Portfolio 4: Aquifer Storage and Recovery (ASR) Accelerated with Deepwater Desal, with Deepwater Desal as a Fallback

Portfolio 4 includes conservation Program CRec (CA-03), coupled with the tapping of excess winter flows from the San Lorenzo River (SLR) to supply efforts to implement ASR in the regional aquifers underlying the Scotts Valley Water District (SVWD) and Soquel Creek Water District (SqCWD). In addition, water purchased and piped from the Deepwater Desal (DW Desal) project would be used to accelerate aquifer recharge and supplement local supplies during the ASR piloting and development phases. By providing potable water for immediate needs and for ASR, this portfolio seeks to accelerate the recovery of regional aquifers by actively recharging the groundwater basins while concurrently avoiding interim water shortages and curtailments. If successful, the active aquifer recharge would enable extraction of groundwater in future dry years at levels needed to meet demands in Santa Cruz.

If initial efforts to implement ASR indicate that the approach will not provide adequate aquifer recharge, storage, and recovery, then the City of Santa Cruz (City) moves ahead by continuing to purchase DW Desal allotments to directly meet both City demands and, as feasible, regional (SVWD and SqCWD) demands.

1. Portfolio Description

In addition to implementing conservation program CRec to accomplish water demand savings in the Santa Cruz Water Department (SCWD) service area, this portfolio includes:

- Plan A, the exploration and potentially successful large-scale implementation of ASR, relying on winter flows to serve as the water source for active aquifer recharge. In addition, water purchased from the DW Desal project would be used to meet City demands during the interim period while ASR is being piloted and fully developed, and to accelerate in-lieu and active aquifer recharge as ASR proceeds.

- Plan B, to be implemented if Plan A appears to be ineffective or insufficient, entails abandoning ASR and instead relying long-term on DW Desal water to meet City demands and, as feasible, regional demands through interties to SVWD and SqCWD. This provision of DW Desal water to neighboring communities will help meet their current demands and, thereby, also provide for in-lieu recharge of regional aquifers.

- The trigger for moving from Plan A to Plan B is: If after 15 years of implementing ASR the City is not able to reliably withdraw at least 70% of the water it puts into the ground during a normal recharge year for use as a drought supply, then switch to using Deepwater Desal as Santa Cruz's main drought supply.

2. Summary of Costs and Yields

Tables 4-1 and 4-2 provide a summary of key water supply and cost estimates for Plan A and Plan B, respectively. Key observations from these tables include:

- If ASR can be implemented successfully and functions as required, and when coupled with DW Desal water and water demand savings from Program CRec as part of Plan A, then the expected yields are sufficient to meet all SCWD service area demands. No shortages or curtailments are anticipated under climate change and DFG-5 fish flow requirements, as modeled, even during the interim period when ASR is being tested and potentially developed.

- If ASR cannot be implemented or does not perform as required, then under Plan B, DW Desal water (e.g., at 1,100 million gallons per year) can be used to meet all SCWD demands such that there are no anticipated shortages or curtailments for SCWD.

- In addition, under Plan B, some of the reliably available DW Desal water can be provided to SVWD and SqCWD. This would provide in-lieu recharge of up to 950 mg per year on average, by meeting up to 62% of the combined demands in SVWD and SqCWD (depending on the total quantity of DW Desal water acquired by SCWD).

3. Project Components: Infrastructure and other Physical Needs

Key infrastructure and other physical asset needs required to implement this portfolio include the following:

Portfolio 4A: ASR Using Winter Flows, Coupled with DW Desal, and Combined with Program C Rec:

ASR Components:

- Turbidity control facilities at Felton Diversion (Ranney Collectors).
- Major upgrades to City distribution system for water transfer to SqCWD and SVWD.
- Eight new injection/extraction wells, four in SqCWD and 4 in SVWD.
- Tait Street improvements (for larger diversions).
- Graham Hill WTP expansion and improvements (to develop potable quality water for ASR).
- Land acquisition for well sites and pipelines (not included in cost estimates).

DW Desal Components: In order to acquire water from the DW Desal facility, the facility itself would need to be permitted and built, including the following infrastructure:

- Deepwater marine intake and pipeline or tunnel to shore.
- Brine storage and brine disposal pipeline.

- Onshore pumping station.
- Pump stations and pipelines for distribution/transmission.
- Desalination facility (e.g., RO and other desal plant components).
- For SCWD itself, there would need to be investment in improvements to the City distribution system to transfer water from SqCWD (assuming DW Desal water will already have pipeline access to SqCWD).

Portfolio 4B: ASR Abandoned; and DW Desal Used for Santa Cruz and Regional Demands and In-Lieu Recharge, Coupled with Program C Rec

- No additional infrastructure: DW Desal water infrastructure and agreements are already in place from Plan A.

4. Institutional Arrangements Required for Implementation

Key institutional arrangements and related agreements and permits required to implement this portfolio include the following:

- Permits and rights of way, and environmental and other reviews, for all pipeline, well, and other infrastructure improvements (including development of DW Desal facility in Monterey).
- Planning document development and processes related to above.
- Interagency agreements between SCWD and the regional water districts (SVWD and SqCWD) for ASR development and agreed upon extraction levels and conditions.
- Interagency agreements between SCWD and regional water districts for ASR and DW Desal cost- and risk-sharing (and/or water purchasing, water-sharing).
- Change in water rights to enable change in place of use
- Purchase agreement for shares of DW Desal facility production (e.g., for about 1,100 mg per year), and similar agreements to sell of shares of DW Desal water if ASR works and SCWD no longer wants or needs its full allotment from DW Desal.

5. Implementation Schedule/Timetable

Portfolio 4A: ASR Using Winter Flows, Coupled with DW Desal, Coupled with Program C Rec

- For ASR Component:
    - Planning, Permitting, and Interagency Agreements - 2 years
    - Higher-Level Feasibility Analyses – 0.5 - 2 years (concurrent with permitting)
    - Pilot ASR Testing – 2 - 4 years (some overlap with implementation of wells)
    - Procurement of ASR Facilities Properties / ROW & Design - 1 - 2 years (could stretch out if wells are developed sequentially)
    - Bidding, Construction, and Startup – 2 - 3 years
    - Total Duration of Estimated Implementation Schedule – 7 - 11 years
- For DW Desal component:
    - Planning, Permitting, and Interagency Agreements 3 years
    - Preliminary and Detailed Design 2 years
    - Bidding, Construction, and Startup 2 years
    - Total Duration of Estimated Implementation Schedule -- 7 years (may be pursued concurrently with ASR-related activities).

<u>Portfolio 4B: ASR Abandoned; and DW Desal Used for Regional Santa Cruz and Regional Demands and In-Lieu Recharge, Coupled with Program C Rec</u>

No new infrastructure or agreements required. ASR is abandoned. DW Desal is already in place, so no timeline applicable for implementation.

6. Key Risks, Uncertainties, and Key Questions to be Addressed

- <u>Will ASR work as required?</u>
    - Will winter flows and available treatment provide enough water for recharge at target levels? What if there is a prolonged drought during the initial recharge years?
    - Can recharge occur at anticipated rates at well sites (even if water is available)?
    - Will recharged water create adverse water quality conditions in the aquifer?
    - How much recharged water will be unrecoverable due to hydraulic loss? Will this loss percentage increase appreciably as recharge levels increase?

- Will enough water be stored by the time extractions are needed to meet dry year demands?
- Can water rights be modified to enable change in place of use?
- How will SqCWD and SC County control private well withdrawals from recharged aquifers?
- Can property rights be acquired across the river from Felton to construct Ranney collectors? Can Ranney collectors be placed in that setting and will they function as required?
- Can extracted water be treated and blended with other supplies to meet dry year needs, and maintain suitable potable water quality? Will Ranney collectors worked as required?
- Are there environmental considerations that may preclude, delay, and/or require expensive mitigation associated with any of the added infrastructure?
- During the interim period, while ASR is being planned/piloted and developed, will DW Desal water be available to help meet otherwise unmet demands for SCWD?

- <u>Can suitable institutional arrangements be developed between the City and SVWD and SqCWD (and others?)?</u>
  - For cost and risk sharing (and/or water purchase agreements and water sharing) for ASR and for DW Desal
  - For land purchases, leases, and rights of way, as needed for pipelines and other required infrastructure.
  - For environmental reviews, approvals, and any necessary mitigation associated with added pipelines and other infrastructure requirements.
  - For extraction from regional aquifers and delivery to SCWD, in suitable quantities, in times of need?
  - How will SqCWD and SC County control private well withdrawals from recharged aquifers?

- <u>Will the DW Desal project actually get permitted, funded and built?</u>
  - Can a reasonable water purchase agreement for shares of DW Desal water be negotiated?

- Can rights of way and other requirements, included environmental permits, enable pipeline to be developed to deliver DW Desal water to the region and SCWD?
- Might there be delays and significant additional costs associated with public support and/or regulatory approvals for the DW Desal project, or for acquiring desal water in Santa Cruz?
- Will energy requirements and greenhouse gas emissions be minimized and effectively offset?

7. Potential Stranded Assets and other Adverse Consequences

- ASR wells and connecting pipelines may be abandoned if Plan A does not perform as required.
- If ASR functions as required, then the City may need or wish to sell some portion (or all) of its DW Desal water allocation.

8. Potential Ancillary Benefits to the City and Region

- Aquifer recharge, whether attained actively through ASR or passively through DW Desal-enabled in-lieu recharge, may provide ancillary benefits by helping to impede seawater intrusion, and/or by providing additional baseflow to local streams.
- Regional collaboration to jointly address water supply challenges – if successful -- may provide a range of long-term benefits and efficiencies.

Table 4-1: Portfolio 4/Plan A: ASR using Winter Flows, Coupled with DW Desal, plus Program C Rec					
	Estimates	**Component 1: Program C Rec**	**Component 2: ASR using SLR winter flows**	**Component 3: Deepwater Desal**	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$95 M	$102 M	$197 M+
B	Annual O&M costs ($M/yr)	n/a	$ 3.7 M	$4.0 M	$7.7 M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$11.3 M	$12.2 M	$24.6 M
D	PV Costs (30 years) ($M)	$23 M	$256 M	$280 M	$559 M
E	Production Supply (mgy)	173 mgy[2]	560 mgy	1,095 mgy	1,828 mgy
F	Average Year peak season Yield (mg)	100 mg	240 mg	n/a[3]	340 mg
G	Worst yr. peak season Yield (mg)	130 mg	980 mg	n/a[3]	1,110 mg
H	Energy Use (MW/MG)	(1.6)	2.1	7.5	[5.0]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$20,179	$11,142	[$13,474]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$21,815	$12,203	[$14,778]
K	Average SV & SqCWD demand served (mg and %)	n/a	n/a	1,530 mg (100%)	1,530 mg (100%)

Table 4-2: Portfolio 4/Plan B: ASR abandoned; and DW Desal Used for Santa Cruz and Regional Demands and In-Lieu Recharge, plus Program C Rec				
	Estimates	**Component 1: Program C Rec**	**Component 2: Deepwater Desal for Regional Use**	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$102 M	$102 M+
B	Annual O&M costs ($M/yr)	n/a	$4.0 M	$4.0 M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$12.2 M	$13.3 M
D	PV Costs (30 years) ($M)	$23 M	$280 M	$303 M
E	Production Supply (mgy)	173 mgy[2]	1,095 mgy	1,268 mgy
F	Average Year peak season Yield (mg)	100 mg	240 mg	340 mg
G	Worst year peak season yield (mg)	130 mg	980 mg	1,110 mg
H	Energy Use (MW/MG)	(1.6)	7.5	[6.3]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$11,142	[$10,513]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$12,203	[$11,671]
K	Average SV & SqCWD demand served (mg and %)	n/a	950 mg (62%)	950 mg (62%)

[1] 25-year average annual cost to utility and customers, omitting administrative costs borne by the Water Department

[2] Average annual water savings over 25 years; maximum savings of 220 mg attained in 2030

[3] If ASR works as required, then all demands are met and DW Desal does not contribute to "yields" as defined here. However, absent ASR, DW Desal does meet all demands and provides yields of at least 240 mg and 980 mg in average and worst year peak seasons, respectively.