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Appendix I**

**Embedded Energy in Water Studies
Study 1: Statewide and Regional Water-Energy Relationship**

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Appendix I Desalination and Recycled Water Supply

I.1 Desalination

A key assumption in the model is that as population grows and surface water is limited, recycled water and desalination will be relied upon to meet demand. To project how much desalination will be used in each region, the Study Team relied upon applications for new ocean and brackish water desalination plants. Assuming that all of the proposed plants are in operation by 2030, the total capacity of desalination is the sum of the current capacity and the projected new capacity. Table 1 shows desalination capacity by hydrologic region.

Table 1. Desalination Capacity by Region

		Desalination Capacity (AFY)									
		NC	SF	CC	SC	SR	SJ	TL	NL	SL	CR
Current	Brackish	0	3,900	0	86,187	0	0	0	0	0	0
	Ocean	0	0	2,504	148	0	0	0	0	0	0
Projected	Brackish	0	0	28,000	60,344	0	0	0	0	0	11,000
	Ocean	0	0	21,818	240,115	0	0	0	0	0	0
Total Capacity (2030)	Brackish	0	3,900	28,000	146,531	0	0	0	0	0	11,000
	Ocean	0	0	24,322	240,263	0	0	0	0	0	0

I.1.1 Ocean Desalination

Current and projected ocean desalination capacity was obtained through the California Coastal Commission's 2004 report, Seawater Desalination and the California Coastal Act.¹ This report lists existing facilities and their capacities, as well as proposed facilities and their capacities. Existing capacities are relatively small, almost 3,000 AFY. The total output of existing and proposed facilities, about 260,000 AFY, represents an 80-fold increase in desalination

¹ <http://www.coastal.ca.gov/energy/14a-3-2004-desalination.pdf>

production. Table 2 and Table 3 below show existing and proposed desalination facilities by region, respectively.

Table 2. Existing Ocean Desalination Capacity

Existing Facilities	Operator	Region	AFY
Gaviota	Chevron	CC	460
Morro Bay	PG&E	CC	482
Moss Landing	Duke Energy	CC	537
Marina Coast Water District	Marina Coast WD	CC	335
Monterey	Monterey Bay Aquarium	CC	45
Diablo Canyon	PG&E	CC	645
Santa Catalina	Santa Catalina Island	SC	148
Total			2652

Table 3. Proposed Ocean Desalination Facilities

Proposed Facilities	Operator	Region	AFY
Cambria	Cambria Community Services District	CC	560
Monterey	Ocean View Plaza	CC	6
Sand City	City of Sand City	CC	30
Santa Cruz	City of Santa Cruz	CC	2800
Long Beach	City of Long Beach	SC	335
Long Beach	City of Long Beach	SC	11000
Los Angeles	LADWP	SC	11000
Monterey	Monterey Bay Shores	CC	22
Sand City	Monterey Peninsula Water and Sanitation District	CC	8400
Moss Landing	Cal-Am	CC	10000
Orange County	MWD of Orange County	SC	30000
Huntington Beach	Poseidon Resources	SC	55000
San Diego	San Diego County Water Authority	SC	55000
Carlsbad	San Diego County Water Authority and Poseidon Resources	SC	55000
San Diego	US Navy	SC	780
West Basin	West Basin MWD	SC	22000
Total			261933

I.1.2 Brackish Water Desalination

Current and projected brackish water desalination was obtained through two sources. First, current and projected capacity was taken from a presentation given by Orange County Water District at a Groundwater Conference in 2005.² Then, further current capacity was taken from a 2007 groundwater assessment study done by MWD.³ Table 4 and Table 5 show the current and projected capacity of groundwater desalination by region, respectively.

Table 4. Existing Brackish Desalination Capacity

Existing Facilities	Participating Agency	Location	HR	Yield (AFY)
Arlington Basin Groundwater Desalter Project	Western Municipal Water District	City of Riverside	SC	6100
Beverly Hills Desalter Project	City of Beverly Hills	City of Beverly Hills	SC	2600
Juan Well Filter Facility	Central Basin Municipal Water District	City of Hawaiian Gardens	SC	900
Lower Sweetwater River Basin Groundwater Demineralization Project	San Diego County Water Authority	National City	SC	3600
Madrona Desalination Facility Project	City of Torrance	City of Torrance	SC	2400
Menifee Basin Desalter Project	Eastern Municipal Water District	Sun City	SC	3360
Mesa Consolidated Colored Water Treatment Facility	Municipal Water District of Orange County	City of Costa Mesa	SC	11300
Oceanside (Mission Basin) Desalter Project Phase I and II	San Diego County Water Authority	City of Oceanside and Camp Pendleton	SC	6500
Temescal Basin Desalting Facility Project	Western Municipal Water District	City of Corona	SC	10000
Tustin Desalter Project	Municipal Water District of Orange County	City of Tustin	SC	3271
West Basin Desalter Project	West Basin Municipal Water District	City of Torrance	SC	1524
Chino Basin Desalination Program	Western Municipal Water District and Inland Empire Utilities Agency	City of Chino Hills	SC	24600
Glenwood Nitrate Water Reclamation Plant –Crescenta Valley	Crescenta Valley Water District	City of La Crescenta	SC	1032
Alameda County WD – Phase 2 Desalter	Alameda County Water District	Alameda County	SF	3900

² <http://www.lib.berkeley.edu/WRCA/WRC/pdfs/Everest.pdf>

³ http://www.mwdh2o.com/mwdh2o/pages/yourwater/groundwater/2007_groundwater_projects.xls

Irvine Desalter –Orange County Basin	Irvine Ranch Water District (IRWD) and the Orange County Water District (OCWD)	City of El Toro	SC	9000
Total				90,087

Table 5. Proposed Brackish Desalination Capacity

Proposed Facilities	Participating Agency	Location	HR	Yield (AFY)
Recovery Enhancement	Eastern Municipal Water District	Sun City	SC	11,200
San Pasqual Basin – Phase III	San Diego County Water District	San Diego	SC	5000
Desalination Project	Coachella Valley Water District	Coachella Valley	CR	11000
Metals Recovery from Brine	Calleguas Municipal Water District	Simi Valley	SC	30000
Pajaro FS	San Benito County Water District	Hollister	CC	28000
San Diego Formation Project – Phase II	San Diego County Water District	San Diego	SC	10000
Arlington Desalter Expansion	Western Municipal Water District	Riverside	SC	4144
Total				99,344

Using these new projected new brackish and ocean desalination plants, the Study Team can estimate the future capacity of desalination under different scenarios. First, under Scenario 1, the state builds only the brackish water desalination plants by 2020, and will not build any ocean desalination plants. Under Scenario 2, the state builds only the ocean desalination plants. Half of the planned ocean capacity will be built by 2020, and the remaining half will be built by 2030. The resulting total desalination capacity by hydrologic region under each scenario is presented in Table 6.

Table 6. Total Desalination Capacity (TAF)

		NC	SF	CC	SC	SR	SJ	TL	NL	SL	CR
Scenario 1	2020	0	4	31	147	0	0	11	0	0	0
	2030	0	4	31	147	0	0	11	0	0	0
Scenario 2	2020	0	4	13	206	0	0	0	0	0	0
	2030	0	4	24	326	0	0	0	0	0	0

I.2 Recycled Water

To project future capacity of recycled water, first a baseline estimate is needed. The Study Team relied upon a 2002 Statewide Recycled Water Survey from the California State Water Resources Control Board (SWRCB).⁴ This report lists current recycled water capacity by county⁵. Using the county divisions, the Study Team was able to group recycled water capacity by hydrologic regions. Table 7 shows current recycled water capacity by hydrologic region.

Table 7. Current Recycled Water Capacity

Hydrologic Region	Current Capacity (AFY)
NC	17,346
SF	40,370
CC	25,295
SC	275,494
CR	9,747
NL	5,758
SL	18,753
SJ	33,547
SR	10,139
TL	108,532
Total	544,980

To project future capacity, the Study Team used the SWRCB’s Recycled Water Policy⁶, approved in May 2009. This policy states mandated statewide new capacity of recycled water by 2020 and 2030. Further, the policy states 2020 and 2030 goals for new capacity of recycled water, above and beyond the mandates. These mandates and goals are shown in Table 8.

Table 8. Recycled Water Capacity Mandates and Goals

Policy	Capacity (TAF)
Mandated New Capacity in 2020*	200
Mandated New Capacity in 2030*	300
Goal New Capacity in 2020*	1000
Goal New Capacity in 2030*	2000

*increase above 2002 capacity

⁴http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/docs/wr2002survey_attc.pdf

⁵ A new survey is currently underway, but the SWRCB is still collecting data, so the Study Team must rely on 2002 capacity as the current capacity.

⁶http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf

The Study Team spread the mandates and goals for new recycled water construction across the ten hydrologic regions. To do so, the Study Team took the urban demand from the Regional Water Balances, and applied the percentage of urban demand used in each hydrologic region to the projected statewide new construction. The result is shown below in Table 9.

Table 9. Expected New Capacity by Hydrologic Region (TAF)

	Statewide	NC	SF	CC	SC	SR	SJ	TL	NL	SL	CR
Urban Use (TAF) - Baseline	9,761.5	161.3	1,134.2	313.2	4,531.5	1,010.3	713.8	745.1	42.5	314.8	794.8
Percent of Statewide	100%	2%	12%	3%	46%	10%	7%	8%	0%	3%	8%
Mandated 2020	200	3.3	23.2	6.4	92.8	20.7	14.6	15.3	0.9	6.5	16.3
Mandated 2030	300	5.0	34.9	9.6	139.3	31.0	21.9	22.9	1.3	9.7	24.4
Goal 2020	1000	16.5	116.2	32.1	464.2	103.5	73.1	76.3	4.4	32.3	81.4
Goal 2030	2000	33.0	232.4	64.2	928.4	207.0	146.3	152.7	8.7	64.5	162.8

Using these new construction mandates and goals, the Study Team can estimate the future capacity of recycled water under different scenarios. First, under Scenario 1, the state builds only the mandated new capacity. Under Scenario 2, the state builds the goal capacity. The resulting total recycled water capacity by hydrologic region under each scenario is presented in Table 10.

Table 10. Total Recycled Water Capacity (TAF)

		NC	SF	CC	SC	SR	SJ	TL	NL	SL	CR
Scenario 1	2020	21	41	24	110	38	32	33	18	24	34
	2030	22	52	27	157	48	39	40	19	27	42
Scenario 2	2020	34	134	49	482	121	90	94	22	50	99
	2030	50	250	82	946	224	164	170	26	82	180