Envisioning an Urban Market for Conserved Water in Southern California

Group Project Work Plan | June 2014

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Objectives

1. Investigate potential outcomes of paper water trades between local agencies in Southern California could function.
    a. Determine how to fairly allocate entitlements (rights) among agencies. Develop alternative approaches for allocating entitlements (rights) among agencies.
    b. Determine the economic impacts of a water market on the Long Beach Water Department. Find the potential economic gains or losses from trade; identify which agencies would benefit from a market system, and which would suffer.
2. Investigate the environmental and social benefits resulting from urban water trading.

Significance

The client for this project is the Long Beach Water Department (LBWD), the municipal water supplier for the city of Long Beach, California. LBWD is one of 26 member agencies that make up the Metropolitan Water District (MWD), a wholesale distributor and facilitator of water to Southern California. Under the current term of agreement for the MWD member agencies, public utilities like LBWD that invest in conservation are not able to independently reallocate the water they conserve through mechanisms like water trading or water banking. Instead, that water is redistributed via MWD, outside of the control and direct benefit of the conserving agency. For an agency such as LBWD, these conditions then appear to result in an economically inefficient system in which local utilities remain dependent on imported water and incentive for conservation is reduced. This project will examine the barriers that exist for independent urban-to-urban water markets, and identify scenarios and associated outcomes wherein the benefits of conservation may be more fully realized.

The results of this study will allow LBWD to quantify the potential gains from trade that would be allowed under a water market system. The analysis of this project will provide LBWD with information to guide their internal water management and conservation plans, as well as to engage in discussion and negotiation for system improvements with MWD and their member agencies. The significance of our research therefore may extend beyond LWBD and may benefit water users throughout Southern California by encouraging conservation, water trading, and economic efficiency. Further benefits may then be seen as a result of reduced overall water use, the promotion of sustainable development, and the associated environmental benefits these practices afford.

Background

Overview of water markets

In this project we will consider a market for trading conserved water between water supply agencies in Southern California.

The term 'water markets' encompasses a broad range of transactions. Such transactions may be temporary leases, in which the seller leases the water itself but retains their legal right to it, or they may be permanent sales of the rights themselves. In the latter case, the over-allocation of many river basins in the western U.S. gives rise to a distinction between 'paper rights' and 'wet water': a buyer who purchases paper rights to 100 acre-feet (AF) of water may actually receive less than 100 AF of wet water, depending on the total supply available in a given year. Transactions may also be classified based on the sectors involved; e.g. agriculture-to-agriculture or agriculture-to-urban.

The driving force for trade in a water market is the difference in the value of water to the seller and the buyer. In a market for conserved water, the seller makes water available by decreasing their need for water. For example, a farmer may install an efficient drip irrigation system, or a municipal water district may implement a turf replacement program. They then sell the water to another user at a price that is (hopefully) higher than the cost to conserve the water; this profit motive creates an incentive for further conservation. Water users with a low marginal cost of conservation will tend to be sellers in the marketplace; those with higher marginal costs will tend to be buyers. Much like cap and trade markets for pollution emission credits, the water market efficiently allocates conservation to those who can most afford to conserve, and it encourages conservation by every user over the long run.

The fact that water exists naturally as a flow rather than a stock introduces high transaction costs to water markets. Transactions may involve the physical conveyance of water between seller and buyer, but more often a means of conveyance does not exist, limiting transactions to users within the same river or groundwater basin. California is unique in that its extensive network of aqueducts enables transfers between widely separated basins. Because water is fungible, such transactions may involve merely a transfer of paper rights, with the seller leaving water in the system at one location and the buyer diverting an equivalent quantity of water at another location, accounting for transmission losses along the way.

Water Markets in California

California has had a viable, if somewhat limited, market of water for many years. Short-term leases of water from farm to farm are commonplace in many agricultural districts, as are transfers from

one agricultural district to another. While still rare, long-term transfers from the agricultural sector to the urban sector occasionally make the news, driven by the differential between the high price cities are willing to pay and the low price agricultural users pay for their water. For example, in 2010, the Dudley Ridge Water District agreed to sell 2,000 acre-feet (AF) of water annually to the Tejon Ranch development at a price of $5,850, more than ten times what farmers in the region pay for water.[1] In a previous transaction, Dudley Ridge sold another 14,000 AF to the Mojave Water District for $73 million.[2]

One of the best known examples in California of a market for conserved water is the transfer of 277,700 AF of conserved water from the Imperial Irrigation District to the San Diego County Water Authority.[3] However, the market for conserved water is still limited and usually begins with water being conserved in the agricultural sector.

A potential new source of water for California would be the creation of an efficient urban-to-urban market for conserved water. Southern California is ideal for such a market because much of the urbanized area is connected by a common plumbing system of aqueducts and water mains, enabling easier (re)distribution of water to any point in the system. Having an open and efficient market for conserved water will be increasingly important to California as it looks into a future of increasingly strained water supplies.

Water distribution institutions in Southern California

In the Southern California region, water is distributed via a four-tier structure comprising local retail agencies (such as municipal utilities), sub-regional wholesale water agencies (such as the San Diego County Water Authority), a regional wholesaler (the Metropolitan Water District), and state infrastructure projects (the State Water Project).

At the lowest level, local water retailers sell water directly to residential and commercial customers. These retailers may be municipal utilities that are part of an incorporated city (e.g. the Long Beach Water Department and the Los Angeles Department of Water and Power) or for-profit corporations regulated by the California Public Utilities Commission. At the sub-regional level, some areas are served by agencies that both retail water directly to customers and sell water wholesale to other retail water agencies (e.g. the Western Municipal Water District).

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[1] "Farmers' Water Deals Stir Debate," *New York Times Green Blog*, November 12, 2010, http://green.blogs.nytimes.com/2010/11/12/water-deals-heighten-concern-for-farms/.
[2] "Valley Water Keeps Flowing toward Southern California," October 22, 2010, http://abclocal.go.com/kfsn/story?section=news/local&id=7739061.
[3] Steven P Erie and Harold David Brackman, *Beyond Chinatown: The Metropolitan Water District, Growth, and the Environment in Southern California* (Stanford: Stanford University Press, 2006).

Retail agencies in Southern California have four potential supplies of water. From cheapest to most expensive, they are: local sources (typically groundwater), imported water secured directly by the agency, imported water purchased from a wholesaler, and recycled or desalinated water. Only the Los Angeles Department of Water and Power (LADWP) and the San Diego County Water Agency (SDCWA) have access to their own supply of imported water. LADWP imports water from Owens Valley via the historic LA Aqueduct, while SDCWA imports water from the Colorado River that it purchases from the Imperial Irrigation District through a long-term contract.

Local sources, almost entirely large groundwater basins, meet about half the demand of the Southern California urban region. To meet the rest of their demand, almost all retail agencies in Southern California must buy some imported water wholesale. Because this imported water is more expensive, agencies typically exhaust the cheaper local supplies which they have rights to and then purchase imported water on the margins.

The exclusive regional wholesaler of water in Southern California is the Metropolitan Water District (MWD, known colloquially as 'Met'), a public agency founded in 1927. MWD operates as a cooperative of 26 retail and sub-regional agencies which includes every urban water district in the region. Between 1985 and 2005, MWD supplied an average of 1.85 MAF of water per year to its member agencies – about half the demand of urban Southern California.[4] MWD relies on two sources of imported water for most of its deliveries: the State Water Project (~60%) and the Colorado River Aqueduct (~40%).

The original source of MWD's water is the Colorado River Aqueduct (CRA), built in the 1930s and 1940s. The CRA carries water diverted from the Colorado River at Parker Dam on Lake Havasu across the Mojave Desert to the Southern California metropolitan region. MWD holds appropriative rights to 550,000 AF of water from the Colorado River, which constitutes 12.5% of California's 4.4 MAF annual apportionment.[5] MWD also has agreements with the Imperial Irrigation District, Coachella Valley Water District, and Palo Verde Irrigation District to secure additional water through agricultural conservation and land fallowing; this water is also transported by the CRA.

The second source of MWD's water is the State Water Project (SWP), a 705-mile-long network of aqueducts constructed by the California Department of Water Resources in the 1960s to move water from north of the Sacramento Delta to water-scarce regions to the south. Based on its contribution to the capital cost of the SWP, MWD has a right to purchase 50% of the water supplied through the aqueduct. In a perfect year MWD would receive its full allotment of 1.9 million acre-feet (MAF) of water, but there has never been a perfect year. MWD's actually allocation varies

[4] David Zetland, "Analyzing the Efficiency of Met's Pricing Rules" (presented at the 2006 NIWR/UCOWR, Santa Fe, NM, 2006).
[5] *MWD Annual Report for the Fiscal Year 2012-2013* (Metropolitan Water District of Southern California, 2013), http://www.mwdh2o.com/mwdh2o/pages/about/AR/AR13/2013AR-low-rez.pdf.

from year to year, typically ranging from about 40% to 70%. In the 2013—2014 water year, MWD's allocation was a record low of just 5% of its contracted right.

Water Storage in Southern California

An important aspect of any regional water distribution system is storage, which allows agencies to store their surplus water during rainy years and withdraw it during droughts. At the local level, some retail agencies have the ability to store water in their underlying groundwater aquifers, though this requires the construction of spreading basins or injection wells. The Long Beach Water Department, for example, recently acquired the right to store water in the Central Basin.

MWD operates several reservoirs across Southern California that provide a total storage capacity of about 1 MAF.[6] The largest of these, the recently-constructed Diamond Valley Lake in Hemet, added 810,000 AF of capacity alone. Lake Matthews, with a capacity of 182,000 AF, is the western terminus of the CRA. Finally, MWD now has the ability to store surplus Colorado River water in Lake Mead. These reservoirs constitute a third source of water that MWD can use to meet demand, especially during times of drought.

Allocation of Water to Local Agencies

Allocation during normal years

One of the driving forces behind this project is that MWD allocates water differently in times of abundant supply than in times of shortage.[7] In an abundant year, agencies simply order the quantity of water they think they will need for the next year, and MWD fulfills those orders from its various sources of supply. Agencies buy water by the acre-foot, paying volumetric prices that include the cost of the water itself as well as MWD's cost of treatment, pumping, delivery, and conservation programs. In 2014, the price for an acre-foot of treated water was $890.[8]

When MWD determines that it cannot meet its member agencies water demands from SWP water, CRA water, and storage withdrawals, it declares a *regional shortage*.[9] The level of the shortage, from 1 to 10, depends on what percent of demand it expects to be able to meet. A Level 1 shortage means that MWD can only meet 95% of its members' demand; a Level 2 shortage is 90%, and so on.

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[6] Ibid.
[7] Shortage years and non-shortage years do not necessarily correlate with 'dry' years and 'wet' years, because MWD may use some of the water it has previously placed in storage to meet demand.
[8] "MWD 2014 Water Rates and Charges," accessed April 17, 2014, http://www.mwdh2o.com/mwdh2o/pages/finance/finance_03.html.
[9] *MWD Water Surplus and Drought Management Plan* (Metropolitan Water District of Southern California, 1999), http://www.mwdh2o.com/mwdh2o/pages/yourwater/WSDM_Report1150.pdf.

Allocation during shortage years

A controversial question is how water ought to be allocated between agencies during shortage years. MWD has created several different drought allocation plans over the decades, the oldest of which is *preferential rights*. Although preferential rights have never been invoked, they are important because from them comes the idea that agencies ought to be entitled to water in accordance with how much they pay towards MWD's capital expenditures – operating the CRA, contributing to SWP operations, and building new capacity. In the early days of MWD, these fixed costs were primarily paid through property taxes assessed on member agencies' lands.

MWD's founding statute, the Metropolitan Water District Act, ensured that those cities that paid the most towards MWD's projects secured a right to the most water. Under Section 135 of the Act, each member agency is entitled to a "preferential right" to purchase a share of MWD's total annual water supply in direct proportion to the amount the agency has paid towards MWD's capital expenditures that year through (1) property taxes, (2) readiness-to-serve charges, and (3) capacity charges. (This concept is similar to MWD's rights to water from the SWP, which are proportional to its commitment to capital expenses.) Importantly, payments related to the actual purchase of water are excluded from the calculation of preferential rights.[10]

Because the property tax revenues are much larger than revenues from the other two charges, urban agencies with large property tax bases receive more preferential rights than smaller or suburban agencies. For example, in 2006 the Los Angeles Department of Water and Power (LADWP) had preferential rights to 21.2% of MWD's annual supply. A smaller agency like the Long Beach Water Department had preferential rights to 2.6% of the supply, while the city of San Fernando had only 0.1%.[11] Preferential rights are recalculated each year but generally do not change substantially.

Preferential rights as a method of allocating water has been criticized as unfair by some agencies, notably the San Diego County Water Authority (SDCWA), MWD's largest customer by volume of water purchased. SDCWA's chief complaint is that MWD nowadays receives most of its operating expenses from the sale of water, not property taxes – yet these payments are specifically excluded from the calculation of preferential rights.[12] This exclusion makes preferential rights essentially blind to an agency's historic water use or level of dependence on MWD. For example, despite purchasing 25% of MWD's water, SDCWA has preferential rights to only 17.2% of MWD supply.[13]

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[10] *The Metropolitan Water District Act of 1969*, 1969, http://www.mwdh2o.com/rsap/Act.pdf. Section 135, "Preferential Right to Purchase Water."
[11] MWD 2008 Supply Allocation, Excel spreadsheet provided by Long Beach Water Department.
[12] "Preferential Rights," *San Diego County Water Authority*, accessed April 10, 2014, http://www.sdcwa.org/preferential-rights.
[13] As a counterpoint to San Diego's claim, one may argue that because SDCWA joined MWD relatively late in 1946, it has not paid as much in cumulative property taxes as founding agencies like LADWP (Erie and Brackman, *Beyond Chinatown*). David Zetlin argues in *The End of Abundance* that in the early years of

Being cut back to this amount would be especially devastating to San Diego because they have little local supply and are thus extremely dependent on MWD.

During a drought, any member agency could legally invoke its preferential right by demanding to purchase its assigned share of water from MWD. But in practice, perhaps because of the political infeasibility of making large cuts to the supply of agencies like SDCWA, preferential rights have never been invoked (and may in fact be illegal under California Water Code section 350, which describes how agencies may allocate water during official water shortages)[14]. Instead, MWD has drafted alternate allocation plans which provide a more even level of cutbacks for all agencies.

Shortage Year Allocation – Supply Allocation Plan

MWD currently allocates water during shortage years according to a document known as the Supply Allocation Plan (SAP), approved in 2009. Unlike preferential rights, the SAP takes into consideration factors such as agencies' available local supply, dependency on MWD water, reclamation/recycling efforts, and conservation.[15] The goal of the SAP is to impose a relatively equal cut to customers at the retail level. This results in retail agencies that have low per capita water usage being cut proportionately the same as agencies that have high per capita usage (often measured in GPCD, *gallons per capita per day*). The low usage agencies have less ability to cut back because they have already reduced their discretionary demand (e.g. landscape irrigation) through conservation measures; they must then force customers to reduce the amount of water used for basic domestic needs like drinking and washing[16]. Meanwhile, agencies with high per capita usage need only reduce discretionary usage such as landscape irrigation.

The Supply Allocation Plan therefore creates an incentive for agencies *to consume more water during non-shortage years*; that is, the best protection against catastrophic cutbacks from MWD

MWD, Los Angeles' property taxes effectively subsidized delivery of CRA water to neighboring cities because LA already had an ample supply of water from the LA Aqueduct, its main interest in building the CRA being the power from Hoover Dam.

[14] "CA Water Code Subsection 350 (Water Shortage Emergency)," accessed April 10, 2014, http://www.leginfo.ca.gov/cgi-bin/displaycode?section=wat&group=00001-01000&file=350-359.

[15] *MWD Water Supply Allocation Plan (draft)* (Metropolitan Water District of Southern California, 2009), http://www.ieua.org/news_reports/docs/MWD_Drought_Plan/Draf_WSAP_Handbook.pdf.

[16] The idea that increasing conservation efforts yield diminishing returns is known as *conservation hardening*. Another way of saying this is that the marginal cost of conservation increases as more water is conserved. The quantity of water needed to meet households' basic drinking, cooking, washing, and hygiene needs establishes a floor beyond which further reductions are impossible. Although the SAP does take conservation hardening into account, it has only a small effect on the final water allocation an agency receives.

in a shortage is to maintain very high retail demand.[17] Obviously, this incentive is incompatible with conservation.

The 2013-14 drought illustrates the discontinuity that the SAP creates between the interests of individual agencies and the interests of the MWD system as a whole. Although 2013-14 has been one of the driest water years on record in California, with MWD receiving only 5% of its SWP allocation, MWD did not declare a regional shortage because it used supply banked in Diamond Valley Reservoir to meet about half of its members' demand. The drawdown in Diamond Valley levels leaves Southern California in a precarious position should the drought continue into 2015. Yet few retail agencies have declared a water shortage or implemented emergency conservation measures, and as a result MWD water sales have actually *increased* ~35% in the first third of 2014 compared to the same period of 2013.[18] This behavior is consistent with the agencies' best interests because if and when MWD declares a regional shortage, they will receive more water under the SAP if they don't take measures to reduce their demand. And by continuing their business-as-usual usage, the agencies increase the likelihood of that shortage occurring.

A Market Approach

How should water be allocated to MWD member agencies in times of drought? The lack of a fixed right to water under the Supply Allocation Plan incentivizes waste and inaction in the face of drought. Yet the alternative, preferential rights, has been rightly criticized as outdated and inequitable (and may, as noted, violate state law).

In this project, we will explore the possibility of a third alternative, a market system in which agencies receive a right to purchase a fixed share of MWD's water and then have the ability to trade that water with other agencies. Trading will allow those agencies that invest heavily in conservation, local supply, and water recycling to sell their surplus MWD water to other agencies; it will also allow agencies who may have high marginal costs of conservation or local supply development to purchase extra water, giving them added flexibility during times of drought.

A 'fair share' allocation system

A significant (and no doubt politically fraught) question is how rights to water ought to be initially allocated between agencies. We will consider two alternative methods. The first is a 'fair share' system, devised by our group in consultation with LBWD, in which agencies receive rights based

[17] Matthew Lyons, Director of Planning and Conservation, Long Beach Water Department, *personal communication*, May 21, 2014.
[18] Matthew Lyons, Director of Planning and Conservation, Long Beach Water Department, *personal communication*, June 11, 2014.

on their cumulative historic contribution to MWD's capital expenditures. Although this system may superficially resemble preferential rights, it differs in two key respects:

1. Preferential rights are recalculated each year based on each agency's current tax revenues and fees paid. Under our fair share system, rights would be based on the cumulative historical payments made since the agency joined MWD, adjusted for inflation and present value.

2. Preferential rights explicitly exclude revenues from the sale of water, which currently fund a substantial portion of MWD's capital expenditures. Under our fair share system, rights would be calculated based on *all* historic and current sources of revenue, including property taxes, readiness-to-serve charges, capacity charges, and volumetric sales revenue.

The first part of our project will involve calculating each agency's share under this system and comparing it to the agency's current demand for imported water, its expected allocation under the Supply Allocation Plan, and its preferential rights. We will consider whether this system is equitable from an economic and social justice perspective and whether it leads to any unacceptable distributional effects.

An auction system

In addition to our 'fair share' allocation method, we will also consider an auction system similar to one proposed by David Zetland.[19] Under the Zetland system, each agency receives a 'lifeline' quantity of water equal to the basic domestic needs of each person in the agency's service area. The lifeline quantity may be purchased at relatively cheap rates (Tier I rates, in MWD parlance). Further quantities are auctioned off by means of an "all-in auction" in which agencies bid for the remainder of MWD's supply based on their individual demand schedules for each AF of water.[20] If there are x AF of supply available for auction, then the top x bids are accepted and the price for all units of water is set at the highest losing bid (bid $x+1$).

Under MWD's current pricing system, MWD has to estimate agency demand each year and price their water accordingly to recover their fixed and variable costs of providing the anticipated quantity. Because both supply and demand are difficult to predict in advance, the volumetric prices for water often leave MWD with either a surplus or a shortfall. The all-in auction solves this problem by exactly matching supply to demand (perfect efficiency). It also incentivizes conservation by creating a price signal that depends on agencies' demand curves. Finally, it avoids the problem of raising water rates on low-income customers by ensuring that every agency

[19] David Zetland, "Analyzing the Efficiency of Met's Pricing Rules" (Unpublished, July 16, 2006).
[20] David Zetland, "All-in-Auctions for Water," *Journal of Environmental Management* 115 (January 2013): 78–86, doi:10.1016/j.jenvman.2012.11.010.

receives a lifeline allocation equal to the basic domestic needs of each person in the service area. Also, any excess revenues generated from the auction can be rebated to consumers or go toward paying MWD's fixed costs.

In the second part of our project, we will consider how much trading would take place under each allocation and whether there would be gains from trade. We will also attempt to quantify the possible conservation benefits of this system and ask what might be the environmental benefits. For example, if agencies conserve more aggressively, the MWD system would use less water as a whole on the long term, freeing up SWP water for Central Valley farms and delta flows. Being able to sell surplus water may also incentivize agencies to remediate contaminated groundwater basins.

Finally, we will consider the ways such a system would alter MWD's institutional structure and business model. Would MWD become merely a 'network of pipes', with agencies paying to wheel their (paper) water from one city to another? How would shared infrastructure, such as treatment plants and reservoir storage, be accessed by the agencies? (e.g. we can imagine each agency receiving a right to purchase a share of storage in Diamond Valley).

As drought years and water shortages become the 'new normal', the existing institutional structures and policies for water delivery in Southern California that were developed in times of abundance are becoming strained.[21] MWD has provided water to a growing Southern California for over 80 years. Yet MWD's business model has been widely critiqued as unsustainable, and it has recently sought expert guidance, acknowledging that change will have to occur.[22, 23] We believe is it important to rethink how water is allocated in times of scarcity. Preferential rights remain the method of allocation as dictated by state law in the MWD Act, but they have never actually been invoked. The SAP which MWD created in 2009 is not state law, merely organizational policy, and it has been criticized for disincentivizing conservation.

There are questions as to whether alternative allocation policies can be crafted which may better serve the member agencies as a whole. The first step in our project will be to consider some of these alternate allocation strategies. Through this project's exploration of current and alternative allocation systems, we will then demonstrate the costs and benefits from water conservation to the Long Beach Water Department, and compare the effects between historical and re-envisioned water distribution policies.

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[21] David Zetland, *The End of Abundance: Economic Solutions to Water Scarcity* (Aguanomics Press, 2011).
[22] *Report of the Blue Ribbon Committee* (Metropolitan Water District of Southern California, April 12, 2011), http://www.mwdh2o.com/BlueRibbon/pdfs/BRCreport4-12-2011.pdf.
[23] Dennis O'Connor, *The Governance of the Metropolitan Water District of Southern California: Options for Change* (California Research Bureau, California State Library, 1998), http://134.186.55.80/crb/98/18/98018.pdf.

Technical Approach

1. **Determine the initial allocation of water entitlements to local agencies** (Objective 1a)
   a. Allocation system based on historical payments:
      1. Property tax data, or historical preferential rights for every year
         Where could we access this information for all agencies?
      2. Annual readiness to serve payments by each agency
      3. MET's historical volumetric revenue

   b. Allocation system based on implementation of dry year allocation plan
      1. Inputs into allocation algorithm
         a. For each of the 26 agencies: Reliance on MET, Preferential Rights/ Voting power, Future demand, Lawsuits, Conservation (current and future), Unique concerns

   c. Hybrid allocation system

   d. Define MWD's role in each hypothetical scenario.

2. **Determine the economic impacts of a market system** (Objective 1b)
   a. Gather information on water demand for each agency
      1. Accessed through agency Urban Water Management Plans
      2. Based on population growth, conservation, new local water produced
   b. Gather information on historical water usage for each agency
   c. Project future water supply for each agency based on each allocation system and local sources identified in Water Management Plans
   d. Gather information about MWD projected water prices
   e. Consider short-term market outcomes
      1. Agencies may not be able to pursue alternatives such as conservation
      2. Define market operation in the short-term
      3. Identify short term winners losers
   f. Consider long-term market outcomes
      1. Define market operation in the look like in long-term (20, 50 years)
      2. Identify incentives to conserve

3. **Investigate the environmental benefits from a market system** (Objective 2)
   a. Determine the amount of additional conservation undertaken in a market
   b. Investigate the impacts of conservation on local, regional, and statewide water demand and supply
      1. Identify development of new potentially environmentally harmful sources which could be avoided

4. **Discuss possible environmental justice issues from a market system** (Objective 2a)
   a. Define environmental justice in regards to a water market

b. Identify areas of concern
c. Identify possible environmental justice concerns
d. Identify possible methods to mitigate these concerns

Data Catalog

Long Beach water usage data, 1996 -- present
This detailed dataset, provided to us by LBWD in the form of a spreadsheet, contains the quantity of water purchased from MWD and pumped from local groundwater, by month, for the period October 1996 -- present. The data will help us determine how much water Long Beach would have available to trade in a market system.

Urban Water Management Plans for the 26 MWD member agencies

These management plans were developed by each local agency in accordance with the 20x2020 urban water conservation plan (California Senate Bill 7X). Most plans are available on the agency websites. The plans include data on local supply sources and historical and projected water usage for each agency. This data will help us evaluate each agency's degree of reliance on imported water from MWD, which will partially determine which agencies would be buyers and which would be sellers under a market.

MWD 2010 Regional Urban Water Management Plan

This report contains data on historical and projected water usage for the entire MWD system, broken down by member agency.

MWD Annual Report for the Fiscal Year 2012-2013.

This report contains data on the revenues received by MWD during 2012-13, broken down by sources such as water sales, readiness-to-serve charges, and property taxes. The data will be useful in calculating each member agencies' contribution to MWD's capital expenditures, which will help us determine a fair initial allocation of water entitlements for each agency.

We still need current data on preferential rights, Tier I vs Tier II breakdown, and water delivered under the SAP.

Deliverables

Client Deliverables

The client has not expressed a desire for any deliverables outside of the academic deliverables required by the MESM program. We anticipate that the final report will satisfy the client's interest in our results. As the project progresses, the client may ask for additional deliverables.

Academic Deliverables

These deliverables are required to fulfill the requirements of the MESM degree:

1. **Work Plan** (this document)
    a. May 23, 2014 - Revised work plan due to advisor
    b. June 13, 2014 - Final work plan due to advisor and client

2. **Project Brief**: an eye-catching four-page brief that summarizes the project for an intelligent general audience. First draft due end of winter quarter.
    a. April 10, 2015 - Draft project brief due to advisor.
    b. April 17, 2015 - Final project brief due to advisor and client.

3. **Project Poster**: A poster summarizing the project, suitable for presentation at a conference. Draft due by the second week of spring quarter.
    a. April 10, 2015 - Draft poster due to advisor.
    b. April 17, 2015 - Final poster due to advisor and client.

4. **Academic defense presentation**: A formal defense of the group project before a committee of Bren faculty members (February 27 & March 6, 2015).

5. **Final Report**: A final report detailing the entire project, including the results and conclusions of the analyses.
    a. December 19, 2014 - Outline of final report due to advisor
    b. February 20, 2015 - Draft of final report due to advisor
    c. March 20, 2015 - Final Report due to advisor and GP coordinator

6. **Public presentation**: A presentation of the entire project that will be open to the public, and thus must be geared toward a general interest audience.
    a. April 17, 2015 - Submit draft final presentation to advisor for review
    b. April 24, 2015 - Final Presentations

Milestones

The timeline below identifies the the major expected tasks and deliverables to be accomplished over the course of this project. The project schedule will reviewed periodically and every effort will be extended to follow the milestones as they are described. Over the course of the project, reorganization of milestones or project scope may be conducted if warranted.

Spring Quarter 2014 (April - June 13)

- By Tuesday, June 2 - Submit Work Plan to Faculty Advisor and client for comment
- By Friday, June 6 - Complete draft Group Project Website

- By Friday, June 13 - Submit 1-page summary of work plan review meeting; Submit Final Work Plan; Publish and distribute Group Project website link; submit Self/Peer Evaluation to Faculty Advisor

Summer 2014 (June 14 - October 1)

- Gather Data and Information on LBWD and other identified Southern California water utilities
- Organize and compile data via Google Shared Drive
- Research LBWD and Southern California water use history, and water market/water trading in the southwestern US and add references to Zotero database

Fall Quarter 2014 (October 2 - December 19)

- By October 24 - complete data acquisition and begin analysis; develop allocation scenarios of water entitlements to local agencies
- By November 21 - Conduct Fall review meeting with Faculty Advisors and client
- By November 26 - Submit 1-page summary of fall review meeting to Faculty Advisor
- By December 19 - Submit outline of Final Report to Faculty Advisor and GP Coordinator; submit Self/Peer evaluation to Faculty Advisor

Winter Quarter 2015 (January 5 - March 20)

- By January 30 - Conduct Winter review meeting with Faculty Advisors and client
- By February 20 - Draft of Final Report due to Faculty Advisors
- February 27 & March 6 - Master's Project Defenses
- By March 20 - Final Report due to Faculty Advisor and GP Coordinator; submit Final Presentation program abstract to GP Coordinator; submit Self/Peer Evaluation to Faculty Advisor

Spring Quarter 2015 (March 30 - June 12)

- By April 10 - Draft Project Brief due to Faculty Advisor; draft Project Poster due to Faculty Advisor
- By April 17 - Final Project Brief and Project Poster due to Faculty Advisor, GP Coordinator, and posted on website; Print Project Poster; Group Photo to be taken with Faculty Advisor, draft Final Presentation to Faculty Advisor for review
- April 20 - 23 - Practice and videotaping of Final Presentations
- April 24 - Master's Project Final Presentations
- May 1 - Submit Faculty Advisor Evaluation to GP Coordinator

Management Plan

Group structure and management

Mary-Sophia is the team's Project Manager (PM). The PM is responsible for scheduling group meetings and setting the meeting agenda, handling most communication with the client, and leading conference calls. The PM will also monitor the group's progress towards upcoming deadlines and deliverables.

Dean is the team's Financial Manager (FM). The FM will create a budget for the team and control the dispersal of funds as necessary.

Jim is the team's Web Manager (WM). The WM is responsible for creating and maintaining the group's web presence.

Lauren is the team's Data Manager (DM). The DM is responsible for organizing and maintaining the team's data, notes, deliverable documents, and reference library. The DM will also coordinate the group's use of online tools like Dropbox and Zotero.

The team's faculty advisor is Dr. Gary Libecap, a professor at UCSB with dual appointments in the in the Department of Economics and the Bren School. Dr. Libecap's research focuses on environmental markets and the legal, economic, and policy aspects of water allocation in the western U.S. The faculty advisor will meet weekly with the group and participate in spring and fall review meetings. He will also provide feedback on our deliverables.

The client for this group project is the Long Beach Water Department, a municipal water utility serving the City of Long Beach in California. The primary contacts at LBWD are Kevin Wattier, General Manager, and Matt Lyons, Director of Planning and Conservation. The project proposal grew out of conversations that Mary-Sophia Motlow had with Kevin Wattier in Fall 2013.

The group has sought out several external advisors and informal consultants. Dr. Bob Wilkinson is a professor at the Bren School who specializes in water policy. Dr. Wilkinson was a member of the MWD Blue Ribbon Committee and is an expert in California water policy and politics. The group will meet with Dr. Wilkinson at least twice per quarter to present its progress and get his feedback. Dr. Brigham Daniels is associate professor of law at Brigham Young University. He specializes in environmental law and water law.

Meeting structure

Each quarter, the group will determine a mutually agreeable time for weekly meetings. Dr. Libecap will attend whenever possible. The group will schedule additional meetings as necessary. Normally it is the responsibility of the Project Manager to schedule meetings, but from time to time other group members may take on this responsibility. The person scheduling the meeting is responsible for booking a room on Corporate Time, coordinating with the schedule of the faculty advisor and other guests, reserving equipment such as conference phones, and noting the meeting time and place on the shared group calendar.

A few days before the meeting, the PM will publish an agenda on Google Docs, which other members can add to. The person scheduling the meeting should print out the meeting agenda beforehand.

At the beginning of each meeting, the group will decide on one person to lead the meeting and one person to take notes. Ideally these roles will rotate during each meeting. The notes will be uploaded to Google Docs where they can become the starting point for the next meeting agenda.

Guidelines for interacting with faculty advisors, clients, and external advisors

Mary-Sophia, as the Project Manager, will be the primary point of contact for communication with the client and with Dr. Libecap. Each quarter, the group will schedule one in-person visit and at least one conference call with the client to keep them updated on the group's progress. From time to time the group will also share with the client drafts of deliverables such as the Work Plan, the poster, and the Final Report.

Systems to ensure that critical tasks are completed on time

The project manager will track progress towards completing milestones by utilizing Gantter for Google Drive in conjunction with Google Calendar, which is shared with all group members. The project manager, with assistance and input from the rest of the group, will create action items following each meeting and keep up to date on the status of each action item to ensure they are on track for timely completion. Each action item will be tracked in Gantter listing the responsible person, status, target due date, and completion date.

Procedures for documenting, cataloging, and archiving information

Lauren, as the group's Data Manager, will be responsible for organizing and maintaining the group's documents, data, and reference library. The group will use Google Documents to archive meeting agendas and brainstorming notes, and to collaboratively draft deliverables. Final versions of deliverables, along with raw data and images, will be stored on Dropbox and on the commons computer. The group will use a shared Zotero library to store and manage its reference materials. Finally, the group has set up a shared Google Calendar containing the dates and locations of weekly meetings, conference calls, and important deadlines.

Overall expectations of group members and faculty advisors

Group members will be expected to prepare for, attend, and contribute to meetings. Group members will meet the deadlines established for their individual tasks and generally conduct themselves in a professional manner. Group members will be expected to collaborate with the group to ensure the quality and timeliness of overall project deliverables.

The faculty advisor will be expected to attend meetings on an as needed basis and will be expected to contribute feedback in a timely manner. The faculty advisor will also be expected to facilitate the resolution of any issues the students are unable to resolve on their own and ensure that the group is on remains on target throughout the course of the project.

Conflict resolution process

The group will diligently adhere to and maintain the procedures and tracking documents described above. This will help mitigate any conflicts resulting from uneven distribution of work or low quality work. Each group member will be expected to communicate potential difficulties or problems as soon as they are identified so that the group can address them as proactively as possible before conflict arises. If a resolution cannot be reached using these tools, then the group will engage the faculty advisor or Bren School administration.

Budget

Reason for Expense	Expense	Remaining Budget
Beginning budget	---	$1,300.00
Client visits (gas, parking, etc.)	$400.00	$900.00
Printing costs for poster	$300.00	$600.00
Presentation expenses	$100.00	$500.00
Administrative supplies	$100.00	$400.00
Phone calls	$100.00	$300.00
Miscellaneous	$300.00	$0.00

Acronyms

AF	acre-foot. The average annual water consumption of 2 or 3 households.
CRA	Colorado River Aqueduct
GPCD	gallons per capita per day. A measure of water consumption per person.
IID	Imperial Irrigation District. An agricultural water retailer serving the Imperial Valley in southeastern California.
LADWP	Los Angeles Department of Water and Power
LBWD	Long Beach Water Department
MAF	million acre-feet [of water]
MWD	Metropolitan Water District
MWDOC	Metropolitan Water District of Orange County
SAP	Supply Allocation Plan. An MWD document describing how water is to be allocated among member agencies during drought years.
SDCWA	San Diego County Water Agency
SWP	State Water Project
UWMP	Urban Water Management Plan

References