



## Summary of Costs and Benefits of Water Supply Alternatives

Linda Sheehan, CCKA

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This white paper compiles information regarding the relative costs of seawater desalination versus sustainable water supply strategies. In particular, the paper touches on water recycling, stormwater capture/reuse, and conservation as energy-efficient alternatives that can create millions of acre-feet of “new,” local water supplies that are far less costly than seawater desalination and new surface storage. Each of these is briefly discussed below. Attached for reference is a detailed graphic from the recent LAO’s October 2008 Water Primer<sup>1</sup> as well as relevant pages from a recent Los Angeles business group report on water strategies and a Pacific Institute report on desalination.

### DESALINATION

Seawater desalination has consistently been found in study after study to be more costly and more energy intensive than most if not all other sources of water. The Pacific Institute compared the costs of seawater desalination, water recycling and gravity-fed surface water from 1971 through 2005 and consistently found that desalination was far more costly than the other two sources examined.<sup>2</sup> A more recent Southern California business leader report found that not only was desalination more costly than many other sources, it also scored by far the worst of all sources on greenhouse gas emissions.<sup>3</sup> The report stated that:

[d]esalination facilities are expensive to build, and they must be located near a large source of salty water like the ocean. A large amount of energy is required in the reverse osmosis process to push salty water at high pressure through a membrane. Because of this, desalination plants will not be economically viable without subsidies unless the price of competing sources go up.<sup>4</sup>

It should be noted that the cost data for desalination in the report, however, were provided by Poseidon Resources, the builder and proponent of desalination facilities. The report accordingly added that:

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<sup>1</sup> CA Legislative Analyst’s Office, “California’s Water: An LAO Primer,” Ch. 6 (Oct. 2008) (LAO Report), available at: [http://www.lao.ca.gov/2008/rsrc/water\\_primer/water\\_primer\\_102208.pdf](http://www.lao.ca.gov/2008/rsrc/water_primer/water_primer_102208.pdf) (see Attachment 1). Water savings could also be obtained from such actions as land retirement and groundwater treatment as well; these could be reviewed separately.

<sup>2</sup> Pacific Institute, “Desalination, with a Grain of Salt: A California Perspective,” at p. 58, Figures 19 and 20 (June 2006), available at: [http://www.pacinst.org/reports/desalination/desalination\\_report.pdf](http://www.pacinst.org/reports/desalination/desalination_report.pdf) (see Attachment 2).

<sup>3</sup> LAEDC, “Where Will We Get the Water? Assessing Southern California’s Future Water Strategies,” at p. 2 (Aug. 14, 2008) (LAEDC Report); available at: [http://www.laedc.org/sc/c/documents/Water\\_SoCalWaterStrategies.pdf](http://www.laedc.org/sc/c/documents/Water_SoCalWaterStrategies.pdf) (see Attachment 3).

<sup>4</sup> *Id.* at p. 16.

Over half the revenue generated per acre-foot will be used to amortize the debt incurred in constructing the \$300 million plant. If the plant operates significantly below capacity, the debt payments will be spread over fewer acre-feet, so the price per acre-foot will rise. This is a real concern—Poseidon developed a plant in Florida that has consistently produced less water than its forecast production capacity.<sup>5</sup>

Finally, as indicated in Attachment 1, the LAO also found ocean desalination to be costlier than most other water supply strategies.

These significant cost figures, moreover, tend to ignore seawater desalination's enormous energy and GHG emission costs. As noted above, the Los Angeles Economic Development Corporation found ocean desalination to emit more greenhouse gases than any water source. The Inland Empire Utilities Agency, in a presentation before the State Water Board in March 2009, similarly reported that ocean desalination uses *over ten times more energy* in its service area than water recycling.<sup>6</sup>

## SUSTAINABLE WATER STRATEGIES

### Water Recycling

DWR's 2005 Water Plan finds that "[t]here is a potential of about 0.9 million to 1.4 million acre-feet annually of *additional* water supply from recycled water by the year 2030."<sup>7</sup> The costs associated with water recycling can vary significantly with the level of treatment and the amount of infrastructure (pipes, etc.) needed. In light of the wide range of local conditions that can affect costs, the majority of applications would cost between \$300 and \$1,300 per acre-foot of recycled water.<sup>8</sup>

The more recent Los Angeles County Economic Development Corporation (LAEDC) report identifies more than 30 recycling projects in Los Angeles, Orange County, San Diego and the Inland Empire alone with the potential of yielding more than 450,000 acre-feet of water within five years.<sup>9</sup> This report states that "[w]ater recycling projects require a significant amount of initial capital because expensive treatment and distribution facilities must be constructed and winter storage is required to fully utilize available wastewater"; it then estimates a cost averaging \$1,000 per acre-foot to produce highly treated recycled water in Orange County.<sup>10</sup> Recycled water treated for less sensitive uses and with lower infrastructure costs (at the Eastern Municipal Water District) averaged \$350 per acre-foot, by contrast.<sup>11</sup>

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<sup>5</sup> *Id.*

<sup>6</sup> Martha Davis, Inland Empire Utilities Agency, Presentation to SWRCB (March 2009), available at: [http://www.swrcb.ca.gov/water\\_issues/programs/climate/docs/ieua\\_030409.pdf](http://www.swrcb.ca.gov/water_issues/programs/climate/docs/ieua_030409.pdf). See also California Energy Commission, "Life-cycle Energy Assessment of Alternative Water Supply Systems in California" (CEC-500-2005-101) available at [http://www.energy.ca.gov/research/environmental/project\\_summaries/PS\\_500-02-004\\_HORVATH.PDF](http://www.energy.ca.gov/research/environmental/project_summaries/PS_500-02-004_HORVATH.PDF) (evaluating the global warming potential of desalination versus recycling and import of water).

<sup>7</sup> DWR, "California Water Plan Update 2005," DWR Bulletin 160-05, at p. 16-2 (Dec. 2005) (2005 Water Plan) (emphasis added), available at <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch16.pdf>.

<sup>8</sup> *Id.*

<sup>9</sup> LAEDC Report at p. 13.

<sup>10</sup> *Id.*

<sup>11</sup> *Id.* at p. 14.

The benefits associated with reducing the energy embedded in water must also be considered in assessing overall costs, however. As discussed in the California's AB 32 Scoping Plan,<sup>12</sup> the DWR report, "Water Recycling 2030: Recommendations of California's Recycled Water Task Force,"<sup>13</sup> finds that "approximately ten percent of municipal wastewater in California is being recycled, but as much as 23 percent of the municipal wastewater flow could be recycled." The California Energy Commission has reported that water supply and conveyance of water from northern to southern California consumes an estimated 3.2 MWh per acre foot (AF). In contrast, the estimated energy needed to recycle wastewater is approximately 0.7 MWh per AF (which will vary with the level of treatment required). As a result, the potential energy savings that could be realized through water recycling, based on the 23 percent recycling goal by 2030, is estimated as 2.5 MWh per AF in southern California communities that import water.<sup>14</sup>

### **Stormwater Capture/Reuse**

The AB 32 Scoping Plan specifically promotes low-impact development (LID) as an energy-efficient, sustainable water source, and adds that up to 333,000 acre-feet of stormwater could be captured annually in urban Southern California alone.<sup>15</sup> This would achieve a corresponding 200,000 metric tons of carbon dioxide reductions by 2020.<sup>16</sup> In an August 2008 report covering Los Angeles, Orange, San Bernardino, San Diego, Riverside and Ventura counties, the LAEDC highly ranked "local stormwater capture" as a cost-effective, energy efficient, relatively immediate local water source, ranking far higher than desalination and new dams. The report found a potential for "[h]undreds of thousands of acre-feet" of water from stormwater capture and reuse.<sup>17</sup> Sample projects include the Inland Empire Utility Agency's water recharge project, which will capture 15,000 to 20,000 acre-feet per year, and the Coachella Valley Water District's project in La Quinta, which will capture 40,000 acre-feet per year via 39 recharge basins on 165 acres.<sup>18</sup> An August 2009 report by NRDC and the Bren School at U.C. Santa Barbara estimates that implementing LID practices solely in new and re-developments in urban Southern California and parts of the Bay Area can yield over 400,000 acre-feet of water annually by 2030 – roughly *two-thirds* of Los Angeles' water use each year.<sup>19</sup>

The January 2009 California Little Hoover Commission report on water governance echoes that:

[a] 2005 report by the Los Angeles and San Gabriel Rivers Watershed Council noted that 500,000 acre-feet of stormwater runoff flow from the Los Angeles County basin to the ocean each year. The report noted that if the region could instead capture that water and reuse it, Southern California would be less dependent on water imports from Northern California.<sup>20</sup>

DWR's 2005 Water Plan reports similarly that:

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<sup>12</sup> California Air Resources Board, "Climate Change Scoping Plan," (Dec. 2008) (AB 32 Scoping Plan), available at: <http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm>.

<sup>13</sup> <http://www.owue.water.ca.gov/recycle/docs/TaskForceReport.htm>.

<sup>14</sup> AB 32 Scoping Plan, Volume 1, at p. C-133, available at:

[http://www.arb.ca.gov/cc/scopingplan/document/appendices\\_volume1.pdf](http://www.arb.ca.gov/cc/scopingplan/document/appendices_volume1.pdf).

<sup>15</sup> *Id.* at p. C-135.

<sup>16</sup> *Id.*

<sup>17</sup> LAEDC report at pp. 9-10.

<sup>18</sup> *Id.* at p. 10.

<sup>19</sup> NRDC and U.C. Santa Barbara, "A Clear Blue Future," at p. 4 (Aug, 2009) (NRDC Report), available at: <http://www.nrdc.org/water/lid/>.

<sup>20</sup> California Little Hoover Commission, "Clearer Structure, Cleaner Water," at p. 81 (Jan. 2009), available at: <http://www.lhc.ca.gov/studies/195/report195.pdf>.

The Fresno-Clovis metropolitan area has built an extensive network of storm water retention basins that not only recharges more than 70 percent of the annual storm water runoff (17,000 acre-feet) and removes most conventional storm water pollutants, but also recharges excess Sierra snow melt during the late spring and summer (27,000 acre-feet). Los Angeles County recharges an average 210,000 acre-feet storm runoff a year, which reduces the need for expensive imported water. Agencies in the Santa Ana Watershed recharge about 78,000 acre-feet of local storm runoff a year. The Los Angeles and San Gabriel Watershed Council has estimated that if 80 percent of the rainfall that falls on just a quarter of the urban area within the watershed (15 percent of the total watershed) was captured and reused, total runoff would be reduced by about 30 percent. That translates into a new supply of 132,000 acre-feet of water per year or enough to supply 800,000 people for a year.<sup>21</sup>

LID water management strategies are a “major area” of activity for the State Water Board under its 2008-2012 Strategic Plan, which states that LID simultaneously improves water quality and water supply, enhances neighborhoods, and provides flood control. U.S. EPA found that using LID methods rather than traditional storm water management resulted in cost *savings* of between 15% and 80%.<sup>22</sup>

As is the case for water recycling, the costs associated with LID vary and depend on the situation and locale. The LAEDC report found that notable initial costs can be incurred if aquifer storage is sought (boundaries must be established to protect against contamination, rights to the groundwater must be obtained, associated infrastructure must be installed, etc.). Gravity feeds of excess water into the ground can keep maintenance costs low, though a spreading basin can require significant maintenance to optimize the permeability of the soil. In consideration of these variables, though, the LAEDC report still found very low relative costs, on the order of \$350 per AF, based on projects planned and operated by the Inland Empire Utility Agencies and the Coachella Valley Water District.<sup>23</sup> Cities such as Seattle also have found significant savings using LID in street design or improvement projects, which they determined “cost about 10 to 20 percent less than traditional street redevelopment with curb, gutter, catch basins, asphalt, and sidewalks.”<sup>24</sup>

### **Water Conservation/Efficiency**

Using water more efficiently is one of the key ways to provide water for a growing California. As discussed in the AB 32 Scoping Plan, the Governor directed State agencies to develop and implement a plan to achieve a 20 percent reduction in per capita urban water use by 2020. California should achieve approximately 1.8 million acre-feet of urban water use efficiency by 2020 to meet the Governor’s call.<sup>25</sup> This would achieve a corresponding 1.4 million metric tons of carbon dioxide reductions by 2020.<sup>26</sup> Another study (Pacific Institute’s “Waste Not, Want Not”) indicated even greater potential savings of 2 to 2.3 million acre-feet per year from existing urban conservation techniques.<sup>27</sup> The LAEDC report found that in Los Angeles, Orange, San Bernardino, San Diego, Riverside and Ventura

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<sup>21</sup> 2005 Water Plan at p. 21-3, available at <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch21.pdf>.

<sup>22</sup> See U.S. EPA LID website at: <http://www.epa.gov/nps/lid/>.

<sup>23</sup> LAEDC Report at pp. 10-11.

<sup>24</sup> NRDC Report at p. 14.

<sup>25</sup> AB 32 Scoping Plan, Volume 1, at p. C-132.

<sup>26</sup> *Id.*

<sup>27</sup> 2005 Water Plan at pp. 22-2 – 22-3, available at: <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch22.pdf>.

counties, “[u]rban water conservation could have an impact equivalent to adding more than 1 million acre-feet of water to the regional supply (about 25% of current annual use.”<sup>28</sup>

The California Bay Delta Authority (CBDA) sponsored a study of urban water conservation potential as part of its comprehensive review of the Water Use Efficiency Element of the CALFED Bay-Delta Program. The CBDA estimated the technical potential for water savings by 2030 at approximately 3.1 million acre-feet per year. Advances in water-saving technology over the next 25 years, which the CBDA analysis did not evaluate, potentially could push savings beyond that.<sup>29</sup>

Costs also favor increased water conservation/efficiencies. The LAEDC report cost out Santa Monica’s conservation strategies in its Sustainable Cities Plan at \$210 per AF of water saved.<sup>30</sup> The Legislative Analyst’s Office wrote recently that according to DWR estimates, urban water use efficiency costs about \$1,000 to achieve one acre-foot of water savings per year, making urban water use efficiency “both the most cost-beneficial and the highest potential water producer of all of the solutions evaluated.” By contrast, CALFED surface storage (a longer-term solution) costs about \$10,000 to achieve one acre-foot of water savings per year.<sup>31</sup>

With respect to agricultural water use efficiency, the 2005 Water Plan reports that the CALFED Record of Decision “estimates that efficiency improvements will result in a water savings (reduction in irrecoverable flows also referred to as net water use) ranging between 120,000 to 563,000 acre-feet per year by 2030. The study also showed a 1.6 million AF per year reduction in applied water (combined recoverable and irrecoverable flows) that provides environmental and crop production benefits.”<sup>32</sup> The referenced ROD further “estimates the cost of 563,000 acre-feet net water savings at \$35 to \$900 per acre-foot.”<sup>33</sup> Additional information on costs associated with agricultural water conservation can be found in a just-released report by the Pacific Institute.<sup>34</sup>

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<sup>28</sup> LAEDC Report at p. 6.

<sup>29</sup> 2005 Water Plan at pp. 22-3 – 22-4.

<sup>30</sup> LAEDC Report at pp. 7-8.

<sup>31</sup> LAO Report at pp. 65-67.

<sup>32</sup> 2005 Water Plan at p. 3-5, available at <http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2ch03.pdf>.

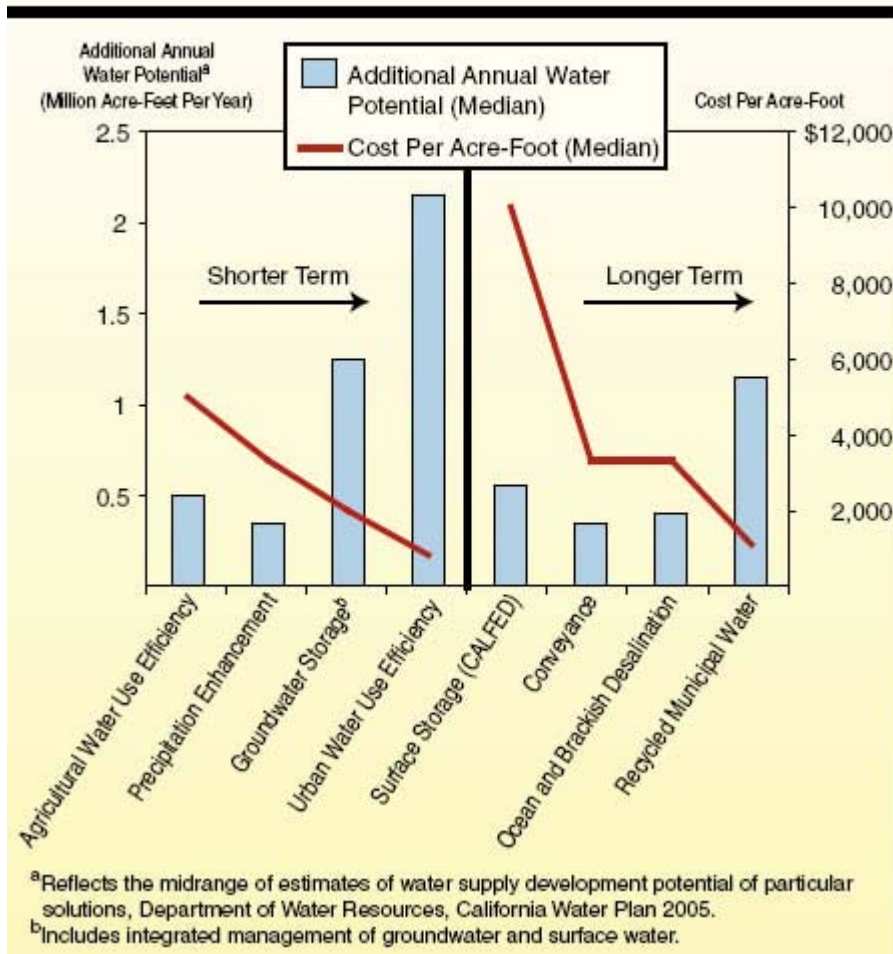
<sup>33</sup> *Id.* at p. 3-7 (costs would need to be normalized to ensure a consistent statewide baseline, such as in the LAEDC report – see attached LAEDC table).

<sup>34</sup> Pacific Institute, “Sustaining California Agriculture in an Uncertain Future” (July 2009), available at: [http://www.pacinst.org/reports/california\\_agriculture/final.pdf](http://www.pacinst.org/reports/california_agriculture/final.pdf).

## ATTACHMENT 1:

# LAO ANALYSIS OF BENEFITS AND COSTS OF WATER SUPPLY ALTERNATIVES

**Figure 2**  
**Options for Additional Water Supply:**  
**Benefits and Costs**



Legislative Analyst's Office, "California's Water: An LAO Primer" (Oct. 22, 2008), [http://www.lao.ca.gov/2008/rsrc/water\\_primer/water\\_primer\\_102208.pdf](http://www.lao.ca.gov/2008/rsrc/water_primer/water_primer_102208.pdf)

# **ATTACHMENTS 2 AND 3**

## **ATTACHMENT 2:**

### **COMPARATIVE COSTS OF DESALINATION, WATER RECYCLING AND GRAVITY-FED SURFACE WATER**

Pacific Institute, “Desalination, with a Grain of Salt: A California Perspective,” Fig. 19-20 (June 2006),  
[http://www.pacinst.org/reports/desalination/desalination\\_report.pdf](http://www.pacinst.org/reports/desalination/desalination_report.pdf)

## **ATTACHMENT 3:**

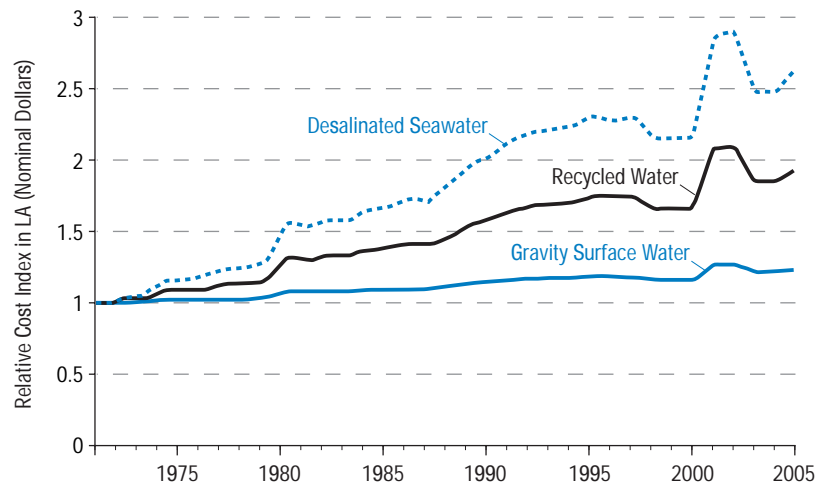
### **ASSESSMENT OF SOUTHERN CALIFORNIA’S FUTURE WATER STRATEGIES**

LAEDC, “Where Will We Get the Water?” (Aug. 14, 2008),  
[http://www.laedc.org/sclc/documents/Water\\_SoCalWaterStrategies.pdf](http://www.laedc.org/sclc/documents/Water_SoCalWaterStrategies.pdf)

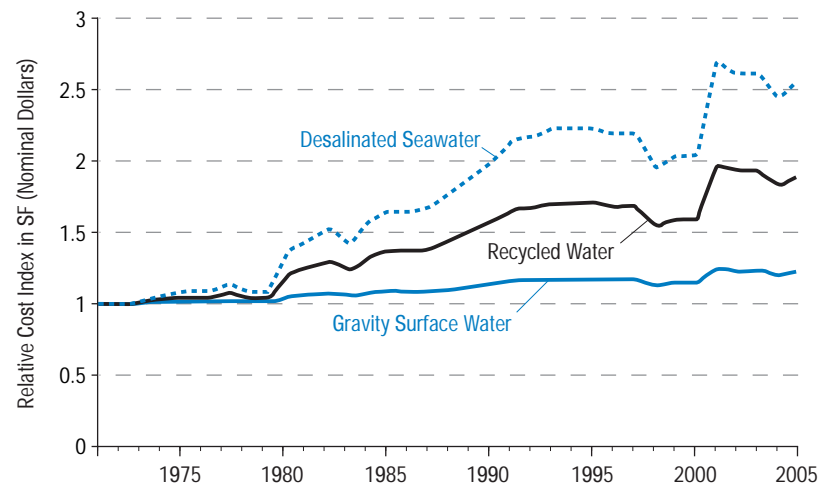
without accounting for energy price increases.

Figures 19 and 20 show the cost time trends for the relative cost of potable water from a typical ocean desalination, wastewater recycling, and gravity surface water source, in Northern and Southern California, using the electricity price time series described above, from 1971 through 2005. By relative cost, we mean that the cost of each option has been normalized to “1” in the first year of the time series. This does not mean that the three options have equal costs in that year. The normalization simply makes the comparison of options over time more convenient. The figures show that the upward trend in cost, and the year-to-year volatility in cost, varies significantly by source as a function of energy intensity. Potable water produced by seawater desalination rises in cost more rapidly than other sources, and has greater year-to-year variability, because less of its cost is due to fixed capital expenses.

**Figure 19**  
Relative Cost of Potable Water from a Typical Ocean Desalination, Wastewater Recycling, and Gravity Surface Water Source in the Los Angeles Metropolitan Area



**Figure 20**  
Relative Cost of Potable Water from a Typical Ocean Desalination, Wastewater Recycling, and Gravity Surface Water Source in the San Francisco-Oakland-San Jose Area



## Assessing Southern California Water Strategies

Strategy	2025 Regional Potential (TAF*)	Typical Project Characteristics							
		Timeframe (years)	Drought-Proof (Reliability)	Risk (Project Aborted)	Enviro Opinion	GHG	Initial Cap. Cost (\$millions)	Annual Oper. Cost (\$millions)	30-yr cost Treated (\$/AF)
<i>Strategies to Replace or Augment Imported Water</i>									
Urban Water Conservation	1,100+	0-2	●	●	●	●	\$0	\$0.5	\$210
Local Stormwater Capture	150+	3-5	●	●	●	●	\$40-\$63	\$1-\$3.5	\$350+
Recycling	450+	6-10	●	●	●	●	\$480	\$30	\$1,000
Ocean Desalination	150+	6-10	●	●	●	●	\$300	\$37	\$1,000+
Groundwater Desalination	TBD	6-10	●	●	●	●	\$24	\$0.7	\$750-\$1,200
<i>Strategies to Increase Imported Water</i>									
Transfers-Ag to Urban	200+	1-5	●	●	●	●	n/a	n/a	\$700+
<i>Strategies to Increase Reliability</i>									
Inter-agency Cooperation	**	0-5	●	●	●	●	low	low	n/a
Groundwater Storage	1,500+	3-5	●	●	●	●	\$68-\$135	\$13	\$580
Surface Storage	0	10+	●	●	●	●	\$2,500+	\$7.5-\$15.5	\$760-\$1,400

\*TAF-Thousand Acre-Feet

\*\* Improves reliability and efficiency of existing supplies

Source: LAEDC

<span style="color: green;">●</span> Favorable	<span style="color: yellow;">●</span> Neutral	<span style="color: red;">●</span> Unfavorable
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