over responsibility for and repayment of the Southern Nevada Water System (SNWS, SNWA 1999). The 1999 Facilities and Operations Agreement signed by SNWS purveyor members lays out understandings and agreements of the SNWA and the SNWS purveyor members "respecting (i) operation, expansion, and improvement of the SNWS (including the addition of facilities providing enhanced water treatment), (ii) construction of dedicated facilities for the delivery of Raw Water to SNWS Purveyor Members, (iii) acquisition and allocation of NWS Water Supplies, (iv) delivery through the SNWS of water to which each of the SNWS Purveyor Members has a right, (v) payment of the Authority's costs (including Finance Costs) respecting the SNWS, and (vi) application of Other SNWS Revenues (SNWA 1999, Recital K). The agreement included a firm intention to expand and improve the system to meet increased demand from 400 MGD to 900 MGD by 2014, i.e. "the capacity and reliability to access its entire 300,000 acre-feet allocation of the Colorado River, plus any banked, transferred, or purchased water that may be delivered to Nevada via the Colorado River" (SNWA 2007). This expansion plan was formalized in SNWA's initial Capital Improvements Plan (CIP). The "Capital Improvements Construction (sub fund), is funded almost entirely by tax-exempt municipal bonds the SNWA has sold" (SNWA 2006). The debt service costs are incorporated into commodity charges.

The SNWA annually revises its CIP for the expansion and improvement of the SNWS. Above and beyond this CIP there is no guarantee that SNWA will expand the system to meet every request for added provision of raw water by a purveyor member (SNWA 1999, Recital F and G). A SNWS purveyor member can request that SNWA construct a new raw water facility. If this request is approved the CIP is modified and the purveyor member and the SNWA enter into a Raw Water

Facilities Agreement (SNWA 1999, Sec 2.2.3.2). The purveyor member is responsible for the following: (i) the Capital Cost of the Raw Water Facilities to be constructed for it, (ii) a proportionate share of the Capital Cost of any other SNWS facilities that will be utilized in the delivery of Raw Water to such SNWS Purveyor Member, and (iii) the Capital Costs incurred by the Authority relating to the acquisition of an SNWS Water Supplies delivered… The Authority may, but shall not be required to, finance any or all of such Capital Costs using any funds available to it for such purposes." The division of costs between the SNWA and the purveyor member will be set forth in a Raw Water Facilities Agreement (SNWA 1999, Sec 4.2.1 and Sec 4.2.2). In FY 2007 the Raw Water Facilities Charge (levied on purveyor members) raised $35.86 million which compares to $121.36 million in revenues from regional connection charges, $18.83 million in regional water charges, $3.71 million from SNPLMA, and $55.06 million in Clark County Sales Tax revenue (SNWA 2007b).

A principle of SNWA is to minimize infrastructure charges via the efficient use of current facilities. When new facilities are required they "shall be located and sized, and the construction of such facilities shall be timed, so as to achieve a balance among the following objectives: .. maximize utilization of the SNWS operational capacity and flexibility for the benefit of all…; enable each SNWS Purveyor Member to maximize utilization of its delivery system for the benefit of its customers; minimize the necessity for construction of additional SNWS facilities so as to reduce the construction costs of the SNWS as a whole and to minimize the Authority's charges to all SNWS Purveyor Members; and minimize the necessity for construction of additions to SNWS Purveyor Member systems, or changes in such systems, for purposes of connecting to the SNWS" (SNWA 1999, Sec 2.3.1). The SNWA operates three sub funds. Two of the sub funds are concerned with paying for infrastructure. The New Expansion Debt Service "is funded primarily by connection charges, usage fees and sales taxes; and (the) Capital Improvements Construction (sub fund), which is funded almost entirely by tax-exempt municipal bonds the SNWA has sold" (SNWA 2006). "Revenues received to fund new expansion are reported .. as capital contributions. Capital contributions received for the fiscal years ended June 30, 2007 and 2006 were as follows:

Capital Contributions	June 30, 2007	June 30, 2006
Regional Connection Charge	$ 121,359,088	$ 188,454,011
Contributed Capital	4,310,316	2,595,661
Sales Tax	55,060,027	54,158,795
Raw Water Facilities Charge	35,864,100	1,465,965
Regional Commodity Charge	15,049,243	10,773,616
Regional Reliability Charge	3,779,815	3,440,227
Southern Nevada Public Lands Management Act	3,708,440	135,441,776
Purveyor Member Debt Service Billings	76,573	76,573
Total Capital Contributions	$ 239,207,602	$ 396,406,624

Source: SNWA 2007a.

SNWA's main revenue source is the regional connection charge. "This charge is on every new connection to the system is collected by the SNWA's purveyor members" (SNWA 2006). "Connection charges are mainly set based on a "blended equivalent" which represents the

equivalency of a ⅝" and ¾" service size… weighted based on the population of such meters in service throughout the SNWA service area" (SNWA 2007a). The average effective rate per blended equivalent was $4,247 in FY 2007 and raised $121.36 million in the Las Vegas Valley Water District, City of Henderson and City of North Las Vegas (SNWA 2007a). The rate for a residence with 8 or fewer units per acre in the period May 2007-June 2007 was $4,410 for both a ⅝" and ¾" meter. Commercial interests also pay the connection charge, in May 2007 it was $2,520 per hotel room, $40,503 per irrigated golf course acre, $1,260 per RV park space, and $69,670 for ⅝" meter industrial laundry (SNWA 2007b). This charge ensures that new M&I growth, not existing water rate payers, pay the capital costs of expanding and upgrading the SNWS.

Whereas the ¼ sales tax shifts the cost burden of developing new water from new development to all taxpayers. "The ¼ cent sales tax (levied in Clark County since April 1999) is currently capped at $2.3 billion or 2025, whichever comes first, and is fully committed to paying for the regional improvements implemented by SNWA over the past ten years. (It is likely that) the cap will be reached by 2021. ..The extension of the ¼ cent sales tax would create a more diverse, stable funding plan as well as provide substantial funding for future water resource projects" (SNWA 2005). "Over the life of the tax SNWA is expected to receive 57 percent of the (total) proceeds" (SNWA 2006) and it is lobbying for an extension to this tax. This tax is the second largest revenue source for SNWA: cumulative revenues raised from this source through December 2006 were $300.3 million which compares to $1,079.3 million raised from connection charges, $280.2 million from SNPLMA, $67.7 million from commodity charges and $23.8 million from reliability charges (SNWA 2006).

In 2002 the Major Construction and Capital Plan (MCCP) was created "to address the need for capital projects not directly related to the expansion of the SNWS to 900 MGD. Unlike the CIP which has a finite life, the MCCP is intended to have an unlimited life. The MCCP defines and authorizes projects that are necessary to maintain facilities.. maintain or improve water quality, develop water resources, reduce operating costs, address environmental and safety issues, provide support facilities (including power), and meet other objectives defined by the Board. ..its total authorized amount (is) $1.2 billion. Either the wholesale delivery charge or new expansion revenues are designated as the funding source for each (of 73) MCCP projects …16 projects will be funded by new expansion revenues while 55 projects will be funded by the wholesale delivery charge (and) two projects will be jointly funded by the two revenue sources" (SNWA 2007a).

12. Method of allocating variable delivery costs among end users

SNWA operates three primary sub funds. The Wholesale Delivery Operations sub fund is paid by wholesale delivery charges paid by retail purveyor members of the SNWA (SNWA 2006). This fund "cover(s) the costs of administration and operation of the Southern Nevada Water System. For the fiscal year ended June 30, 2006, the Wholesale Delivery Charge was $252 per acre-foot of treated Colorado River water delivered to purveyor members of the SNWA. …Nellis Air Force Base pays a modified Wholesale Delivery Charge, and Boulder City pays a Raw Water Wholesale Delivery Charge (SNWA 2006). The raw water charge was $190 per af and is delivered for use on golf courses in the city (SNWA 2007a). The wholesale delivery charge rose to $257 per af in FY

2008 in response to higher energy costs (SNWA 2007a). SNWA does not practice marginal cost pricing for allocating variable costs: wholesale delivery charges (Commodity Charge) … are applied uniformly to Henderson, North Las Vegas, and the District and the treated water components of the wholesale delivery charge is applied uniformly to all SNWS purveyor members and the raw water component of this wholesale delivery charge is also applied uniformly to those receiving raw water (SNWA 1999 Sec 7.8).

Evaluation

The SNWA has a diverse portfolio of revenues some of which follow the principle of marginal cost. The largest source of revenues for the Authority is a connection charge levied on all new M&I and golf course irrigation connections in its service area. This charge ensures that new development pays for the expansion of the system and for conservation measures that generate 'new' water. The Raw Water Facility Charge also ensures that those purveyor members that require new facilities pay a portion of the associated costs. However, the Authority also receives significant funds from a ¼ cent sales tax and from the sale of federal land in the valley. These two revenue sources shift some of the burden of expanding the water system to all Clark County sales tax taxpayers, including out-of-state and international visitors, and to Nevadan taxpayers who could have used the SNPLMA funds for alternative uses. Operational costs are melded; the SNWA levies a postage stamp rate on the delivery of water to its customers' facilities, however purveyor members do pay higher costs for treated water.

VI. Texas case study

A. North Texas Municipal Water District, Texas

1. Background, legal basis and organizational structure

The North Texas Municipal Water District (NTMWD) was created in 1951 under the Water Conservancy Act. The District is a wholesale water provider authorized by the State of Texas to "acquire, treat, and distribute potable water" (NTMWD 2008a). It is also provides wastewater treatment and solid waste services. Its service area is Dallas' north and eastern suburbs.

2. Types of end users

The District serves a total 1.5 million people in its 13 Member Cities and 32 Water System (M&I) Customers. In the 2006-07 Water Year (August 2006-July 2007) Member Cities accounted for 87 percent and Customers 13 percent of total deliveries (NTMWD 2008b).

3. Types of service

The District delivers potable treated wholesale water to its Member Cities and Water System Customers. It has no retail customers.

4. Quality of delivered water

The District delivers treated surface water in its service area. "Water quality meets and/or exceeds the state and federal standards" (NTMWD 2008c).

5. Sources of water

NTMWD water is sourced from three regional lakes (NTMWD 2008b). In addition the District has a permit to reuse treated wastewater which is blended with lake water before delivery to customers (NTMWD 2008c).

6. Basis of delivery volumes

Delivery volumes in the three most recent Water Years (August through July) have varied with climate conditions. In 2004-05 NTMWD delivered 257,333 af, deliveries increased 20 percent during the warm and dry 2005-06 water year to 308,623 af, before declining to 237,846 af in 2006-07, largely as a result of strict conservation measures. Deliveries for the same period in 2007-08 were 276,980 af (NTMWD 2007a). The District met increased demand in the 2005-2006 drought through the draw down of reservoir capacity in the system's three supply reservoirs (NTMWD 2007b). NTMWD did not have to ration water to its customers during this period and reservoir storage has since recovered. This drought experience did encourage NTMWD to initiate its Water Conservation and Drought Contingency Plan in October 2005 (NTMWD 2007b).

NTMWD has contracts with its Member Cities and Water Supply Customers that are set in terms of 'Contract minimums'. These contracts are essentially a take-or-pay system and are necessary to "assure bondholders that [NTMWD] will generate sufficient revenues to satisfy their financial commitments" (NTMWD 2008d). Contract minimums are based on "the previous highest annual usage method. This method is generally referred to as the maximum annual demand method. In contractual terms, it is referred to as minimum annual demand [or contract minimum]" (NTMWD 2008d). Note that this contract minimum never goes down it is the previous highest demand whenever this was recorded. However, there are incentives for member cities to conserve because if a city consumes less than its contract minimum it is reimbursed the variable cost of operations conversely if it consumes more than its minimum annual demand it pays the variable cost of treating and delivering the excess water. Furthermore this excess volume "escalates to the full cost the following year as part of the minimum annual demand requirement" (NTMWD 2008d).

7. Basis of end users' entitlements

The District has contractual arrangements with its Member Cities and Water Supply Customers. The contracts are designed to ensure that the District has sufficient funds to cover its debt and operation and maintenance costs – they are therefore set in terms of 'Contract Minimums'. The rationale for this is that the District does not have other funding sources e.g. it does not have the authority to levy taxes. "Its revenues are generated by the services it provides to the cities. Therefore, it has been necessary to develop effective relationships in order for the District to be able to issue bonds to finance the development of projects needed to provide its services. The State of Texas has authorized contracts between local governments that allow water providers to issue contract revenue bonds to finance projects. These contracts require the water provider to receive sufficient revenues from the cities it serves to pay the debt service and operation and maintenance costs of the provider's system. The cities must then charge a sufficient amount to cover not only the provider's cost, but the cost of operating their own systems". The contracts must be approved by the Texas Attorney General in order for the provider to issue bonds

(NTMWD 2008d). The member cities and water supply customers pay the same rate per acre foot of delivered regardless of their contract minimum.

8. Water rights/entitlements

The District not the end-user holds the water entitlements.

9. Significant 'sidebars' on delivery

NTMWD delivers treated water to its Member Cities and Customers, these entities then set rates to cover the cost of NTMWD water supplies and the "cost of operating their own systems" (NTMWD 2008d). If water restrictions are necessary each member city and water supply customer will receive delivery of water in proportion to the water it received in the last year without water restrictions (pers comm. Judd Sanderson, Finance Director, NTMWD, September).

10. Method of allocating water acquisition costs among end users

NTMWD must develop approximately 100 mgd supply every ten years to keep pace with development in the service area (pers. comm. Judd Sanderson, Finance Director, NTMWD, September 18, 2008).

Texas water providers must participate in state-mandated Water Plans which are developed every five years. Each plan forecasts future water demand for the next 50 years and recommends augmentation requirements and specific projects for each water provider. If the population and gpcd projections on which the future water demand by wholesale water provider are based are reasonable then NTMWD's customers will not have to compete with each other for water supplies, so long as, augmentation water supplies are available at reasonable cost. The water planning process identifies, evaluates and selects water supply and water management strategies. This planning process contains water supply competition at the level of regional water providers not between the end-users they serve (WP 2006).

The District anticipates serving an additional 700,000 residents by 2020 (NTMWD 2008e). To meet this challenge the District must augment water supplies. Two projects; one a reuse project, are being developed. In addition the District through end-user conservation efforts and the adoption of Best Management Practices plans to conserve 10 percent (NTMWD 2008f). These savings are equivalent to those achieved by end-users in 2006-07 during extreme dry conditions (NTMWD 2008g). The East Fork Reuse Project will use a constructed wetland to treat imported raw water from the Trinity River which will then be blended with other NTMWD water supplies before delivery to end-users. This project will provide between 80,000 af and 102,000 af additional water. A second project will augment supplies by an additional 50,000 af to 80,000 af a year. By the end of 2006 the District had awarded contracts totaling $278 million to augment supplies (NTMWD 2008g).

The water rate methodology used by the District ensures that those cities which are growing fastest or doing the least to conserve in hot, dry years pay for new supplies. "Contract minimums are .. utilized by [NTMWD] to determine the proportional share of cost to be paid by cities" (NTMWD 2008d). The contract minimum is set in terms of the historic highest annual demand the

city has placed on the District's system. "The District has been required to provide the raw water .. to meet this demand. Under the minimum annual demand method, the city that created the demand on the District's system is required to pay its fair proportional share of the increased cost to develop [augment supplies]. This method ensures that the city that created the demand on the system pays for that demand" (NTMWD 2008d).

11. Method of allocating infrastructure/development costs among end users

The minimum annual demand method also ensures that the cities that generate increased demand on the District's system for "treatment plant capacity, pipeline capacity and pump capacity to meet this demand" and pay "its fair proportional share of the increased cost to develop, operate and maintain supplies and facilities" (NTMWD 2008d).

12. Method of allocating variable delivery costs among end users

In the 2009 Budget wholesale water rates are $1.18 per 1000 gallons of which 53¢ is variable costs. This is up from 42¢ in 2008 largely because chemical prices have been volatile (pers. comm. Judd Sanderson, Finance Director, NTMWD, September 18, 2008). All member cities are charged a uniform rate for water regardless of conveyance distance or actual treatment costs for a specific member city. However, NTMWD through its variable cost surcharge and rebate mechanism has created incentives for water conservation. The allocation of additional variable costs to the cities is determined in the annual budget process. "The budget is proportioned among the cities based on each city's minimum annual demand. Should a city consume a greater volume of water than its minimum annual demand, the excess water is purchased at the variable cost for electrical power and chemicals required to produce the additional volume of water. This excess volume of water escalates to the full cost the following year as part of the minimum annual demand requirement… The variable cost charged to the cities allows the cities to benefit from the larger sales in their systems that year. In future years, the additional volume must be reserved in capacity for each city" (NTMWD 2008d). The flip side is that to encourage conservation efforts the District has "established a rebate program. Should a city consume less than its minimum annual demand, the Board of Directors generally rebates back to the city the variable cost of operations (power and chemicals) that were budgeted but not incurred to meet the city's actual consumption" (NTMWD 2008d).

Evaluation

The NTMWD has adopted policies that promote fairness within the regional water district. The minimum annual demand methodology used to determine water rates ensures that those Member Cities and Water Supply Customers that experience rapid growth in water demand pay for the additional costs associated with developing, treating and delivering more system water. They do not pay for augmentation costs upfront, except for variable costs incurred by the District, but rather they pay for augmentation-related costs over time by paying a larger share of the District's total costs.

VII. Utah case study

A. Jordan Valley Water Conservancy District, Utah

1. Background, legal basis and organizational structure

The Jordan Valley Water Conservancy District (JVWCD) was created in 1951 under the Water Conservancy Act. It is one of the largest water districts in Utah. It is primarily a provider of wholesale water to 18 member agencies in the Salt Lake Valley region but ten percent of its M&I deliveries are retail water provided to six cities. The district also treats and delivers water by contract to another water district and to the state.

2. Types of end users

The JVWCD delivers around 35,000 af of raw water to irrigated agriculture and just under 90,000 af a year to 18 wholesale M&I customers in the fast growing Salt Lake Valley region (JVWCD 2007a).

3. Types of service

JVWCD supplies mostly wholesale water to its member agencies. It also treats or delivers 8,500 af a year to cities outside its service area as well as delivering raw water to agriculture (JVWCD 2007a).

4. Quality of delivered water

90 percent of the water delivered by JVWCD to M&I customers is wholesale, untreated water, just ten percent is retail, treated water.

5. Sources of water

JVWCD firm water supplies increased from 40,000 af in 1989 to 135,000 af in 2006 (JVWCD 2006a). New supplies include Utah Lake System water provided by the Central Utah Project (CUP), imported surface water from irrigation exchanges, groundwater development and supplies from groundwater remediation. Remediated groundwater supplies were developed with the Kennecott Utah Copper Corporation. The reverse osmosis treatment plant began operation in 2006 producing 3,500 af per year and the second phase of the project will produce an additional 428 af to 1,458 af annually (JVWCD 2006a). JVWCD has also purchased "additional water and water rights from nearby lakes and rivers" (Business Wire 2005). In fiscal year 2006/07 JVWCD invested $991,935 in water rights acquisition on the Jordan River, Utah Lake irrigation stock and Provo River irrigation stock (JVWCD 2007a).

6. Basis of delivery volumes

Note from Point 2 and Point 5 above that currently JVWCD firm water supplies exceed water deliveries and therefore the question of how to distribute available supplies between competing wholesale member agencies and retail customers has not yet arisen.

JVWCD has a variety of contract types with its wholesale customers. Many wholesale water contracts are perpetual and include minimum annual purchases on a "take-or-pay" basis (JVWCD

2004a and 2007a). Other contracts are for fixed terms and water is also sold without any contract at extra capacity rates. This rate combines the highest quarter average wholesale rate + pumping costs + 10% (JVWCD 2004). New retail customers must apply for water service, sign a Water Application and Agreement, and pay impact fees for connection (JVWCD 2006b).

7. Basis of end users' entitlements

The 18 member agencies have contracts, often perpetual, with JVWCD for wholesale water supplies. Retail water customers have a service contract with JVWCD.

8. Water rights/entitlements

The water entitlements belong to JVWCD.

9. Significant 'sidebars' on delivery

Wholesale water is delivered and metered to member agencies treatment plants and treated water is delivered, metered and billed to retail customers.

10. Method of allocating water acquisition costs among end users

To the extent that it is new development that requires the District to purchase new surface water rights or develop new groundwater supplies i.e. current customers' gpcd usage is static or declining[8] then new water district property tax levies will at least partially pay for new water supplies. The water district property taxes assessed on the value of a typical Salt Lake valley home are $93.82 per year. The District sees "property taxes (as) .. an important revenue source for water districts and water development" (JVWCD 2007d). Of course existing homeowners continue to pay property taxes including the water district levy but growth increases the tax base and the revenues available to the District to invest in water development and new infrastructure.

The JVWCD's public literature also states that "(water) rates (levied on old and new customers alike) will continue to rise whether people conserve water or not due to growth and the need to develop new sources of water and build new treatment plants" …All of the "cheap" sources of water are appropriated, or spoken for. Future water supplies will be much more costly, and with growth and the need to supply water to our children and grandchildren, we will need to develop new, more expensive sources of water. Conserving water stretches our existing resources and defers costly new facilities" (JVWCD 2004b).

11. Method of allocating infrastructure/development costs among end users

New retail customers must pay impact fees to connect to JVWCD retail network. The connection fee for a typical single family residence consists of a $2,320 impact fee + $525 installation cost = $2,845 (JVWCD 2006b). The district also receives property tax revenues levied in its service area revenues that are used for infrastructure development.

[8] Average water consumption in 2007 in the JVWCD service area was 250 gpcd the same as in 2001 but higher than the 210 gpcd average in 2005 (JVWCD 2007b). If a typical household has 2.5 people then average annual household usage is 0.7 af. On the revenue side a typical single family residence pays $93.82 annually in property taxes to the District.

12. Method of allocating variable delivery costs among end users

The JVWCD practices a form of marginal cost pricing for delivery to its customers. Wholesale customers in 2007 paid between $235.09 to $399.68 per af of water delivered in winter and a higher $293.86 to $486.98 per af in the summer months. The range of costs is based on "cost of service to customer" (JVWCD 2007c). Deliveries peak in summer and therefore summer rates are higher as it is these peak deliveries, and not average deliveries, for which the District has to design and construct infrastructure. Annual average costs for wholesale M&I deliveries to seven cities was available and are in the middle of the winter-summer rate range at $269 per af to $382 per af.[9] In 2007 industrial customers were charged $260.81 per af in winter and $324.41 per af in summer and retail customers paid $345.40 per (treated) af in winter and $433.38 per af in summer plus a flat fee monthly meter charge. In addition to type of user and seasonal cost pricing the District also levies a "pumping surcharge" of $52.14 per af to retail customers in areas where water has to be pumped to the elevation of a customer's home to deliver water. This surcharge is another example of the District practicing some form of marginal delivery cost pricing.

Evaluation

The JVWCD practices price discrimination based on delivery economies of scale (wholesale member agency rates < industrial rates < retail rates), seasonal cost of delivery (winter rates < summer rates) and for their retail customers a pumping surcharge is levied when water must be pumped to the house for delivery. The District also levies connection impact fees on new retail customers to shield existing customers from development-related delivery infrastructure expenses.

Property tax revenues are also a significant revenue source for the District and one which it wishes to expand. To put these revenues in perspective in fiscal year 2007/08 JVWCD total revenues were expected to be $91.20 million (on 71,200 af wholesale water and 9,500 af retail water delivered) of which: wholesale water sales revenues were expected to raise $25.63 million; retail water sales $4.15 million; water district-property taxes $12.96 million; and impact connection fees $0.16 million. Property taxes were budgeted to raise 14 percent of its total revenues up from 13 percent in FY2006/07: the increase was based on the District pushing through an increase in the current water district property tax rate to its statutory maximum rate of 0.0004 (JVWCD 2007e). There are economic efficiency reasons against using property taxes to finance water supply namely taxes subsidize water rates and thereby diminish the price signal for consumers to conserve water (Miller 1993). In fact average per capita water consumption rates are high in the JVCWD service area. An alternative to the current hybrid property tax-water rates system would be to eliminate property taxes and raise water rates to cover the costs of water supply. The JVWCD's own analysis estimates that if water district property taxes were eliminated that wholesale water rates would increase by as much as 113 percent and retail rates by as much as 75 percent. The average household would see its water bill rise from $605.60 ($93.82 property tax + $511.78 current water rates) to $1,056.90 (if usage remained static). The District concludes that "Property taxes are [currently] an important revenue source for water districts and water development. An elimination of property taxation by water districts would shift more of the cost

[9] $/af calculated from JVWCD 2007c and JVWCD 2007b.

burden to [all existing] homeowners, churches and public education—away from businesses and owners of undeveloped land" (JVWCD 2007d). However, there is yet another alternative: the District could extend its price discrimination policies—essentially levying higher surcharges on new development (higher impact fees on new retail customers and higher rates on water deliveries to wholesalers in excess of their current contracted supplies) so that new development and not current water users fund water supply augmentation.

3. INTERNATIONAL CASE STUDIES

A. Southern Murray-Darling Basin: Interstate Water Trading

1. Background, legal basis and organizational structure

The push to reform Australia's water industry started in 1992 (Bjornlund, 2005). In February 1994, the Communiqué of the Council of Australian Governments (COAG) approved a package of water market initiatives. In 1996, the Murray-Darling Basin Ministerial Council (MDMC) approved the establishment of an initial pilot project to introduce trade in permanent interstate water property rights in the Mallee Regions, incorporating areas in New South Wales (NSW), South Australia (SA) and Victoria (MDMC, 1996). This is considered a major milestone in Australia's water industry that broadened the scope of water marketing in the southern Murray-Darling Basin. On 28 November 1997, the MDMC approved *Schedule E - Interstate Transfer of Water Allocation,* which enabled irrigators in NSW, SA and Victoria to trade water entitlements across state boundaries in a permanent fashion (Bjornlund, 2005). Water trading has been encouraged by state governments as a means of moving water to its highest return value use (Prasad and Khan, 2006). Initially water trading was confined within irrigation systems, however over time, changes have been made to the trading rules, which have permitted inter-valley and more recently interstate trade to take place.

2. Types of end users

Within the Murray-Darling Basin, the water market is primarily intra-agriculture. Buyers are often irrigators who grow high value crops such as citrus and vines. The metropolitan areas on the south and east coast, e.g. Melbourne, Sydney and Brisbane cannot, without significant costs, benefit from the water since they are on the other side the Great Dividing Range (Bjornlund and McKay, 1995). Smaller urban centers have been guaranteed water separately and are therefore not active in the market (Bjornlund and McKay, 2000).

3. Types of service

The Southern Murray-Darling Basin has two types of water entitlements – high security and general security. Water trading is restricted to the high security water entitlements held by individual irrigators who pump water directly from the rivers. This high priority water is available in all but the worst drought years (Bjornlund, 2005) and the holders of high security water receive their entitlements in full, while general security holders share what is left. Until May 19, 2006, a total of 312 interstate transfers of entitlements were recorded where a total of 25,843 af (31,865 megalitres) of water traded (Cummins & Watson, 2006). The table below shows the breakdown of the exchange.

Murray-Darling Water Transfers 1996-2006, af

Origin	Destination			Total
	NSW Pilot	SA Pilot	Victoria Pilot	
NSW		6,092	280	6,371
SA	81		1,682	1,763
Victoria	4,210	13,499		17,709
Total	4,291	19,590	1,962	25,843

Source: Tim Cummins & Associates (with Alistair Watson), 2006

According to an evaluation by Cummins & Associates (2006), at the end of the pilot phase, net transfers of water entitlements into Victoria stood at around 96,513 af (119,000 megalitres) (including the net transfers out to SA and NSW). Transfers out of the Goulburn-Murray Irrigation District supported the increase in this part of Victoria. Rapid expansions in the total area irrigated, first in the wine industry and then in the almond industry, led to a net transfer of 111,922 af (138,000 megalitres) into the Mallee region during the pilot project. Interstate water trade benefited Victoria and SA.

4. Quality of delivered water

Surface water quality in the Basin is not high due to the biophysical nature of the Basin (Bek and Robinson 1991). Not only is it a naturally saline environment, turbidity levels are naturally high and as are nutrient levels, originating in the rocks and soils of the catchment (DWR 1993).

5. Sources of water

The region is supplied by two systems: the Murray River and Goulburn River. The two systems have different levels of supply reliability, where the Murray system is most reliable and has the highest level of annual water entitlement sales. Certain restrictions on trade exist between the two systems since water can only physically move from the Goulburn to the Murray system and not in the other direction.

6. Basis of delivery volumes

As discussed earlier, in 1998 the MDMC established a pilot interstate water trading project that allowed water users in the NSW, SA, and Victoria to buy and sell water across state boundaries. Water trading in the pilot project was limited to permanent transfer of high security water entitlements where each trade must have been approved by respective state authorities (MDMC, 2006). All applications for water trading were subject to a comprehensive environmental impact evaluation process, including water supply, water quality, land capability and suitability, environmental and nature conservation and cultural and heritage matters are considered as part of a single assessment and approval process. For example, irrigators are required to submit comprehensive plans that address environmental protection issues.

7. Basis of end users' entitlements

Water users in all states hold a legal entitlement to water and it generally specifies the source of the water, its reliability and conditions on how that water may be used (MDMC, 2006). For example, whether it must be used within one year or whether it can be carried over into subsequent years. Some entitlements, known as high reliability entitlements, produce the same quantity of water in every year, while water allocations of medium or low reliability entitlements, are determined by climatic factors. Under the water trading arrangements it is possible for all irrigators to buy high security entitlements, but these entitlements cost twice as much as general security entitlements (Bjornlund, 2005).

Permanent trade in entitlements occurs when the seller relinquishes all rights to the water entitlement. Temporary trades occur when the water allocation made to an entitlement is sold for a specified period (usually one year), or when only the water contained in the water account is sold. The market for temporary trades is substantially larger than that for permanent trade. For example, of the 802,902 af (990,000 megalitres) traded across the Murray-Darling Basin in 2001/02 only 8% was traded permanently.

The table below reveals the evolution of the annual trading market over nine seasons. In 1998/99 trade represented just 4% of on-farm water use, whereas in the drought year of 2002/03 trade represented 18% of water used (ICF International, 2007). Scarcity is a driver of water value: record prices were paid in the drought year of 2002/03.

Murray-Darling Water Trades 1998-2006

Season	Acre feet traded	Total value of all sales '000 $	Average Price, $/af	Lowest sales $/af	Highest sales $/af
98/99	41,363	826	16	6	65
99/00	49,473	2,237	37	21	85
00/01	58,394	1,121	16	8	30
01/02	55,961	2,845	41	20	75
02/03	48,662	12,636	209	100	350
03/04	64,071	5,712	72	50	150
04/05	54,339	4,968	74	44	200
05/06	77,048	4,214	44	34	140

Source: ICF International Limited, 2007

8. Water rights/entitlements

In order to limit the impact that the interstate transfer of a water entitlement may have on supply security — and hence on other water users — and the environment, exchange rates have been developed by the Murray-Darling Basin Commission. They are based on a set of principles that are considered to be equitable with regard to all water users. The exchange rates have been applied to all transfers taking place under the Pilot Project.

Exchange rates have been determined for interstate transfers to accommodate any losses through changes in the level of security for supplying water and to ensure that the overall security of the system is not compromised, that is, that other users are not adversely affected by

the trade. Currently, it appears that the impacts of moving water in the relatively small trial zone are minimal and so a 'security' exchange rate of 1.0 has been determined for transfers between New South Wales and Victoria. However, a transfer from South Australia to New South Wales or to Victoria has a 'security' exchange rate of 0.9 because of the reduced security of supply upstream of the Darling River and Lake Victoria. The median flow of the Murray at Euston is 0.9 of the combined median flows of the Murray and Darling rivers.

Transfers between New South Wales and Victoria attract the Pilot Project exchange rate of 1.0. Thus a sale of 1,000 af from New South Wales would mean the receipt by an irrigator in Victoria of 1,000 af. Similarly, a sale of 1,000 af from Victoria would mean the receipt by an irrigator in New South Wales of 1,000 af. Transfers from South Australia to New South Wales or Victoria attract a Pilot Project exchange rate of 0.9 or a reduction of 10% (because of the reduced security of supply). Thus a sale of 1,000 af from South Australia would mean the receipt by an irrigator in New South Wales or Victoria of 900 af.

9. Significant 'sidebars' on delivery

Interstate water transfer takes place between the seller in the State of origin and the purchaser in the State of destination, and requires the approval of the water licensing authorities in both States. Since the applicants must satisfy the requirements of the origin and destination states and agencies that are involved, there is variation in the details of the process depending on the locations of the individual water traders. States and Territory Governments, through relevant agencies, implement comprehensive systems of water allocations or entitlements, which are to be backed by the separation of water property rights from land and include clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality.

Under the Australian constitution, responsibility for natural resource management rests with the States and Territories. Following the CoAG Water Reform Framework, MDMC has developed a package of diverse but interrelated requirements to generate an economically viable and ecologically sustainable water industry. They are:

- all water pricing is to be based on the principles of full cost recovery;
- any future new investment in irrigation schemes, or extensions to existing schemes, are to be undertaken only after an appraisal indicates it is economically viable and ecologically sustainable;
- the formal determination of water allocations or entitlements, including allocations for the environment as a legitimate user of water;
- trading, including cross border sales, of water allocations and entitlements within the social or physical and ecological constraints of catchments; and
- an integrated catchment management approach to water resource management must be adopted.

10. Method of allocating water acquisition costs among end users

In this market-driven approach it is the purchasers of water allocations (leases) or entitlements (water right purchase) that pay water acquisition costs to the seller of the lease or water right.

Exchange rates have been developed; see Point 9, to reduce third party environmental and economic impacts of temporary and permanent water sales.

11. Method of allocating infrastructure/development costs among end users

Under the terms of the Murray Darling Basin Agreement, the MDMC recovers the costs of operating, maintaining, and upgrading/acquiring assets. Previously, operating costs were shared equally by NSW, SA, and Victoria and capital costs were evenly divided between the Commonwealth, NSW, SA, and Victoria. From July 1998 a new system is in place which links payment with the services provided (MDMC, 2002).

12. Method of allocating variable delivery costs among end users

The principles for allocating costs between water users and the government are still under development. For the time being, the Commonwealth Government has agreed (in principle) to take significant responsibility of the total project costs.

Evaluation

The Murray-Darling Basin water market has matured: water trades are on-going and market prices have stabilized though they remain responsive to climatic conditions, i.e. record prices were recorded in the 2002/03 extreme drought year. However, the volume of water traded remains small perhaps indicating that there are barriers to trade. Significant water conveyance barriers to water trades between irrigators and municipal interests exist and furthermore the Pilot Program was exclusively established to enable intra-irrigator trades. The Pilot Program nevertheless demonstrates that there are willing sellers and willing buyers of temporary and permanent water rights and that the market facilitated the movement of water from low-value to higher-value uses in both wet and dry years.

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