San Diego County Water Authority

September 15, 2010

Attention: Water Planning Committee

Unit Cost of New Local Water Supply Alternatives (Information)

Purpose

This report discusses current unit costs for new local water supply alternatives including water recycling, indirect potable reuse, brackish groundwater desalination and seawater desalination. In addition, this report includes a follow-up on the unit costs estimated for the Water Authority's supply diversification strategy discussed at the August 2010 Board meeting.

Background

The Water Authority and its member agencies are in the process of preparing 2010 updates to their Urban Water Management Plans (UWMP) and continue to plan for and evaluate new local water supply alternatives. The comparative unit cost of various water supply alternatives is a key parameter in that evaluation. There has been much attention lately given to the comparative costs of local water supply options and their relative cost effectiveness. Although an important measurement, unit cost does not provide the complete picture of a resource's overall potential or limitations, the feasibility of its implementation, or other direct or indirect benefits that may occur because of its development. In order to compare unit costs for different water supply alternatives, it is critical to define the basis for calculating a unit cost for a particular water supply. For the purposes of this report, unit cost will generally be defined as the following:

$$\frac{\text{Amortized annual capital cost (\$) + Annual Operating Cost (\$)}}{\text{Annual beneficially used water production in acre-feet (AF)}} = \text{Unit Cost (\$/acre-foot)}$$

A major factor influencing unit cost is the location, size and configuration of the project. For example, non-potable recycled water projects, such as those in Los Angeles County with large industrial customers, with year-round demand and less extensive distribution systems have lower unit costs than non-potable projects in San Diego County that are more reliant on seasonal irrigation customers and have more extensive distribution systems. Similarly, brackish and seawater desalination project unit costs can vary based on the extent of the product water conveyance required, pumping requirements, access to existing infrastructure and the distance to, or method of brine discharge. Projects with easy access to sewer lines or outfalls and close to existing potable distribution lines have lower unit costs than projects that have to construct disposal lines, pump to higher elevations and convey water greater distances to connect to existing potable pipelines.

Ultimately, the decision to pursue the development of a new water supply is a comprehensive business decision of the agency considering that supply. That decision will consider not just the unit cost of the new supply, but also the improved reliability associated with the supply and avoided operating and capital costs, external funding and offsetting revenue. For example, a water recycling project may avoid expansion of a potable water treatment plant by reducing the demand for potable water or may avoid wastewater operating costs associated with pumping wastewater to a coastal

treatment plant for disposal. Agencies contracting with the Metropolitan Wastewater System or the Encina Wastewater Authority avoid certain variable costs of wastewater treatment that often serves to incentivize the development of a recycled water project. Brackish and seawater desalination plants avoid additional surface water treatment capacity and may also avoid the construction of pipelines and pump stations to bring in additional imported supplies. All local supply projects avoid the cost of purchasing imported water. Brackish and seawater desalination projects, as well as Indirect Potable Reuse (IPR) projects, can also improve the overall water quality of the potable water system due to the high quality and low Total Dissolved Solids (TDS) of those supplies. IPR projects also free up wastewater outfall capacity by eliminating discharges to the ocean. Unit costs can be reduced further through external funding including grants, incentives, or some other revenue source that offsets the cost of creating the water supply. The credits a project takes to reduce the net impact to the agency's ratepayers varies from project to project and is specific to that agency's circumstances. For this report, staff is unable to generalize as to those credits. Where available, this report notes a net unit cost to the agency, after accounting for avoided costs, revenues and benefits, separate from the actual marginal unit cost of developing the supply.

Discussion

While the unit costs for similar water supply projects outside the San Diego region will be considered in this report, the primary focus of this report are the unique unit costs of existing and proposed water supply projects in the San Diego region. Where possible, these costs are based on reconciled costs of projects receiving funding from the Water Authority's Local Water Supply Development Program (LWSDP), or from Metropolitan Water District's Local Resources Program (LRP) or Groundwater Recovery Program (GRP). Where reconciled costs are not available, information comes from publicly available information or the project sponsor. Finally, all unit costs are shown in 2010 dollars. Where needed, referenced unit costs have been escalated to 2010 using the Consumer Price Index for All Urban Consumers (CPI-U) for local projects within San Diego County and national CPI-U data for projects located outside San Diego County.

Recycled Water

Existing Projects: There are 17 water recycling projects currently operating in San Diego County, all of which deliver non-potable recycled water. These projects deliver approximately 28,000 AF annually (FY 2010). The range of existing unit costs of those projects is illustrated in a sampling of four representative projects. These projects were chosen because they represent both projects that include a treatment plant and a non-potable distribution system as well as projects that purchase recycled water from another agency. The table below shows the annual yield and unit cost for each project based on available project cash flow information developed as part of the administration of the LWSDP.

Existing Recycled Water Project	*Annual Yield (AF)*	*Unit Cost ($/AF)*
San Elijo	1,308 (FY 09)	1,308[1]
Carlsbad	3,944 (FY 09)	1,544[2]
Fallbrook	591 (FY 09)	1,662[3]
Otay	4,707 (FY 09)	1,259[4]

Proposed Projects: Future recycled water projects being considered to meet goals in the Urban Water Management Plan include both potable and non-potable supplies. A significant portion of the projected increase in non-potable recycling will be driven by the expansion of existing facilities. These are very cost effective projects that maximize already sunk investments. However, the relative amount of yield at these costs is limited. For entirely new non-potable projects requiring new treatment and distribution facilities, there is limited information available for the San Diego region. One data point identified for new treatment and distribution facilities is from the City of Oceanside. It is important to point out that no final decision has been made to develop these projects.

A subset of water recycling, IPR projects use advanced treatment technologies including reverse osmosis membrane technology to purify tertiary-treated wastewater (i.e. non-potable recycled water) into potable water. This purified water is then conveyed to a groundwater basin or a surface water reservoir for blending with potable source water supplies and detention. As a final barrier in the multi-barrier approach to IPR, the water is subsequently re-treated at a conventional water treatment plant before ultimate distribution as potable water supply.

Two IPR projects are currently under development in San Diego County, and one operating project using similar treatment technology is located within close proximity in Orange County. The city of San Diego is currently preparing an IPR demonstration project that will be constructed at the city's North City Water Reclamation Plant. The purpose of the demonstration facility is to evaluate the feasibility of developing a full-scale IPR project at the North City site and refine earlier cost estimates for the project. The North City IPR project would convey and blend advanced treated recycled water with surface water at the enlarged San Vicente Reservoir. Helix Water District and Padre Dam MWD are also jointly developing an IPR project known as the El Monte Valley Project that will recharge a groundwater aquifer with advanced treated recycled water where it will be blended with native waters. It will then be extracted from the basin and re-treated at the R.M. Levy Water Treatment Plant. An important element of this project is a revenue-producing sand mining operation.

The Orange County Water District (OCWD) Groundwater Replenishment System (GWRS) is a large scale, 70,000 AFY IPR project recharging the northern Orange County groundwater basin with advanced treated recycled water. One of the key benefits of the GWRS IPR project is the economy of scale that can be achieved due to the volume of water produced by the project that can be retained in the ground given the size of the Orange County groundwater basin. This economy of scale is not achievable in the currently planned projects in San Diego County and results in lower unit costs for the GWRS when compared to similar projects in San Diego County. The OCWD GWRS project considers the cost of extraction separate from the GWRS and typically cites the project cost as $887/AF[5]. In order to be more comparable to local San Diego County projects in terms of the cost delivered to the retail agency distribution system, Water Authority staff included the estimated cost for extraction of $412/AF[6].

Proposed Recycling Projects	*Annual Yield (AF)*	*Unit Cost ($/AF)*
Infill Projects	(insufficient data)	490[7] - 1,000[8]
Oceanside Phase 4	570	2,250[8]
North City IPR	10,500	2,437[9]
El Monte Valley IPR	5,000	2,300[10]
OCWD GWRS	70,000	1,299 [5,6]

Both the North City IPR project and the El Monte Valley IPR project provide significant benefits, avoided costs and the potential for external funding to offset development costs to each agency. When these credits are taken into account in their respective planning studies, the net costs to the respective agencies are provided below. As an example, the escalated net unit cost of $1,815/AF (equivalent to $1,630/AF in 2005$) for the North City IPR project shown below is based on unit costs presented in the 2006 City of San Diego Water Reuse Study. In that study, a net unit cost of $1,630/AF (2005$) is shown for the project based on a total unit cost of $2,190/AF (2005$) less cost credits equal to $560/AF (2005$).

Proposed IPR Project	*Avoided Costs/Benefits /Other Revenue ($/AF)*	*Net Cost to Agency ($/AF)*
North City IPR	623[9]	1,814[9]
El Monte Valley IPR	900[10]	1,400[10]

Groundwater Desalination

Existing projects: While there are existing municipal groundwater extraction efforts located primarily in the Sweetwater Authority service area, in Lakeside, in the Yuima MWD service area and on Camp Pendleton, additional groundwater development will most likely involve brackish groundwater that will require desalination treatment. There are two existing groundwater desalination projects currently operating in San Diego County: The Reynolds Groundwater Demineralization Project (Sweetwater Authority) and the Mission Basin Groundwater Desalting Facility (Oceanside). For comparison, the unit cost for the Menifee Basin Desalter, a groundwater desalter in Riverside County, is also shown. The table below shows the yield and unit cost for each project based on available project cash flow information.

Existing Groundwater Desalination Project	*Annual Yield (AF)*	*Unit Cost ($/AF)*
Sweetwater (Reynolds)	3,454 (FY 09)	835[11]
Oceanside (Mission Basin)	1,876 (FY 08)	1,236[12]
Menifee Basin Desalter	1,638 (FY 08)	1,210[13]

Proposed projects: According to the local groundwater supply development data recently collected as part of the development of the 2010 Urban Water Management Plan, verifiable groundwater yield is projected to increase from 18,557 AF in 2010 to 26,970 AF in 2030. The overwhelming majority of this increase will be driven by the expansion of existing facilities. These expansions include proposed Sweetwater and Oceanside project expansions.

Beyond these expansions, other conceptual groundwater desalination facilities are being considered by member agencies including Sweetwater, Otay and the city of San Diego. One significant issue facing these new projects is concentrate disposal. Both the Reynolds facility and the Mission Basin facility utilize straightforward, cost effective solutions for concentrate disposal (discharge to the adjacent Sweetwater River (Reynolds) and use of an existing outfall (Mission Basin)). New projects will likely require additional infrastructure to convey concentrate to an available disposal pipeline for ultimate discharge. As an example, the proposed Otay River Brackish Desalination Project assumes both a cost contribution towards a regional brine disposal pipeline and a 1.3 mile disposal pipeline for the project. The table below summarizes the unit cost information for proposed groundwater desalination projects.

Proposed Groundwater Desalination Project	*Annual Yield (AF)*	*Unit Cost ($/AF)*
Sweetwater Expansion	5,500	769 - 850[14]
Mission Basin Expansion	4,500	900[15]
Otay River Brackish Desalination	4,050	1,475 - 2,086[16]

Seawater Desalination

Existing Projects: With no operating seawater desalination projects currently in San Diego County, the unit costs for existing projects must come from outside the region. For this comparison, the table below shows unit costs for three recently constructed projects in Australia, along with the recently completed Hadera, Israel project, the design of which is mirrored by the Carlsbad Desalination Project. The relatively low cost for Hadera is reflective of a price "at the fence" (no distribution costs), low electricity costs ($0.04/kw-hr), the use of existing collocated discharge facilities and the economies of scale for a large desalination facility. As a reference, the latest unit costs for the Tampa Bay desalination project are also included, even though the source water salinity for the Tampa project is less than the Pacific Ocean.

Existing Seawater Desalination Plant	*Annual Production (AF)*	*Unit Cost ($/AF)*
Perth 1	36,500	1,515[17]
Gold Coast	37,000	3,034[17]
Sydney	74,000	2,542[17]
Hadera	97,000	814[18]
Tampa	28,000	1,100[19]

Proposed Projects: There are two proposed projects located in San Diego County: the fully permitted Carlsbad Desalination Project developed by Poseidon Resources (Poseidon) and the recently completed feasibility study for the Camp Pendleton Seawater Desalination Project. While not yet under full construction, the Carlsbad project is fully planned to the point that construction

bids are currently being prepared. With the approval of the July 22, 2010, Board approved Term Sheet that provides the framework and basic conditions for a yet-to-be negotiated water purchase agreement between the Water Authority and Poseidon, a unit cost ceiling has been established.

For the Camp Pendleton project, a recently completed feasibility study identified two sites in the southwest part of Camp Pendleton that would provide the rare opportunity (along the San Diego County coastline) to develop a large, regional desalination project. The project would be constructed in multiple phases over time, with an initial phase of 50 million gallons per day (GPD) including construction of much of the necessary infrastructure to facilitate future expansions. Additionally, unit costs for two other proposed southern California projects – the West Basin Desalination Project and the MWDOC South Orange Coastal Ocean Desalination Project – were identified. The proposed desalination project costs are shown in the table below.

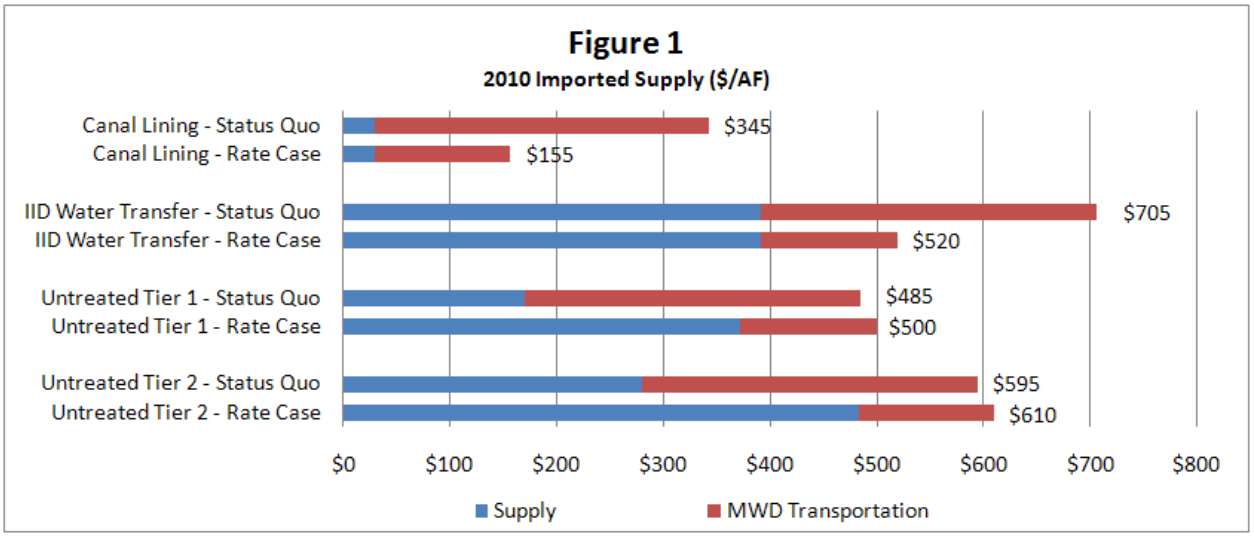
Proposed Seawater Desalination Plant	*Annual Production (AF)*	*Unit Cost ($/AF)*
Carlsbad	56,000	1,600[20]
Camp Pendleton	56,000 (Phase 1)	2,340[21]
	112,000 (Phase 2)	1,880[21]
West Basin	22,000 - 112,000	1,265 - 1,700[22]
MWDOC (Dana Point)	16,500	1,300[23]

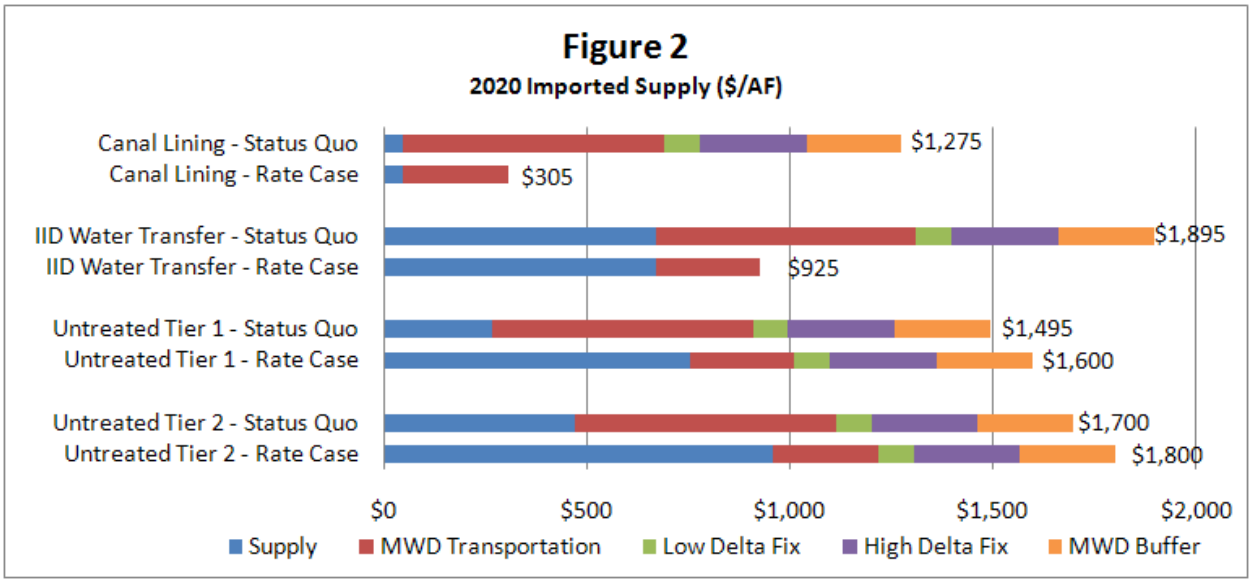
One key factor in the lower unit cost of the Carlsbad project compared to other projects, in particular the Australia projects, is the ability of the Carlsbad project to utilize the existing power plant intake and discharge infrastructure as well as a proposed straightforward construction of the product water conveyance pipeline. This compares, for example, to the Sydney plant where a new $600 million distribution pipeline crosses Botany Bay and new 13 foot diameter intake and discharge tunnels extend offshore over 8,000 feet. Even with planned intake modifications that will occur as part of the Carlsbad project when the power plant ceases its once-through-cooling requirements, not having to construct new intake infrastructure has been estimated by Poseidon to save between $200/AF[24] and $570/AF[24] in capital costs, depending on the type of intake constructed. Such is not the case with the proposed Camp Pendleton project. That project will require new intake and discharge infrastructure similar to the Australia projects.

Supply Portfolio Unit Cost Comparison

All of the above referenced local supply costs are calculated as delivered into an existing distribution system, meeting all state and federal water quality requirements. It is more appropriate to compare the unit costs of imported water to the components of imported supply that make up the region's supply portfolio. In reviewing the untreated imported water purchased at the wholesale level by the Water Authority, unit costs are established for existing imported supplies, both current (Figure 1) and projected (Figure 2). These costs are shown both as "Status Quo" and "Rate Case" assuming the Water Authority is successful in its MWD rate challenge. The projected costs shown in Figure 2 include a range for the projected cost impact to MWD water from a Bay-Delta fix,

currently projected to cost between $10 billion and $40 billion. The costs shown in Figure 2 for the range of Delta Fix costs ("Low Delta Fix" and "High Delta Fix") are assumed to be transportation costs under Status Quo and supply costs under the Rate Case. In addition, the costs for the MWD Buffer proposed in MWD's draft Integrated Resources Plan are also assumed to be transportation costs under Status Quo and supply costs under the Rate Case. The cost of MWD Tier 2 water in both figures is assumed to be the "marginal cost" of imported water.





When comparing the unit costs of imported supplies to the marginal cost of new local supply development, it is important to point out that MWD rates reflect a melding of low cost older

supplies and newer more costly supplies. Also, in general, the ability to develop additional increments of the lower cost imported supplies, such as the canal linings, were unique opportunities that are not anticipated to be duplicated in the future.

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[1] San Diego County Water Authority Local Water Supply Development Program, draft independent review of the cumulative net balance and cash flow information for San Elijo Joint Powers Authority, dated July 9, 2010

[2] San Diego County Water Authority Local Water Supply Development Program, draft independent review of the cumulative net balance and cash flow information for City of Carlsbad, dated July 9, 2010

[3] San Diego County Water Authority Local Water Supply Development Program, draft independent review of the cumulative net balance and cash flow information for Fallbrook PUD, dated July 9, 2010

[4] San Diego County Water Authority Local Water Supply Development Program, draft independent review of the cumulative net balance and cash flow information for Otay Water District, dated July 9, 2010

[5] GWRS Annual Cost for Fiscal Year 09/10, OCWD Water Issues Committee agenda item number 10, September 8, 2010 meeting

[6] OCWD 2008-2009 Engineer's Report, Table 7, Estimated 2010-11 Groundwater Production Costs

[7] City of San Diego Water Reuse Study, Figure 7-15, Volume and Cost Summary for Strategy NC-1, unit cost for infill (with costs credits included from Table 7-12, page 7-37), $440/AF (2005$) escalated to 2010

[8] City of Oceanside Recycled Water Master Plan, Table 7.2, Recycled Cost Analysis – Total Cost, Phase 3 unit cost, $904/AF, Phase 4 unit cost, $2,020/AF, all costs escalated to 2010, October 2005

[9] City of San Diego Water Reuse Study, Figure 7-17, Volume and Cost Summary for Strategy NC-3, unit cost for SV IPR (costs credits included from Table 7-12, page 7-37), $1630+$560 = $2,190/AF (2005$), all costs escalated to 2010

[10] Email communication from Tim Smith, Helix WD, September 14, 2010

[11] MWD Fiscal Year 2008/09 Reconciliation of Lower Sweetwater River Demineralization Project, (unit cost adjusted to include grants), February 17, 2010

[12] MWD Fiscal Year 2007/08 Reconciliation of the City of Oceanside Desalting Facility Expansion, (actual annualized capital cost adjusted for grants used), April 29, 2009

[13] MWD Fiscal Year 2007/08 Reconciliation of Eastern MWD Menifee Basin Desalter

[14] Telephone interview with Michael Garrod, Sweetwater Authority, September 8, 2010

[15] Telephone interview with Greg Blakely, City of Oceanside, September 8, 2010

[16] Otay River Brackish Groundwater Desalination Feasibility Study, June 2009

[17] Water Desalination Report, Volume 46, Number 29, page 2, August 2, 2010

[18] Email communication from Kent Turner, President, IDE Americas, Inc., September 12, 2010

[19] Email communication from Neil Callahan, RW Beck, Tampa, FL, September 14, 2010

[20] Base Price from Carlsbad Desalination Project Term Sheet between the San Diego County Water Authority and Poseidon Resources, approved July 22, 2010

[21] San Diego County Water Authority Camp Pendleton Seawater Desalination Project Feasibility Study Final Report, SRTTP site, capital costs amortized for 30 years at 5.5%, December 2009

[22] West Basin MWD staff presentation to the MWD Special Committee on Desalination and Recycling, June 22, 2010

[23] Telephone interview with Richard Bell, Municipal Water District of Orange County, September 10, 2010

[24] 304 mgd Intake Cost Estimates, capital amortized at 6% for 30 years, escalated to 2010$, Poseidon Resources, October 2007