

Appendix A: Levelized Cost Methodology

We adopt a levelized-cost approach to estimate the cost of alternative water supply and demand management options. This method accounts for the full capital and operating costs of a project or device over its useful life and allows for a comparison of alternative projects with different scales of operations, investment and operating periods, or both. For each alternative, a ratio of net costs (cost minus benefits) to the output achieved in physical terms is determined. For the purposes of this study, the output refers to a unit of water in the case of a new supply, or a unit of water savings in the case of a water conservation and efficiency measure. The levelized cost of water is expressed as 2015 dollars per acre-foot of water.

Key inputs to calculate the levelized cost of water include capital costs, operation and maintenance (O&M) and replacement (R&R) costs, useful life, water production capacity (or savings potential), actual water production, and discount rate. The annualized capital cost is determined by multiplying the total capital cost by a capital recovery factor (CRF), which is equivalent to an amortization factor used in financial analysis. A mathematical equation to calculate the levelized cost is as follows:

$$\text{Levelized Cost of Water} = \frac{(\text{capital cost} \times \text{CRF}) + \text{annual O\&M costs} + \text{R\&R costs}}{\text{average annual yield in acre-feet}},$$

$$\text{where CRF} = \frac{r(1+r)^n}{[(1+r)^n - 1]}; \quad n = \text{useful life (in years)}; \quad r = \text{discount rate}$$

In practice, we use plant capacity as the denominator to estimate unit cost from capital investment and average annual yield as the denominator for annual O&M and other costs. We make this adjustment in order to remain conservative as some systems overbuild in anticipation of future expansions, while annual costs vary by the volume of water produced. Actual costs per unit of additional water would be higher as plants do not operate at their full capacity for their entire useful life.

Cost evaluation requires the selection of an appropriate discount rate to convert expenditures in different years to present-year dollars. We adopt a discount rate of 6%, which is currently used by the Department of Water Resources to analyze the benefits and costs of water projects. Although this rate appears to be high, it is chosen to maintain conceptual consistency between DWR-funded projects and those funded by other sources.

All costs have been converted to year 2015 dollars. For large construction projects, we use the Engineering News Records (ENR) construction cost index (CCI) to adjust for inflation of capital expenditures and the Consumer Price Index (CPI) for other costs. CPI is also used to convert the costs associated with urban water-efficiency strategies to real dollars.

We provide a cost range for each water supply option based on the first and third quartiles of the available data.¹ The cost range for each water conservation and efficiency measure is based on varying, device-specific assumptions about the cost and/or water savings (see Appendix B for more detail on these assumptions).

List of Projects Included in the Analysis

Table 1.

Stormwater Capture Projects

Projects	Sources
Blosser Bioretention Low Impact Development	Proposition 84 Storm Water Grant Program Applications
Calimesa Creek Flood Control and Aquifer Recharge Project	Proposition 1E Round 2 Stormwater Flood Management Applications
Cañada Gobernadora Multipurpose Basin	Proposition 1E Round 1 Stormwater Flood Management Applications
Canterbury Avenue Power Line Easement Stormwater Capture Project	LADWP (2015). Stormwater Capture Master Plan - Appendices
East Valley Baseball Park Infiltration System	LADWP (2015). Stormwater Capture Master Plan - Appendices
Fancher Creek Flood Control Improvement Project	Proposition 1E Round 1 Stormwater Flood Management Applications
Francis Street Storm Drain and Ely Basin Flood Control and Aquifer Recharge Project	Proposition 1E Round 2 Stormwater Flood Management Applications
SEWD Flood Detention and Groundwater Recharge Facility	Proposition 1E Round 2 Stormwater Flood Management Applications
Tujunga Spreading Grounds Enhancement Project	Proposition 84 Round 1 Implementation Grant Program Applications
Walnut Spreading Basin Improvements Project	Proposition 84 Round 2 Implementation Grant Program Applications

¹ The only exception is large stormwater capture projects, in which we used the projects' levelized cost as the range and their average as the median.

Table 2.

Non-potable Reuse (NPR) Projects

Projects	Sources
City of Pleasanton Recycled Water Facility -- Alt. 2A)	Carollo (2013). The City of Pleasanton Recycled Water Feasibility Study
City of Pleasanton Recycled Water Facility -- Alt. 3A)	Carollo (2013). The City of Pleasanton Recycled Water Feasibility Study
City of Santa Barbara Recycled Water Enhancement Project (El Estero Waste Water Treatment)	Proposition 84 Round 2 Implementation Grant Program Applications
San Jose Creek Water Reclamation Plant	Proposition 84 Round 2 Implementation Grant Program Applications
Victor Valley Wastewater Reclamation Authority Sub-Regional Reclamation Project	Proposition 84 Round 2 Implementation Grant Program Applications
West Basin Municipal Water District Title 22 Recycled Water	Mary-Ann Rexroad and Elise Goldman, West Basin Municipal Water District, Personal Communication (12/11/15)
Western Water Recycling Facility	Brenda Meyer, Western Municipal Water District, Personal Communication (1/20/2015)

Table 3.

Indirect Potable Reuse (IPR) Projects

Projects	Sources
Foothill Municipal Water District Recycled Water Project	Phoenix Civil Engineering (2012). Foothill Municipal Water District Water Recycling Facilities Planning/ Project Report
Groundwater Replenishment System (GWRS)	Mehul Patel, Orange County Water District, Personal Communication (1/7/15)
Leo J. Vander Lans Advanced Water Treatment Facility	Paul Fu, Water Replenishment District of Southern California, Personal Communication (1/23/15)
Pure Water San Diego	City of San Diego (2013). Section 5: Full-scale Facility Estimated Costs
Santa Cruz Regional Groundwater Replenishment Project	Kenney/Jenks Consultants (2014). Draft Technical Memorandum #2 Recycled Water Alternatives. Memo to the Board of Directors
West Basin Advanced Treated Recycled Water	Mary-Ann Rexroad and Elise Goldman, West Basin Municipal Water District, Personal Communication (12/11/15)

Table 4.

Brackish Water Desalination Projects

Projects	Sources
BAWSCA HDD Well Intake #2	CDM Smith (2015). BAWSCA Long-term Reliable Water Supply Strategy: Strategy Phase II Final Report
BAWSCA HDD Well Intake #3	CDM Smith (2015). BAWSCA Long-term Reliable Water Supply Strategy: Strategy Phase II Final Report
BAWSCA HDD Well Intake #4	CDM Smith (2015). BAWSCA Long-term Reliable Water Supply Strategy: Strategy Phase II Final Report
BAWSCA Inland Brackish Vertical Well #4	CDM Smith (2015). BAWSCA Long-term Reliable Water Supply Strategy: Strategy Phase II Final Report
BAWSCA Open Bay Intake Facility	CDM Smith (2015). BAWSCA Long-term Reliable Water Supply Strategy: Strategy Phase II Final Report.
Bay Area Regional Desalination Project -- Alt 1	MWH (2010). Bay Area Regional Desalination Pilot Plant: Appendix I Full-scale Cost Estimates
Bay Area Regional Desalination Project -- Alt 2	MWH (2010). Bay Area Regional Desalination Pilot Plant: Appendix I Full-scale Cost Estimates
Chino Desalter (Phase I and Expansion)	Michael Chung, Chino Basin Desalter Authority, Personal Communication (1/8/15)
Chino Desalter (Phase II)	Michael Chung, Chino Basin Desalter Authority, Personal Communication (1/8/15)
Irvine Desalter Project	Dane Johnson, Irvine Ranch Water District, Personal Communication (2/19/15)
Irvine Ranch Wells 21 and 22	Dane Johnson, Irvine Ranch Water District, Personal Communication (2/19/15)
Menifee Desalter	Raquel Hamilton, Eastern Municipal Water District, Personal Communication (3/12/15)
Newark Desalination Facility	Greg Watson, Alameda County Water District, Personal Communication (1/9/15)
North Pleasant Valley Groundwater Desalter	Lucia McGovern, City of Camarillo/ Camarillo Sanitary District, Personal Communication (1/15/15)
Perris Desalter	Raquel Hamilton, Eastern Municipal Water District, Personal Communication (3/12/15)
Robert W. Goldsworthy Desalter	Paul Fu, Water Replenishment District of Southern California, Personal Communication (1/23/15)

Table 5.

Seawater Desalination Projects

Projects	Sources
Camp Pendleton Seawater Desalination #1	RBF Consulting (2009). Camp Pendleton Seawater Desalination Project Feasibility Study
Camp Pendleton Seawater Desalination #2	RBF Consulting (2009). Camp Pendleton Seawater Desalination Project Feasibility Study
Carlsbad Desalination Project	Gina Molise, San Diego County Water Authority, Personal Communication (1/15/15)
Doheny Desalination Project/South Orange Coastal Ocean Desalination Project	Municipal Water District of Orange County (2014). Final Summary Report: Doheny Ocean Desalination Project Phase 3 Investigation
Huntington Desalination Project	John Kennedy, Orange County Water District, Personal Communication (4/15/15)
Monterey Bay Regional Water Project (DeepWater Desal)	Kennedy/Jenks Consultants (2014). Evaluation of the Deep Water Desalination Project Costs
Monterey Peninsula Water Supply Project (CalAm)	California American Water (2012). Monterey Peninsula Water Supply Project CPUC Cost Workshop: Project Costs
City of Santa Cruz and Soquel Creek Water District Regional Seawater Desalination Project (scwd ²)	Kenny/Jenks Consultants (2013). Conceptual-level Cost Comparison of Water Supply Alternatives