Portfolio 1: In-lieu Aquifer Recharge Using Winter Flows

Portfolio 1 includes conservation Program CRec (CA-03), coupled with the tapping of excess winter flows from the San Lorenzo River (SLR) to enable in-lieu recharge of regional aquifers underlying the Scotts Valley Water District (SVWD) and Soquel Creek Water District (SqCWD). By providing potable water to SVWD and SqCWD, these districts can rest their aquifers (i.e., reduce groundwater extraction) and, thus, provide in-lieu recharge. If adequate aquifer recharge and storage can be accomplished in this manner, then the City of Santa Cruz (City) can eventually receive groundwater back from SVWD and SqCWD in times of water need.

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 use of in-lieu recharge, relying on winter flows to meet demands in areas now relying on groundwater. Excess water from Loch Lomond might also be used to support in-lieu recharge, when that water is available. Once aquifers are recovered sufficiently, using strategies outlined in the recent Water Transfer report, a yet to be fully quantified amount of additional water using infrastructure installed as part of the in lieu service program would be available to Santa Cruz to reduce its shortages.

- Plan B, to be implemented if Plan A appears to be ineffective or insufficient, entails adding Indirect Potable Reuse (IPR) in the form of purified recycled water from the City being piped up to Loch Lomond (i.e., reservoir augmentation). The IPR supply may supplement the amount of water available to help enhance the level of in-lieu recharge by meeting demands in SVWD and SqCWD.

- The trigger for moving from Plan A to Plan B is: If, after initiation of in lieu recharge Santa Cruz experiences three or more years of curtailments greater than 15% during any six year period, then IPR-based reservoir augmentation is developed.

There are two variations on how Plans A and B might be implemented. One variation entails maintaining a 1000 MG reserve in Loch Lomond as insurance against future severe or prolonged drought events (i.e., drawing down Loch Lomond according to the current operating rule curve). This approach is referred to as Plan A-1 and Plan B-1. The second variation includes reducing this reserve to 500 mg (i.e., revising the Loch Lomond operating rule curve), thereby enabling greater amounts of in-lieu recharge at SVWD and SqCWD (Plans A-2 and B-2).

2. Summary of Costs and Yields (Plans A-1 and B-1)

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

- Relying solely on Plan A, in-lieu recharge from winter flows, and water demand savings from Program CRec, the total amount of average annual in-lieu recharge (reduced groundwater extraction) amounts to 490 mg per year. This is a reduction of groundwater extractions of 32% for an average year.

- For the SCWD service area, Plan A leaves sizable gaps between supply and demand, with peak season yields well below the amount required to avoid curtailments:

    - Worst year peak season yields of 140 mg result in a remaining gap of 970 mg (requiring curtailments of 54%).[1]

    - Average year peak season yields of 110 mg result in a remaining gap of 230 mg (requiring curtailments averaging 13%)

    - If, during the first six years, there are three or more curtailments of 15% or greater, switch to Plan B.

- Adding Plan B's IPR-based reservoir augmentation to further meet SVWD and SqCWD demands will significantly increase in-lieu recharge. The addition of IPR enables SCWD to meet 100% of SVWD and SqCWD demands, with resulting in-lieu recharge amounting to 1,530 mg annually.

- For SCWD, Plan B's use of IPR also fully meets the City's service area's needs (peak season yields are sufficient to fill the estimated supply-demand gap across all years). This eliminates the expected need for curtailments.

- "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).

    - Yields under Plan A-1 or Plan A-2 do not fully address either average or worst year peak season demands, resulting in the need for curtailments as described above.

    - Yields under Plan B (adding IPR reservoir augmentation to the portfolio) do fully meet both average and worst year needs for the SCWD service area, resulting in no anticipated need for curtailments.

[1] 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.

- The capital cost of Plan A amounts to $232 million, with a total annualized cost of 18.6 million per year. Under Plan B, adding reservoir augmentation though the use of purified recycled water (IPR) roughly doubles the capital costs, to $473 million, and increases the total annualized cost to about $45 million per year.

3. Project Components: Infrastructure and other Physical Needs

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

- 1A-1 and 1A-2: In Lieu Recharge Using Winter Flows
  - Two pipelines connecting Felton Pump Station to Loch Lomond
  - Pump station plus intertie to Scott's Valley
  - Tait Street improvements (for larger diversions)
  - Graham Hill WTP expansion and improvements
- 1B: In-lieu Using Winter Flows, Coupled with IPR for Reservoir Augmentation, plus Program C Rec
  - Treatment 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 Loch Lomond.
  - Assumes Tait St. and WTP improvements completed in Phase 1A.

4. Institutional Arrangements Required for Implementation

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

- Interagency agreements related to water purchase agreements and/or cost- and risk-sharing arrangements between SCWD and SVWD and SqCWD.
- Regulatory approvals for possible use of purified recycled water for IPR-based reservoir augmentation.
- Modifying the City water rights to allow change in place-of-use.

- Achieve public buy-in for combining purified water with the City's traditional raw water sources.

- Rights of way, environmental review clearance, and other requirements associated with new pipelines and other infrastructure improvements.

5. Implementation Schedule/Timetable

- 1A-1 and 1A-2: In-Lieu Recharge Using Winter Flows, Coupled with Program C Rec
  - Planning, Permitting, and Interagency Agreements - 4 years
  - Preliminary and Detailed Design - 2 years
  - Bidding, Construction, and Startup - 2 years
  - Total Duration of Estimated Implementation Schedule - 8 years

- 1B: In-lieu Using Winter Flows, Combined with IPR for Reservoir Augmentation, and Including Program C Rec
  - Planning, Permitting, and Interagency Agreements - 4 years
  - Preliminary and Detailed Design - 2 years
  - Bidding, Construction, and Startup - 2 years
  - Total Duration of Estimated Implementation Schedule - 8 years.
  - If steps taken initially (i.e., during Plan A startup period) to plan, permit and design IPR for reservoir augmentation, then remaining implementation (bidding, construction and startup) of Plan B may be reduced to the final 2-year period.

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

- Will SVWD and/or SqCWD be willing to forge a fair and functional agreement with the City to share water, costs, and risks in an equitable manner?

- Will winter flows be available at the levels necessary to provide water to neighboring systems?

- Can winter flows be readily and cost-effectively brought to potable standards for delivery to neighboring systems?

- Will the blending of surface waters (winter flows) with groundwater cause water quality challenges in SVWD or SqCWD?

- How much risk is the City bearing if it modifies the Loch Lomond operating rule curve to enable a 50% reduction in reservoir reserves?

- Will regulators from DPH/DDW issue permits to implement reservoir augmentation through the use of CAT-purified recycled water (i.e., an IPR approach), especially given the likely requirement to demonstrate adequate mixing with surface water? This mixing requirement is likely to be more challenging if SCWD drains the lake to 500 mg (versus 1000 mg under the current operating rule).

- Can City water rights be modified to allow change in place-of-use?

- Can public buy-in be achieved for combining purified recycled water with the City's traditional raw water sources?

- Obtaining easements and rights-of-way for new pipelines and other agency approvals -- Will Caltrans allow the City to install pipelines within the ROWs for state highways? Will there be environmental concerns to be mitigated or that may impede the project?

- Will City need an NDPES permit to discharge purified recycled water into the Loch since some of the water eventually will discharge to Newell Creek?

- How will SqCWD and the County control private well withdrawals from recharged aquifers, to ensure that in-lieu recharge efforts are not offset by private pumping?

7. Potential Stranded Assets and other Adverse Consequences

- No stranded assets identified.

8. Potential Ancillary Benefits to the City and Region

- In lieu recharge eventually should help control sea water intrusion into the Purisima aquifer, as well as help restore other regional aquifers (e.g., underlying SVWD). It may also enable base groundwater-fed baseflow to some hydraulically connected regional streams

9. Key Findings Related to Plan A-2

A modification to this portfolio entails examining how reducing the reserve in Loch Lomond from 1000 mg to 500 mg (i.e., changing the Loch Lomond operating rule curve) would impact the key findings related to this Portfolio. Overall results of this modification are summarized in Table 1-3, and include the following key observations:

- Compared to Plan A-1, the reduction in Loch Lomond reserve under Plan A-2 results in increased in-lieu recharge of 260 mg in an average year (increasing from 490 mg to 750 mg).
- However, by further reducing Loch Lomond reserves, this option places increased risk of shortfalls on the City and the rest of the SCWD service area.
    - Worst year peak season yields of 140 mg result in a remaining gap of 970 mg (requiring curtailments of 54%).
    - Average year peak season yields of 110 mg result in a remaining gap of 230 mg (requiring curtailments averaging 13%)
    - If, during the first six years, there are three or more curtailments of 15% or greater, switch to Plan B.
- Plan B results are not impacted by the potential change in reserve levels at Loch Lomond.

Table 1-1: Portfolio 1/Plan A-1: In-Lieu Recharge Using Winter Flows (w/ Current Loch Operating Rule – Reserve of 1000 MG), Coupled with Program C Rec

	Estimates	Component 1: Program C Rec	Component 2: In-lieu Recharge	Totals [weighted average]
A	Capital (upfront) costs ($M)	n/a	$232 M	$232 M +
B	Annual O&M costs ($M/yr)	n/a	$2.1 M	$2.1 M +
C	Total Annualized Cost ($M/Yr)	$1.1 M[2]	$17.5 M	$18.6 M
D	PV Costs (30 years) ($M)	$23 M	$401 M	$424 M
E	Production Supply (mgy)	173 mgy[3]	500 mgy	673 mgy
F	Average Year peak season Yield (mg)	100 mg	10 mg	110 mg
G	Worst year peak season Yield (mg)	130 mg	10 mg	140 mg
H	Energy Use (MW/MG)	(1.6)	8.6	[$7.4]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$35,000	[$27,682]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$38,274	[$30,569]
K	Average SV & SqCWD demand served (mg and %)	n/a	490 mg (32%)	490 mg (32%)

[2] 25-year average annual cost to utility and customers, omitting administrative costs borne by the Water Department
[3] Average annual water savings over 25 years; maximum savings of 220 mg attained in 2030

Table 1-2: Portfolio 1/Plan B (B1 = B2): In-lieu using winter flows, coupled with IPR for Reservoir Augmentation, plus Program C Rec

	Estimates	Component 1: Program C Rec	Component 2: In-lieu recharge using SLR winter flows (A-1)	Component 3: IPR for Reservoir Augmentation	Totals [weighted average]
A	Capital (upfront) costs ($M)	n/a	$232 M	$241 M	$473 M +
B	Annual O&M costs ($M/yr)	n/a	$2.1M	$7.0 M	$9.1 M +
C	Total Annualized Cost ($M/Yr)	$1.1 M[2]	$17.5 M	$26.3 M	$44.9 M
D	PV Costs (30 years) ($M)	$23 M	$401 M	$598 M	$1,022 M
E	Production Supply (mgy)	173 mg[3]	500 mgy	1,715 mgy	2,388 mgy
F	Average Year peak season Yield (mg)	100 mg	10 mg	230 mg	340 mg
G	Worst year peak season Yield (mg)	130 mg	10 mg	970 mg	1,110 mg
H	Energy Use (MW/MG)	(1.6)	8.6	10.2	[9.0]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$35,000	$26,181	[$26,604]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$38,274	$16,640	[$20,566]
K	Average SV & SqCWD demand served (mg and %)	n/a	490 mg (32%)	1,040 mg (68%)	1,530 mg (100%)

Table 1-3. Portfolio 1/Plan A-2: In-Lieu Recharge Using Winter Flows (w/ Modified Loch Operating Rule – Reserve of 500 MG), Plus Program C Rec

	Estimates	Component 1: Program C Rec	Component 2: In-lieu Recharge	Totals [weighted average]
A	Capital (upfront) costs ($M)	n/a	$232 M	$232 M +
B	Annual O&M costs ($M/yr)	n/a	$2.1 M	$2.1 M +
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$17.5 M	$18.6 M
D	PV Costs (30 years) ($M)	$23 M	$401 M	$424 M
E	Production Supply (mgy)	173 mgy[2]	500 mgy	673 mgy
F	Average Year peak season Yield (mg)	100 mg	10 mg	110 mg
G	Worst year peak season yield (mg)	130 mg	10 mg	140 mg
H	Energy Use (MW/MG)	(1.6)	8.6	[7.4]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$35,000	[$27,682]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$38,274	[$30,569]
K	Average SV & SqCWD demand served (mg and %)	n/a	~750 mg (49%)	750 mg (49%)