Water Supply Advisory Committee Portfolio Building Block Information

7. Deep Water Desalination (DW Desal)

working draft of 20 July 2015

1. Objectives

The technical team prepared this document as part of a series to provide our latest assessment of the anticipated costs, supply production, yields, timelines, and other relevant information for the various water supply enhancement alternatives that may serve as key components ("building blocks") in a future portfolio. Each of the major potential water supply components is now being considered individually so that each of these "building blocks" can be more carefully compared side by side. The objective is to provide WSAC with our best current assessment for each building block, so that the Committee can better evaluate its potential choices as they build portfolios for future consideration.

Disclaimer/Context

The material provided herein reflects the technical team's best assessment given currently available information. At this stage, all estimates are preliminary and suitable only for high level planning: cost estimates are prepared to a planning level, we have included a 50-percent contingency to address "known and 'unknown' unknowns," and the estimated capital and operating costs are intended to be used for comparison purposes, as Class 5 estimates with an accuracy range of -30% to +50%.[1]

As we continue to review and refine underlying assumptions and data, and as new information becomes available, our estimates will likely evolve. More extensive analysis ultimately will need to be conducted to develop more precise estimates – including site-specific field evaluations beyond the scope and timeline for WSAC activities.

Also, please note that the total portfolio yield is not equal to the sum of the individual building block yields. This is because the components operate interactively at a system level (as captured in *Confluence* modeling).

2. Deep Water Desalination -- Overview

In this document, the seawater desalination-based "DW Desal" is envisioned generally as:

1. The City acquiring rights to a share of the Deep Water Desalination facility's anticipated production, with the City share amounting to 3 MGD (about 1,100 MG per year).

2. The City contributing a share of the costs for building a pipe and pumping system to deliver water within the service area of Soquel Creek Water District (with two-thirds of the costs paid by the City and the rest shared proportionally with other North County water agencies investing in DW Desal),

[1] Per the Association for the Advancement of Cost Engineering (AACE), *Standard Cost Estimating Guidelines*. Note too that these are considered "Class 5" planning-level estimates, which include a 50 percent contingency factor, and should also be accompanied by an accuracy range of -30% to +50%. For example, a project presented with a $100M cost including contingency allowance ($66.7 million plus $33.3 million = $100 million) likely would have a final cost between $70 million and $150 million.

and then paying for additional piping and pumping up to an intertie with Santa Cruz Water Department's (SCWD's) existing system at the 41st Street and Soquel Drive intersection.

3. The City distributing the DW Desal water to customers, along with its other finished potable supplies as produced at the Graham Hill Water Treatment Plant (GHWTP).

4. The additional supply provided would help meet water demands for SCWD.

5. Once SCWD needs are met, then any additional available supply could be made available to help meet demands in areas served by the Scotts Valley Water District (SVWD) and Soquel Creek Water District (SqCWD). Such transfers would help restore groundwater levels in the depleted regional aquifers (by enabling passive (in-lieu) recharge), reduce seawater intrusion into the Purisima formation, and provide stored waters that could be tapped in dry periods (including the possible return of some waters from neighboring Districts to the City).

There are numerous specific details and variations on how this DW Desal approach might be structured and implemented. These include, for example, how large a share of the project the City acquires, how the size and cost of pipe and pumping facilities may be influenced by whether other regional entities also buy into DW Desal, and what institutional agreements may be forged with them for cost- and risk-sharing.

As itemized above, another factor is whether any excess SCWD water might be made available to SVWD and SqCWD for in-lieu recharge. If this is included, issues arise regarding the scale and location of any new infrastructure (e.g., interties, pumps, wells) as may be necessary to implement the approach, and the institutional arrangements negotiated between the City and SVWD and SqCWD regarding sharing water, costs, and risks. The latter issue impacts when and how much water may be transferred to and from SVWD and SqCWD (and when), the associated improvements in yields and system reliability, how much the approach would cost, and what an equitable allocation of costs might look like.

In this paper, we aim to be as explicit as possible about the underlying assumptions and constraints that are included in our analysis and findings. Where feasible, we provide preliminary indications of the impact of some of the possible variations. If the City pursues this building block further, the information provided in this document will need to be vetted and developed in more detail to confirm assumptions and refine cost estimates.

3. Base Case Configuration and Assumptions

1. DW Desal water is purchased (i.e., a one-third share buy-in of a 9-MGD facility) based on a desired acquisition of a 3-MGD supply, providing nearly 1,100 MG per year.

2. The costs and timetable for DW Desal water are informed by the developer's projections; however, the Technical Team has modified these estimates to reflect its professional judgment (increasing the costs and lengthening the schedule, as detailed below). Pipeline and pumping costs to move the water (4.5MGD) from the production facility across Aptos are shared with other regional water agencies (because the other entities are expected to also use a portion of the pipeline capacity); the in-City pipeline cost is borne by the City alone to deliver 3MGD to the City.

3. Newell Creek Dam height and Loch Lomond operational rules remain as they currently exist.

4. If in-lieu recharge is considered part of this building block, then the costs, yields, and issues associated with the in-lieu component will depend on several factors, as described in the summary paper for Building Block #1.

5. Yield estimates for in-lieu reflect the assumption that SCWD realizes water savings from Program C Rec (i.e., that C Rec is anticipated to be part of the portfolio along with in-lieu recharge). For purposes of this building block, the assumed peak season demand reduction attained is 150 MG. If additional changes in peak season demands are agreed upon by WSAC, then associated modifications to the yields in this portfolio will be derived.

4. Necessary Capital Improvements and Related Costs[2]

Table 7.1 provides an overview of the major capital investments and other upfront costs associated with developing and operationalizing the DW Desal program.

[2] Note that at this stage of the evaluation process, all cost estimates are highly preliminary, "Planning Level" estimates reflecting a range of –30% to + 50% (per AACE Guidelines), and subject to modification as additional information emerges.

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)	20.00	6.20	26.20
b. DAF (18 mgd)	2.59	0.80	3.39
c. Solids handling	2.75	0.85	3.61
d. Microfiltration (18 mgd)	10.00	3.10	13.10
e. Seawater Reverse Osmosis (16.2 mgd)	15.00	4.65	19.65
f. Conditioning facilities (9.0 mgd)	1.51	0.47	1.98
g. Pumping system (Desalination plant to SCWD)	1.88	0.58	2.46
h. Pipeline installation (From Desalination Plant across Aptos)	41.80	12.96	54.76
i. Pipeline installation (Across Santa Cruz)	19.39	6.01	25.40
Totals	**114.92**	**35.62**	**150.55**

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 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 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. (Pipe sizes and volumes would be revisited during future design.)

If an in-lieu component is linked to the DW Desal approach, additional capital costs would be incurred, as outlined in Building Block summary paper #1.

5. Annual Operation and Maintenance (O&M) Costs and Energy Requirements

Table 7.2 provides additional cost and energy use information, including annual O&M costs, annualized capital costs, total annualized and present value costs, and energy requirements for the DW Desal approach.

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)	$18.4 M
PV Costs (30 years) ($M)[1]	$413 M
Energy Use (MWH/MG)[2]	12.4
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.	

If an in-lieu component is linked to the DW Desal approach, then additional O&M and other costs and energy requirements would be incurred, as outlined in Building Block summary paper #1.

6. Water Supply and Yield Implications

Table 7.3 provides the water supply production and yield estimates and for the DW Desal option, indicating that the availability of this supply of 3 MGD (~1,100 MG annually), in combination with conservation Program C addresses most anticipated future demands for SCWD (resulting in limited shortfalls). The acquisition of DW Desal waters also offers an opportunity to provide in-lieu recharge for up to half of SVWD and SqCWD winter demands.

Given that the total annualized cost of the DW Desal option of $18.3 Million, and an annual supply production of approximately 1,100 MG, the annualized unit cost of production amounts to approximately $16,640 per MG.

Table 7.3. DW Desal: Estimated yields, peak season shortages, and in-lieu demands met for SVWD and SqCWD (MG)

	Santa Cruz yields		Remaining peak-season shortages (% shortfall)		Average annual combined SV and SqC demand served in-lieu of groundwater draw (% met)	Average annual separate SV and SqC demand served in-lieu of groundwater draw
	Worst-year yield	Average-year yield	Worst-year	Average-year		
DW Desal	710	330	400 (21%)	10 (<1%)	770 (50%)	230 to SV 540 to SqC

Note that the yield estimates for DW Desal reflect an assumption that Program C Rec is also part of the Portfolio with DW Desal, such that DW some yield is also attributed to the water savings associated with conservation component.[3]

If an in-lieu component is linked to the DW Desal approach, then additional water supply production and yields would be realized, as outlined in Building Block summary paper #1.

7. Timeline for Implementation and Realizing Water Supply Benefits

The timeline for the DW Desal approach may be up to 7 years (although the developer states that delivery could begin by 2016). Timeline elements consist of the following:

- Permitting, other regulatory approvals, and construction of DW desalination facilities (intake, outfall, treatment process, and all related facilities) to develop the desalinated water for distribution to its investor/customers.

- Permitting, right of way acquisition, and construction of pipelines and pumping facilities to convey DW Desal water from Monterey to Santa Cruz (including the possibility of jointly-developed and shared pipeline facilities to the region).

8. Key Institutional Issues to Resolve

The City, and/or project developers, need to resolve several critical institutional issues in order for a DW Desal program to proceed as envisioned here. Among these are the following:

[3] Please recall that "yields" refer to the ability of a portfolio to meet peak season gaps between supply and demand. Based on *Confluence* model runs reflecting climate change and DFG-5 fish flow requirements, the worst-year peak season shortage amounts to 1,110 MG, given the existing SCWD system portfolio. The average-year peak season shortage is 340 MG. Thus, the maximum yields of a portfolio are 1110 MG and 340 MG for worst and average years, respectively. Program C Rec provides yields of 130 MG and 100 MG in the worst year and average years, respectively.

- Regulatory approval and permits, from the California Coastal Commission and other federal, state and local entities for development of the seawater desalination facilities and all necessary pipelines, and for any mandated or desired environmental and carbon footprint mitigation or restoration/offsets.

- Public and political acceptability of desalinated water as a part of the City's water supply portfolio.

- Agreements with SqCWD, other potential regional DW Desal investors, and perhaps the County, regarding the sharing of major portions of the overall conveyance facilities, including cost and risk sharing and other facets.

- If an in-lieu component is linked to the DW Desal approach, then all the institutional issues associated with that approach (including the need for clear agreements between the City and SVWD and SqCWD on water-, risk- and cost-sharing) would need to be realized, as outlined in Building Block summary paper #1.

9. Other Key Questions, Issues, and Observations

- Given the ability of the DW Desal option (when coupled with Program C Rec) to meet most of SCWD's anticipated supply needs, there is limited need for return flows from a potential in-lieu recharge component. Excess DW Desal water might thus be sold to SVWD and SqCWD, though the viability of water sales may be limited by whether the price set by the City is competitive with other supply options the Districts are considering.

- If and when desal water is no longer needed, or needed in lesser quantities, it may be relatively easy to sell off shares and thus reduce the potential level of stranded assets.

- The potential use of desalinated seawater provides a production supply that is largely independent of rainfall.