Portfolio 2: Aquifer Storage and Recovery (ASR), with Direct Potable Reuse as Fallback

Portfolio 2 is a Santa Cruz centric ASR program that supports regional aquifer restoration only in the event that Plan B is exercised. It 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). By providing potable water for ASR in the regional aquifers, this portfolio seeks to actively recharge the groundwater basins. If successful, this active recharge would enable extraction of groundwater in future dry years at levels needed to meet demands in Santa Cruz. If initial efforts to explore ASR indicate that the approach will not provide adequate aquifer recharge, storage, and recovery, then the City of Santa Cruz (City) moves ahead with purified recycled water to meet both City and 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 hoped for success of large-scale implementation of ASR, relying on winter flows to serve as the water source for active aquifer recharge. No new interim supplies are tapped during the pilot testing and potential development of ASR, resulting in periodic shortages and curtailments. While recharge would largely be in aquifers underlying the service areas and mixed with the groundwater resources of the SVWD and SqCWD, Plan A would not include any attempt at a larger regional aquifer restoration strategy. I.e., water recharged to the aquifers would be available to meet City demand only.

- Plan B, to be implemented if Plan A appears to be ineffective or insufficient, entails full or partial abandonment of ASR and instead using purified recycled water to implement Direct Potable Reuse (DPR). DPR would be used to meet City needs, and also to help meet regional demands through interties to SVWD and SqCWD. This provision of purified recycled 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, within 6 years of initiating pilot testing work on ASR it cannot be demonstrated that at least 30% of the required extraction and delivery of an estimated 500 mgy can (or could) be reliably produced through injection and recovery, then switch to Plan B.

2. Summary of Costs and Yields

Tables 2-1 and 2-2 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 water demand savings from Program CRec in Plan A, then the expected yields are sufficient to meet all anticipated SCWD service area demands. Once ASR is fully operational and aquifers sufficiently restored to support periodic extractions to meet SCWD dry year needs, then no shortages or curtailments are anticipated under climate change and DFG-5 fish flow requirements, as modeled.

- During the interim period while ASR is being designed, piloted and permitted – and later while it is being fully developed – there are expected to be periodic shortages (e.g., in the event of drought) that are addressed by curtailments. These shortages and curtailments are expected to occur at the frequency and severity revealed in prior *Confluence* model results for climate change and DFG-5, for the existing water system portfolio (see Table 2-3).

    - In the interim period (and longer, if ASR is not successful), peak season shortages for SCWD customers are expected to result in curtailments that exceed 15% in 49% of future years.

    - Peak season shortages are expected to require curtailments that exceed 25% in 37% of future years, and shortages are estimated to require curtailments exceeding 50% in 6% of future years.

    - When reviewing the results in Tables 2-1 and 2-2, recall that "Yield" estimates reflect the amount by which SCWD peak-season shortages are reduced by each portfolio. The maximum (worst year) peak season shortage from the *Confluence* modeling is 1,110 mg (and average year peak season shortage is 340 mg).

- If ASR cannot be implemented or does not perform as required, then under Plan B, DPR can be used to meet all SCWD demands (no anticipated shortages or curtailments for the SCWD).

    - At this point, a larger regional aquifer restoration strategy could also be undertaken with this additional DPR resource.

    - Sharing the DPR supplies with neighboring districts will provide in-lieu recharge of 870 mg in an average year, by meeting 57% of the combined demands in SVWD and SqCWD.

- The costs of Plan A (ASR) and Plan B (DPR) are reasonably similar, with estimated capital costs of $95 million and $114 million, respectively (and total annualized costs of $12.4 million and $14.6 million per year, respectively). Compared to Plan A, Plan B produces nearly twice as much water, relies on a reliable climate-independent source, uses more energy, and faces different risks and uncertainties in terms of its potential success.

3. Project Components: Infrastructure and other Physical Needs

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

- Portfolio 2A: ASR Using Winter Flows, Coupled with Program C Rec
    - 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 four 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).
- Portfolio 2B: DPR for Regional Demands and In-Lieu Recharge + Program C Rec
    - Complete Advanced Treatment (CAT) facilities to produce purified recycled water.
    - New line maintenance facility to free space at WWTP for new treatment facilities.
    - Pump station and pipeline(s) to convey water to WTP.
    - Assumes Tait St. and WTP improvements completed as part of Plan A.

4. Institutional Arrangements Required for Implementation

Key institutional agreements 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
- Planning document development and processes related to above.
- Interagency agreements for ASR development and agreed upon extraction levels and conditions.
- Interagency agreements for ASR and/or DPR cost- and risk-sharing (and/or water purchasing, water-sharing)
- Change in water rights to enable change in place of use

5. Implementation Schedule/Timetable

- Portfolio 2A: ASR Using Winter Flows, Coupled with Program C Rec (update for pilot testing, per PWR)
    - 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
- Portfolio 2B: DPR for Regional Demands and In-Lieu Recharge + Program C Rec
    - Planning, Permitting, and Interagency Agreements - 5 years
    - Preliminary and Detailed Design - 2 years
    - Bidding, Construction, and Startup - 2 years
    - Total Duration of Estimated Implementation Schedule - 9 years.
    - This total duration for Portfolio 2B probably can be accelerated considerably in a period of extended drought as regulatory reviews and permitting are expedited. Also some steps may be pursued concurrently rather than sequentially.
    - Also, advance action (i.e., while Plan A is being explored) to address the initial planning and preliminary design steps can potentially reduce timeline for implementation (bidding, construction, and startup) to 2 years.

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

- Will ASR work as required?
    - 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 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?
- 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?
- Are there environmental considerations that may preclude, delay, and/or require expensive mitigation associated with any of the added infrastructure?

- Can suitable institutional arrangements be developed between the City and SVWD and SqCWD (and others)?
  - For cost and risk sharing (and/or water purchase agreements and water sharing)
  - 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?
- Will DPR obtain public support and regulatory approval, in SCWD, and in SVWD and SqCWD?
  - Might there be delays associated with public support or regulatory approvals?

- Will additional treatment or other investments need to be made in order to obtain regulatory approvals (and/or public acceptance)?

- Will the treatment processes and delivery systems work as planned?

7. Potential Stranded Assets and other Adverse Consequences

If ASR fails to operate as required, then there likely will be stranded assets in the form of some recharge/extraction wells and associated pipelines, pumps, etc. (i.e., abandoned ASR facilities)

8. Potential Ancillary Benefits to the City and Region

- Aquifer recharge, whether attained actively through ASR or passively through DPR-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 2-1: Portfolio 2/Plan A: ASR using Winter Flows, Coupled with Program C Rec				
	Estimates	**Component 1: Program C Rec**	**Component 2: ASR using SLR winter flows**	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$95 M	$95 M+
B	Annual O&M costs ($M/yr)	n/a	$ 3.7 M	$3.7 M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$11.3 M	$12.4 M
D	PV Costs (30 years) ($M)	$23 M	$256 M	$279 M
E	Production Supply (mgy)	173 mgy[2]	560 mgy	733 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)	2.1	[1.2]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$20,179	[$16,958]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$21,815	[$18,626]
K	Average SV & SqCWD demand served (mg and %)	n/a	n/a	0 mg

Table 2-2: Portfolio 2/Plan B: DPR for Regional demands and In-Lieu Recharge + Program C Rec				
	Estimates	**Component 1: Program C Rec**	**Component 2: DPR for City and Regional Use**	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$114 M	$114 M+
B	Annual O&M costs ($M/yr)	n/a	$4.4 M	$4.4M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$13.5 M	$14.6 M
D	PV Costs (30 years) ($M)	$23 M	$307 M	$330 M
E	Production Supply (mgy)	173 mgy[2]	1,715 mgy	1,888 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)	6.4	[5.7]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$7,872	[$7,749]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$8,543	[$8,520]
K	Average SV & SqCWD demand served (mg and %)	n/a	870 mg (57%)	870 mg (57%)

[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

Table 2-3: Probabilities and projected peak season supply shortfalls of in any year: Climate change, DFG-5, and revised interim mid-range demand forecast

Shortage (mg)	Shortage %	Probability
> 950 mg	>50%	6%
480-950 mg	25% to 50%	31%
290-450 mg	15% to 25%	12%
100-290mg	5% to 15%	6%
0-100 mg	<5%	45%