Block 1 - In-lieu recharge of regional aquifers

Table 1.1 In-lieu supplied by winter flows capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost*	Total capital cost
In-lieu supplied by winter flows			
a. Intertie No. 1 Pipeline (City to Scotts Valley)	3.2	1.0	4.2
b. Pump Station (City to Scotts Valley) Intertie No. 1	1.1	0.3	1.4
c. Intertie Pipeline (City to Soquel Creek)	9.9	3.1	13.0
d. Tait Street Diversion Improvements	10.3	3.2	13.5
e. Graham Hill WTP Improvements	47.3	14.7	62.0
f. Extraction Wells in Scott's Valley (4 wells)	7.2	2.2	9.4
g. Extraction Wells in Soquel Creek (4 wells)	7.2	2.2	9.4
h. Iron & Manganese Treatment (All)	4.7	1.5	6.2
i. Land Acquisition	1.2	0.4	1.6
Totals	**92.1**	**28.6**	**120.7**

* Soft cost includes engineering, site investigations, construction management, permitting, City contract administration and legal.

a. Build a 1.5-mile, 12-inch diameter pipeline as sufficient to convey 2 MGD of potable water to the Scotts Valley distribution system.
b. Construct a 1,800 GPM pump station to move water from Santa Cruz to SVWD through Intertie No. 1.
c. Build a 4.7–mile, 16-inch diameter pipeline to convey about 2.6 MGD of potable water from Santa Cruz to the SqCWD distribution system (SqCWD's average winter demand) and return about 2.0 MGD back to SCWD. Reduced return flow recognizes potential for lost water as well as use of some stored water by SqCWD.
d. Improve and expand Tait Street Diversion facility to add capacity for increased flow.
e. Improve and expand capacity at Graham Hill Water Treatment Plant to treat added flow. GHWTP would require improvements to produce more winter flow consistency, especially because winter water is more challenging to treat.
f. Construct four new 350-GPM wells to withdraw stored water to send to SVWD. Wells receive 2 mgd for 180 days per year.
g. Construct four new 350-GPM wells to withdraw water to send to SqCWD. Wells receive 2 mgd for 180 days per year.
h. Include iron and manganese treatment on all eight extraction wells for parity with existing groundwater treatment needs. Necessity at these new wells will be verified during project development.
i. Acquire land on which to locate the ASR well with adjacent treatment system – eight separate well sites, 65'x15' footprint each.

Table 1.2 In-Lieu Recharge Using Winter Flows in millions 2015 $s	
Estimates	**In-lieu Recharge**
Annual O&M costs ($M/yr)	$2.5
Total Annualized Cost ($M/yr)	$12
PV Costs (30 years) ($M)[1]	$276
Energy Use (MWH/MG)[2]	6.6
NOTES: 1. Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%, bond issuance cost = 3%. 2. Existing SCWD water production requires 1.6 MWH/MG	

Block 2 – ASR Using Winter Flows

Table 2.1 ASR capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost*	Total capital cost
ASR			
a. Intertie pipeline (City to/from SqCWD)	13.2	4.1	17.3
b. Pump Station (SqCWD to Aquifer)	1.1	0.3	1.4
c. Intertie No. 1 Pipeline (City to Scotts Valley)	4.3	1.3	5.6
d. Pump Station (City to Scotts Valley) Intertie No. 1	1.1	0.3	1.4
e. Tait Street Diversion Improvements	10.3	3.2	13.5
f. Graham Hill WTP Improvements	47.3	14.7	62.0
g. ASR Wells in SVWD (6 wells)	10.8	3.3	14.1
h. ASR Wells in SqWD (6 wells)	10.8	3.3	14.1
i. Iron & Manganese Treatment (All)	7.0	2.2	9.2
j. Land Acquisition	1.8	0.6	2.4
Totals	**107.7**	**33.3**	**141.0**

Note:

* Soft costs include engineering, site investigations, construction management, permitting, City contract administration and legal.

a. Build a ~4.7-mile, 16-inch diameter pipeline to convey water from the Santa Cruz distribution system to the SqCWD distribution system.

b. Construct a 1,800-GPM pump station to move treated water within the SqCWD distribution system into their new aquifer storage and recovery well field (2.5-MGD).

c. Build a 1.5-mile, 16-inch diameter pipeline to connect the Santa Cruz distribution system to the SVWD distribution system (2.5-MGD).

d. Construct a 1,800-GPM pump station to move water from Santa Cruz to SVWD through Intertie No. 1.

e. Improve and expand Tait Street Diversion facility to add capacity for increased flow (to 14 MGD).

f. Improve and expand the Graham Hill Water Treatment Plant to handle increased flow (to 14 MGD). GHWTP would require improvements to produce more winter flow consistently, especially because winter water is more challenging to treat.

g. Construct six new 350-GPM aquifer storage and recovery wells to store some of the additional captured water in Scotts Valley and later withdraw it. Wells receive 2.5 mgd for 180 days per year.

h. Construct six new 350-GPM aquifer storage and recovery wells to store some of the additional captured water in SqCWD Creek and later withdraw it. Wells receive 2.5 mgd for 180 days per year.

i. Include iron and manganese treatment in all twelve ASR wells for parity with existing groundwater treatment needs. Necessity of treatment at these new wells will be verified during project development.

j. Acquire land on which to locate the ASR well with adjacent treatment system – twelve separate well sites, 65'x15' footprint each.

Table 2.2 ASR Using SLR Winter Flows	
Estimates	**ASR Using SLR winter flows**
Annual O&M costs ($M/yr)	$3.4 M
Total Annualized Cost ($M/Yr)	$15 M
PV Costs (30 years) ($M)[1]	$335 M
Energy Use (MWH/MG)[2]	6.1
NOTES: 1. Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%, bond issuance cost = 3%. 2. Existing SCWD water production requires 1.6 MWH/MG.	

Block 3 – Direct Potable Reuse

Table 3.1 DPR capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost	Total capital cost
DPR			
a. Nitrification (6.1 mgd)	2.25	0.70	2.95
b. Equalization basin	0.75	0.24	0.99
c. Ozone/BAC filters (6.1 mgd)	13.50	4.19	17.69
d. Microfiltration (6.1 mgd)	21.00	6.51	27.51
e. Reverse osmosis (5.5 mgd)	30.00	9.30	39.30
f. Advanced oxidation (UV + Peroxide) (4.7 mgd)	4.88	1.52	6.39
g. Conditioning facilities (4.7 mgd)	2.15	0.67	2.82
h. Effluent diffuser modification	1.50	0.47	1.97
i. Pumping system (WWTP to CAT)	2.58	0.80	3.38
j. Pipeline installation (WWTP to CAT)	0.17	0.06	0.22
k. Pumping system (CAT to Bay St. Reservoir)	1.92	0.60	2.52
l. Pipeline installation (CAT to Bay St. Reservoir)	3.96	1.23	5.19
m. Line maintenance facility relocation	N/A	N/A	5.20
Totals	**84.66**	**26.29**	**116.13**

Table 3.2 DPR for Regional demands

	Estimates	DPR for City and Regional Use
	Annual O&M costs ($M/yr)	$5.2 M
	Total Annualized Cost ($M/Yr)	$14.5 M
	PV Costs (30 years) ($M)	$328M
	Energy Use (MWH/MG)	8.6

Block 4 – IPR to Loch Lomond for Reservoir Augmentation

Table 4.1 IPR to Loch Lomond capital improvement needs and costs (millions of 2015 $)

Capital improvement item	Hard capital cost	Soft capital cost	Total capital cost
IPR			
a. Nitrification (6.1 mgd)	2.25	0.70	2.95
b. Equalization basin	0.75	0.24	0.99
c. Ozone/BAC filters (6.1 mgd)	13.50	4.19	17.69
d. Microfiltration (6.1 mgd)	21.00	6.51	27.51
e. Reverse osmosis (5.5 mgd)	30.00	9.30	39.30
f. Advanced oxidation (UV + Peroxide) (4.7 mgd)	4.88	1.52	6.39
g. Conditioning facilities (4.7 mgd)	2.15	0.67	2.82
h. Effluent diffuser modification	1.50	0.47	1.97
i. Pumping system (WWTP to CAT)	2.58	0.80	3.38
j. Pipeline installation (WWTP to CAT)	0.18	0.06	0.24
k. Pumping system (CAT to Loch Lomond)	1.92	0.60	2.52
l. Pipeline installation (CAT to Loch Lomond)	44.88	13.92	58.80
m. Line maintenance facility relocation	N/A	N/A	5.20
Totals	**125.59**	**38.98**	**169.76**

Table 4.2 IPR for Reservoir Augmentation

Estimates	IPR for Reservoir Augmentation
Annual O&M costs ($M/yr)	$7.2 M
Total Annualized Cost ($M/Yr)	$21 M
PV Costs (30 years) ($M)	$471 M
Energy Use (MWH/MG)	9.6

Block 5 – IPR for Seawater Barrier in Soquel Creek

Table 5.1 IPR with seawater barriers capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost	Total capital cost
IPR with seawater barriers			
a. Nitrification (6.1 mgd)	2.25	0.70	2.95
b. Equalization Basin	0.75	0.24	0.99
c. Ozone/BAC Filters (6.1 mgd)	13.50	4.19	17.69
d. Microfiltration (6.1 mgd)	21.00	6.51	27.51
e. Reverse Osmosis (5.5 mgd)	30.00	9.30	39.3
f. Advanced Oxidation (Peroxide + UV) (4.7 mgd)	4.88	1.52	6.39
g. Conditioning Facilities (4.7 mgd)	2.15	0.67	2.82
h. Effluent Diffuser Modification	1.50	0.47	1.97
i. Pumping System (WWTP to CAT)	2.58	0.80	3.38
J. Pipeline Installation (WWTP to CAT)	0.18	0.06	0.24
k. Pumping System (WWTP to Soquel Creek Coast)	2.88	0.90	3.78
l. Piping to SW Barrier Wells	11.94	3.70	15.63
m. Under San Lorenzo Riverway	1.04	0.33	1.37
n. Under Woods Lagoon	1.33	0.41	1.74
o. Pipeline Installation (WWTP to wells 1-5, 18")	3.93	1.22	5.14
p. Pipeline Installation (WWTP to wells 6-12, 14")	1.22	0.38	1.60
q. Pipeline Installation (WWTP to wells 8-11, 12")	2.10	0.65	2.74
r. Pipeline Installation (WWTP to wells 12, 8")	0.35	0.11	0.46
s. Injection Wells (SqCWD coastline)	9.00	2.79	11.79
t. Line Maintenance Facility Relocation	N/A	N/A	5.20
Totals	**112.58**	**34.95**	**152.69**

Table 5.2 IPR for Barrier Wells

	Estimates	Seawater Intrusion/IPR
	Annual O&M costs ($M/yr)	$5.5 M
	Total Annualized Cost ($M/Yr)	$18 M
	PV Costs (30 years) ($M)	$401 M
	Energy Use (MWH/MG)	7.8

Block 6 – Convert Indirect Potable Reuse to Direct Potable Reuse

Table 6.1 DPR capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost	Total capital cost
DPR			
a. Pumping system (CAT to Bay St. Reservoir)	2.31	0.72	3.02
b. Pipeline installation (CAT to Bay St. Reservoir)	4.76	1.48	6.23
Totals	**7.07**	**2.20**	**9.25**

NOTE: Additional 20% contingency mark-up added to account for needed on-site modifications. Decommissioning of the IPR pipeline and well field is not included.

a. Install pumps to pump Complete Advanced Treatment-purified water to the Bay Street Reservoir.

b. Build pipeline to convey Complete Advanced Treatment-purified water to the Bay Street Reservoir.

Table 6.2. DPR Converted from Seawater IPR

	Estimates	Conversion of CAT to DPR for City and Regional Use[1]
	Capital (upfront) costs ($M)	$9 M
	Annual O&M costs ($M/yr)	$5.3 M
	Total Annualized Cost ($M/Yr)	$120M
	Energy Use (MWH/MG)	8.6

1. For consistency, this option only includes incremental costs associated with the added infrastructure to repurpose the CAT system to DPR, rather than IPR use for seawater intrusion barriers. O&M costs reflect incremental operational expense for DPR configuration.

Block 7 – Deepwater Desalination

Table 7.1 DW Desal capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost	Total capital cost
DW Desal			
a. Intake (18 mgd) & Outfall (9 mgd)	20.0	6.2	26.2
b. DAF (18 mgd)	2.6	0.8	3.4
c. Solids handling	2.8	0.9	3.6
d. Microfiltration (18 mgd)	10.0	3.1	13.1
e. Seawater Reverse Osmosis (16.2 mgd)	15.0	4.7	19.7
f. Conditioning facilities (9.0 mgd)	1.5	0.5	2.0
g. Pumping system (Desalination plant to SCWD)	1.9	0.6	2.5
h. Pipeline installation (From Desalination Plant across Aptos)	41.8	13.0	54.8
i. Pipeline installation (Across Santa Cruz)	19.4	6.0	25.4
Totals	**114.9**	**35.6**	**150.5**

NOTE:

* Soft costs include engineering, construction management, permitting, City contract administration and legal.

** The facility is designed to produce 9 MGD of potable water to allow both SCWD and its neighbors to purchase water. It is assumed that SCWD will purchase one-third of this volume. The facility was sized for the full flow and the facility cost represented here is one-third of the total. The pipeline cost breakouts are itemized below.

a. Build an 18-MGD seawater intake and a 9-MGD outfall extending out into the ocean from Moss Landing. The intake and outfall construction costs for the alignment in the *Initial Evaluation of the Deep Water Desalination Project Costs* (Kennedy Jenks 2014) were deemed overly optimistic given the challenging alignment requirements through coastline navigation channels and environmentally sensitive areas. These costs have been substantially increased based on comparison of costs with other sweater desalination projects and engineering judgment.

b. Part of the Seawater Desalination Treatment Process: Install a dissolved air filtration (DAF) pretreatment for algae removal (pre-treatment for the microfiltration [MF] process).

c. Part of the Seawater Desalination Treatment Process: Construct a solids handling system (for waste from DAF process).

d. Part of the Seawater Desalination Treatment Process: Install MF pretreatment to remove solids (for the seawater reverse osmosis [SWRO] process).

e. Part of the Seawater Desalination Treatment Process: Install seawater reverse osmosis (RO) treatment.

f. Modify the pH and add alkalinity to stabilize the highly purified RO effluent for corrosion control in the distribution system.

g. Install a 6,250-gpm pumping system to move the desalinated water from the plant to Santa Cruz; 1/3 cost paid by 1/3 cost paid by SCWD.

h. Build a 15-mile, 20-inch pipeline section to convey 4.5-mgd of desalinated water across Aptos to the Santa Cruz area. SCWD and SqCWD share the pipeline; SCWD pays 2/3 of the cost for

this pipeline. City pays 2/3 the cost to move the water.

i. Build a second 16-inch pipeline section to convey 3-mgd of the desalinated water to connect the 20-inch pipeline to the SCWD distribution system at the 41st Street and Soquel Drive intersection. Full cost paid by SCWD.

Table 7.2 Deep Water Desalination Used for Santa Cruz and Regional Demands	
Estimates	**DW Desal for Regional Use**
Annual O&M costs ($M/yr)	$6.3 M
Total Annualized Cost ($M/Yr)	$18 M
PV Costs (30 years) ($M)	$413 M
Energy Use (MWH/MG)	12.4
NOTES: Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%, bond issuance cost = 3%.	

Block 8 – SCWD^2 desalination

Table 8.1 SCWD^2 desal capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost*	Total capital cost
SCWD^2 Desalination Plant			
a. City desalination plant capital cost (at 3-MGD scale)	N/A	N/A	138.0
b. Effluent outfall modifications	1.5	0.5	2.0
Totals	**1.5**	**0.5**	**140.0**

NOTES:

* Soft costs include engineering, construction management, permitting, City contract administration and legal.

a. Construction of 3-MGD seawater reverse osmosis-based treatment plant. *Source: 2012 scwd^2 report*; cost scaled to 3-mgd and 2015 dollars.

b. Modify the existing wastewater treatment plant outfall to accommodate disposal of SWRO brine.

Table 8.2 SCWD^2 Desal Used for Santa Cruz and Regional Demands	
Estimates	**SCWD^2 Desal for Regional Use**
Annual O&M costs ($M/yr)	$3.9 M
Total Annualized Cost ($M/Yr)	$15 M
PV Costs (30 years) ($M)	$343 M
Energy Use (MWH/MG)	11.0
NOTES: Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%, bond issuance cost = 3%.	

	Updated and Expanded Building Block Summary	*6-Aug-15*											
	Building Block #	**1**	**2**	**3**	**DPR**	**3-small**	**4**	**5**	**6**	**7**	**7-lg**	**8**	**8-lg**
	Building Block Approach	**In-Lieu**	**ASR**	**DPR**	**M. M-M**	**DPR small**	**IPR-Loch**	**IPR-SeaBar**	**IPR=>DPR***	**DW Desal**	**DW lg.**	**Local Desal**	**Local Dsl lg.**
a	Capital Cost ($ M)	121	141	116	99	90	170	153	9	151	173	140	161
b	Annual O&M cost ($ M)	2.5	3.4	5.2	4.4	3.7	7.2	5.5	5.3	6.3	7.9	3.9	4.9
c	Total Annualized Cost ($ M)	12	15	15	13	11	21	18	6	18	22	15	18
d	Present Value Costs ($M)	276	335	328	296	279	470	400	120	410		340	
e	Energy Use (MWH/MG)	6.6	6.1	8.6	**9.0**	**9.3**	9.6	7.8	8.6	12.4	15.5	11.0	13.8
f	Annual Production Cost ($/MG)	133,300	42,900	8200***			12,200	na	3300***	16,700	16,000	13,700	13,100
g	Average Annual Production (MG/year)	90	350	1715	1300	1100	1715	na	1715	1100	1375	1100	1375
h	Worst Year Yield (MG)	780	800	1110		710	1050	na	1110	710		710	
i	Average Year Yield (MG)	290	310	340		330	330	na	340	330		330	
j	Worst year yield unit cost (Total Ann Cost/Wst Yr Yield)	16,400	18,800	12,600		15,500	19,900	-	5,000	25,900	-	21,300	
k	Average year yield unit cost (Total Ann Cost/Ave Yr Yield)	44,100	48,400	41,200		33,300	63,300	-	16,500	55,800	-	45,800	
l	Worst Year Peak Season Shortage (MG)	330	310	0		400	60	na	0	400		400	
m	Worst Year Peak Season Shortage (%)	17%	17%	0%		21%	3%	na	0%	21%	<15%**	21%	<15%**
n	Average Year Peak Season Shortage (MG)	50	30	0		10	0	na	0	10		10	
o	Average Year Peak Season Shortage (%)	<3%	<2%	0%		<1%	0%	na	0%	<1%		<1%	
p	Approximate Timeline (Years)	8	15 to 20	9 to 13		9 to 13	8	8	2 (plus 8)	7	7	6	6

* NOTE: As this is a conversion of Block 6 the unpaid capital costs from Block 6 would still need to be paid. Those are not included in the Block 6 costs.

** Yields not estimate at this time by *Confluence* runs, but worst year shortages expected to be less than 15%.

*** This number will increase slightly.