Dear WSAC Members,
I am submitting this portfolio with input from Erica Stanojevic and members of Desal Alternatives. I am submitting this document in addition to the submission from the group, Sid, Mark, Greg, and myself. The consensus reached by the four of us did not encompass everything that I wanted the WSAC to consider. Hence I am submitting this separately.
-Rick Longinotti

Aquifer Restoration Using Surface Water

Brief Description:
This portfolio creates a minimum of 3 billion gallons in additional storage through in lieu recharge, supplemented by direct injection.
This recharge strategy can be continued after the goal of 3 billion storage is reached if

- more storage is needed in order to cope with more severe climate change than is currently modeled[1]
- the goal is to provide higher base flow in area streams to improve fish habitat

Assumption: The City will adopt the Master Conservation Plan, including additional measures to be recommended by the WSAC.

Level 1 Measures
Level 1 measures mimic Building Block 1, adding injection wells in Scotts Valley, and the testing of injection at existing City production wells in Live Oak.
Level 1 is estimated to achieve the same reliability as estimated in Building Block 1, which is sized to resolve all shortfalls except a 17% shortfall in a worst-case year. This remaining shortfall is not due to inadequate storage, but due to infrastructure constraints. It could be eliminated with larger capacity wells and interconnects. Or it may be resolved with the new pipeline from Felton to Loch Lomond, modification of "first flush" operations, etc.

NOTES

[1]**How much storage is available in local aquifers?** According to Pueblo (2015) "A generally accepted first-approximation method is that it is approximately equal to the amount of cumulative historical storage depletion." According to Kennedy/Jenks progress report on their groundwater model, the amount of depletion of the three aquifers in the Santa Margarita Basin is over 9 billion gallons. According to Hydrometrics, the depletion of the Purisima Aquifer is 3.3 billion gallons. That's a total of over 12 billion gallons of potential storage. For K/J report, see SVWD agenda packet 3/12/15.

Significant additional yield for Santa Cruz may result from an agreement with Soquel Creek Water District that the water transferred to the District be used in lieu of pumping from District wells that are closest to Santa Cruz (Service Area 1&2). With aquifer recovery in the vicinity of its own wells, Santa Cruz may be able to pump additional water from City wells during drought years. Due to concerns over salt water intrusion, Santa Cruz currently limits pumping to 1.1mgd during drought years, far less than the capacity of those wells.

Cost Minimization
Level 1 minimizes costs by using existing treatment plant capacity[2] and incremental improvements to the Tait river diversion capacity[3]. Excess surface water is treated and transferred to Soquel Creek District using existing interties[4] (1.5 mgd). A new intertie is built to transfer 2 mgd to Scotts Valley (1mgd to satisfy SVWD demand, and 1 mgd available for injection, should that strategy prove to work). During drought years a new pump station would send water from existing wells[5] in Soquel Creek District to Santa Cruz through existing interties (1.5mgd). New wells in Scotts Valley and new intertie would be capable of sending 2.5mgd to Santa Cruz during drought years.

This portfolio adopts the same Bld Block 1 total 4mgd transfer to Santa Cruz in drought years, but with a slight difference in allocation: 1.5mgd from Soquel District and 2.5mgd from Scotts Valley. The rationale is explained in footnote 4.

Yield to Santa Cruz before 3 billion gal storage is reached
Building Block 1 notes that "The amount of water Santa Cruz can get back and when is an administrative agreement issue and not completely a technical issue". In letters to the City, the Soquel Creek District has indicated their willingness to negotiate a return of water to Santa Cruz before groundwater levels reach their target levels.

NOTES

[2] **Capacity at Graham Hill Plant** According to the Kennedy/Jenks, *Conjunctive Use and Enhanced Aquifer Recharge Project (2011),* "In the wintertime the Graham Hill Water Treatment Plant excess capacity is 8mgd". This capacity estimate was revised downward in the *Water Transfers Final Report (2015)*, where the plant capacity is estimated at 10mgd in the winter months, partly due to taking plant components offline for maintenance, and partly due to water quality issues. According to Water Department staff, the 10mgd estimate needs to be verified, since the plant does not normally run at that rate during the winter. Staff intends to test the capacity of the plant this coming winter. In the meantime, this portfolio assumes 10mgd treatment capacity, which includes 6.5mgd base City winter demand and 3.5mgd available for transfer.

[3] **Capacity at Tait Diversion** According to the *Water Transfers Final Report,* a range of improvements are possible. *"Depending on the different potential water transfer scenarios, different levels of improvements would be required for the Tait Street Diversion. Regardless of which scenario is employed, use of lower-quality winter-time San Lorenzo River water will necessitate additional sand and silt removal, haul away and disposal as well as increased maintenance of the facility."* The cost of these improvements range from $3 million to maintain existing capacity of 7.5 mgd to $6 million to increase Tait capacity to 14mgd. (Building Block 1 estimates Tait Diversion improvements to cost $13.5million.) For purposes of Level 1, existing capacity of Tait Diversion is assumed to be adequate, given the availability of N. Coast water and the ability of Felton Diversion to supply additional water to the treatment plant. In order to use Felton Diversion for direct diversion to the treatment plant, the City's water rights application needs to be approved. This is assumed to be likely once the HCP is approved. So $3 million cost for Tait Diversion improvements is assumed.

[4] **Existing Intertie** In this portfolio, a decision is made not to upgrade the existing intertie with Soquel Creek Water District, since that upgrade is estimated to be $13 million according to Building Block 1. Rather, the intertie with Scotts Valley is up-sized for 2.5mgd (rather than the 2.0mgd proposed in Building Block 1)

[5] **Existing SqCWD wells** The *Water Transfers Final Report* indicates that existing wells are capable of providing SC with 1.5mgd*: "*With current infrastructure and the addition of a pump station at 41st Avenue, Soquel could theoretically pump 1.44 mgd to the City, or 172.8 million gallons (530 acre-feet) over a 4 month period."

Regarding Scotts Valley, John Ricker wrote, "The advantage of using the Scotts Valley aquifer for banking is that more of the water can be recovered and that it probably could be further depleted in the short term while it is filling up, without significant adverse effects." Scotts Valley General Manager, Piret Harmon, told the WSAC on June 12th that she would be willing to negotiate a transfer of water to Santa Cruz beyond whatever has been banked in the short term, so long as the net gain for the aquifer is achieved over the longer term.

Long-term Aquifer Management

Once the desired levels of aquifer recharge are reached, the amount of treated surface water delivered for injection or in lieu use will be scaled back to the level needed to "top off" aquifers following drought year withdrawals. Hence the long-term operation of the recharge strategy will require a lower level of energy use than the first stage of aquifer filling. As the potential for passive rainwater infiltration projects become clearer (e.g. results from the current Resource Conservation District study), these projects may offer a long-term sustainable path to aquifer recharge.

Costs of Level 1 Infrastructure

System Costs

- Tait Diversion improvements $3 million

Transfer Costs: Santa Cruz—Soquel Creek District

- New pump station $1.4 million[6]

Transfer Costs: Santa Cruz---Scotts Valley Water District

- Intertie $4.2 (in million dollars)
- 4-6 wells $9.4 - $14.1
- Iron & Mang. trtmt $3.1[7]
- Pump station $1.4
- Land acquisition $1.6
- Total SC-SVWD $19.7 - $24.4

Total Level 1 Costs $24.1 - $28.8 million

NOTES

[6] **Pump station** This item was overlooked by Bld. Block 1

[7] **Iron & Mg treatment** Since this is not needed for ScCWD wells, we assume half the cost listed in revised Bld Block 1.

Level 2

Level 2 measures are meant to accelerate aquifer recharge in the event that aquifer recovery rate is slower than expected at the time of this planning (e.g. a target might be set at 3 billion gallons stored within 8 years of operating transfers with both Districts.)
Some uncertainties have been identified that could result in a slower than expected rate of recharge:

- Current treatment capacity is inadequate to support adequate transfers to neighboring districts
- Injection wells testing results show them to be infeasible
- Injection wells aren't working at expected rates of recharge
- Injection wells work initially, but fouling takes one or more of them offline
- The estimate of 60% return water from the aquifers of Building Block #1 turns out to be overestimated due to higher aquifer "leakage"

The basic approach to accelerating aquifer recharge in the event of slower-than-expected results is for the City to make cost-effective choices among strategies that reduce the constraints to aquifer recharge. Some of those constraints and possible measures to address them are:

- Constraint: Treatment capacity
    - Increase capacity at Graham Hill Treatment Plant
    - Ranney Collector(s) at Felton
    - Additional small satellite treatment plant
- Constraint: Intertie capacity Santa Cruz-SqCWD
    - Increase intertie capacity
- Constraint: Injection well capacity
    - Build more injection wells
- Constraint: Water rights limitation
    - Apply for increase in water rights

In addition to the above measures, the City could also evaluate demand reduction measures that offer potential due to advances in technology and practices.

Level 3

In the event that Level 2 measures prove insufficient to provide aquifer recharge at the rates anticipated at the time of this planning, the City would evaluate the reasons for the deviation from the expected recharge. This analysis could include revision of the groundwater models, revision of stream flow projections, demand projections, etc. This would inform the City's evaluation of how and whether further investment in aquifer recharge strategies is cost-effective.

If analysis demonstrates that further investment in aquifer recharge strategies is not expected to be cost-effective or feasible in producing the desired rates of recharge, the City would conduct a review of potential water supply strategies and demand reduction strategies. The review could update any of the strategies considered by the WSAC, or new technologies that have become viable. The City and its regional partners could also employ the new powers of Regional Groundwater Sustainability Agencies to:

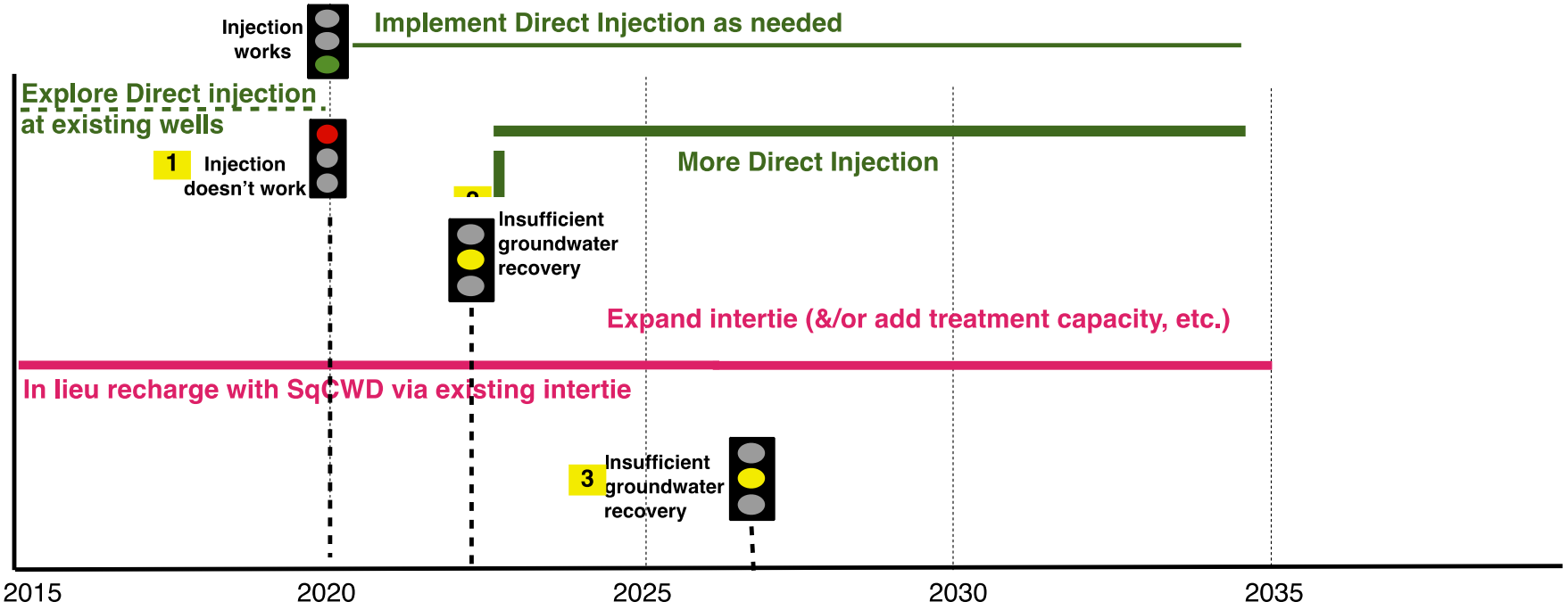
- Incentivize or require lower pumping by private wells
- Require golf courses to be supplied with recycled water
- Implement measures to reduce farmland irrigation demands on the aquifer
- Require minimum customer conservation standards for all partners using the aquifers
- Incentivize onsite water recycling[1]
- Incentivize rainwater catchment[2]

What if Bruce Daniels is right?
If climate change turns out to be worse than the current WSAC model, that would not be a reason to resort to Level 3 measures. As indicated above, a potential aquifer storage approaching 12 billion gallons should be sufficient to cope with a climate change scenario much worse than the WSAC model scenario.

[1] See San Francisco ordinance: http://sfappeal.com/2015/06/supervisors-pass-ordinance-requiring-onsite-water-recycling/
[2] "As of 2010, 43% of Australian dwellings had rainwater tanks". -Cahill, Lund, *Residential Water Conservation in Australia and California*

Sample timeline: Purisima Aquifer Recovery

Goal by 2035 = Protective levels; 1.5mgd transferred from SqC to SC in drought; higher yield from City wells in Live Oak
Interim goal = rising groundwater trend, sufficient to warrant water transfer to Santa Cruz during drought years and a total of 3 billion gallon storage in Purisima & St.Marg. basin within 8 years of operation.



e, more injection wells, etc.

3 If insufficient rate of recovery is achieved, evaluate Level 3 measures

• Proposal-wide Ratings

Adaptive Flexibility (Scalability)

Adaptive Flexibility measures the capacity of a set of blocks to respond to changing conditions, for example to higher or lower demands, to more or less impact of climate change. Adaptive flexibility enhances the ability to meet the requirements of changing circumstances in a timely and cost effective manner. When you rate your proposal, for now just consider the adaptability of the blocks together—this isn't meant to be a rating of your process (contingencies/decision structure etc). We will get to those later.)

Question: How adaptable or flexible is this proposal likely to be in the face of changing climate conditions, demand levels or streamflow requirements?

- **Proposal provides significant adaptive flexibility benefits;**
- Proposal provides moderate adaptive flexibility benefits;
- Proposal provides minimal additional adaptive flexibility benefits;
- Proposal does not increase or decrease adaptive flexibility;
- Proposal reduces or eliminates existing adaptive flexibility in the system.

Optional: provide a rationale for your rating.

Supply Reliability

Reliability of water supply relates to how much water can be produced under various climate conditions such as drought or extreme precipitation and includes the system's ability to perform well in a variety of conditions, for example, high flow conditions that may increase turbidities in source waters. The focus of this criterion is on the likelihood that your proposal will improve the reliability of the Santa Cruz water system.

Question: How adaptable or flexible is this proposal likely to be in the face of changing climate conditions, demand levels or streamflow requirements?

- **Proposal provides significant supply reliability benefits;**
- Proposal provides moderate adaptive flexibility benefits;
- Proposal provides minimal additional adaptive flexibility benefits;
- Proposal does not increase or decrease adaptive flexibility;
- Proposal reduces or eliminates existing adaptive flexibility in the system.

Optional: provide a rationale for your rating.

Supply Diversity

This criterion measures the how well prepared or positioned the system will be to respond to future uncertainties based on the diversity of its supply portfolio. The premise is that supplies coming from different sources are less likely to be as vulnerable to the same kinds of uncertainties.

Questions How does this Approach affect the diversity of Santa Cruz water sources?

- **Proposal significantly increases the diversity of Santa Cruz's supply portfolio.**
- Proposal somewhat increases the diversity of Santa Cruz's supply portfolio.
- Proposal does not increase the diversity of Santa Cruz's supply portfolio.

Optional: provide a rationale for the rating.

This portfolio significantly increases the amount of groundwater available to the City from approx. 12% in a severe drought peak season, to 50%.

Environmental Profile:

The environmental profile of a proposal takes into account all the potential environmental impacts and benefits associated with that proposal.

Question: What is the environmental profile of this proposal?

- The Environmental profile of this proposal provides significant environmental benefits
- **This proposal has some environmental benefits**
- The environmental profile of this proposal is acceptable without mitigation
- The environmental profile of this proposal is acceptable with appropriate and effective mitigation
- The environmental profile of this proposal is not acceptable and/or cannot be made acceptable even with effective mitigation

Optional: provide a rationale for this rating.

This proposal involves increased energy use that could be mitigated with new development of renewable power.
Stream flow increases will result from aquifer recharge.

Political Feasibility

The extent to which a proposal will claim and retain the support of the community, both formal political entities as well as informal social and political groups and the community at large.

Question: What level of political support is the proposal likely to have?

- **Widely acceptable**
- With timely and appropriate informational and educational outreach to the community may be acceptable in the near future;
- Not acceptable now but highly likely to be acceptable in the future – 5 or more years out;
- Not acceptable now and highly uncertain about acceptability in the future;
- Likely never acceptable.

Optional: provide a rationale for your rating.

Block-by-Block Proposal Ratings

Regulatory Feasibility: Rate each block

Regulatory Feasibility addresses the certainty, ease and likely timeframe of receiving necessary regulatory approvals for the block. If you are worried about a lawsuit regarding a regulatory permit, that concern should be addressed here (not in *Legal Feasibility).*

Question: How easy or difficult would the regulatory approval process be for this Block? (Indicate one; cut and paste if you need more scales)

Block__One_ Rating: (bold, circle or otherwise indicate your rating)

- Highly certain for regulatory reviews and approvals to be easy and quick; regulatory issues are limited, routine, and/or non-controversial;
- Regulatory review process likely to be slow but relatively sure; regulatory issues include some challenges but approvals and completed processes likely achievable within 6 to 12 months;
- **Regulatory review process likely to be slow but with some questions due to number or complexity of regulatory issues needing to be resolved; Can probably acquire; achievable within 12 to 36 months;**
- Regulatory approvals likely to be difficult to acquire; new regulations may need to be developed, the scope or number of regulatory process or approvals involves complex, contentious issues, timeframe for completion likely more than 3 years;
- Significant regulatory challenges make approvals or completion of the regulatory review process in a reasonable, predictable time highly uncertain, likely would be expensive and require more than 5 years, if ever, to complete.

Block __Two_ Rating:

- Highly certain for regulatory reviews and approvals to be easy and quick; regulatory issues are limited, routine, and/or non-controversial;
- Regulatory review process likely to be slow but relatively sure; regulatory issues include some challenges but approvals and completed processes likely achievable within 6 to 12 months;
- **Regulatory review process likely to be slow but with some questions due to number or complexity of regulatory issues needing to be resolved; Can probably acquire; achievable within 12 to 36 months;**
- Regulatory approvals likely to be difficult to acquire; new regulations may need to be developed, the scope or number of regulatory process or approvals involves complex, contentious issues, timeframe for completion likely more than 3 years;
- Significant regulatory challenges make approvals or completion of the regulatory review process in a reasonable, predictable time highly uncertain, likely would be expensive and require more than 5 years, if ever, to complete.

Optional: provide a rationale for your rating(s)

Energy – Rate by Block

This criterion focuses on the acceptability of the energy use of the block.

- How much energy will this block require per million gallons of water produced?

In the meantime, please use this rating scale:

Block __1__ Rating:

- **The energy profile of this block is acceptable without mitigation**
- The energy profile of this block is acceptable with appropriate mitigation
- The energy profile of this block is not acceptable and/or cannot be made acceptable with mitigation

Mitigation is desired.

Block __2__ Rating:

- **The energy profile of this block is acceptable without mitigation**
- The energy profile of this block is acceptable with appropriate mitigation
- The energy profile of this block is not acceptable and/or cannot be made acceptable with mitigation

Mitigation is desired.

Legal Feasibility: Rate each block

Legal Feasibility addresses siting including acquisition of land, easements or rights or way, water rights, or other legal rights relevant to implementing the alternative as envisioned. This criterion is distinct from Regulatory Feasibility, which relates to specific regulatory approvals that would be required, separate from the legal requirements addressed here. Lawsuits about regs are still part of 'regulatory feasibility.'

Question: Does this Proposal have the necessary rights in the form needed?

Block __1__ Rating:

- Unambiguous "yes;" legal issues are routine, non-controversial;
- Yes, but with some ambiguities; achievable within 6 to 12 months from the start point;
- **Can probably acquire; achievable within 12 to 24 months from the start point;**
- Difficult to acquire; complex, contentious issues involved, likely requiring more than 2 years to resolve from the start point;
- Very unlikely; significant and contentious legal issues involved, likely requiring more than 5 years from the start point, if ever, to resolve.

Block __2__ Rating:

- Unambiguous "yes;" legal issues are routine, non-controversial;
- Yes, but with some ambiguities; achievable within 6 to 12 months from the start point;
- **Can probably acquire; achievable within 12 to 24 months from the start point;**
- Difficult to acquire; complex, contentious issues involved, likely requiring more than 2 years to resolve from the start point;
- Very unlikely; significant and contentious legal issues involved, likely requiring more than 5 years from the start point, if ever, to resolve.

Administrative Feasibility: Rate each block

Extent to which success of the proposal is dependent on the actions, cooperation, collaboration, financial participation or willingness to enter into intergovernmental agreements of other partners or players.

Question: To what degree does this proposal require the cooperation, collaboration, financial participation, and/or intergovernmental agreements to succeed, and how likely is it that these can be obtained?

Block __1__ Rating:

- Agreement with other parties is not essential
- Agreement is essential and highly likely
- **Agreement is essential and likely**
- Agreement is essential and not likely
- Agreement is essential but almost impossible

Block ___2_ Rating:

- Agreement with other parties is not essential
- Agreement is essential and highly likely
- **Agreement is essential and likely**
- Agreement is essential and not likely
- Agreement is essential but almost impossible

Cost Metrics: rate each block

Question: What is the unit cost for the water produced by this block, when compared across blocks? ($/mg)

Block __1__ Rating:

- **Unit cost is comparably low**
- Unit cost is in the middle range
- Unit cost is high

Block _2___ Rating:

- Unit cost is comparably low
- **Unit cost is in the middle range**
- Unit cost is high

Optional: provide a rationale for your rating(s)
Using the rationale field is especially important if you want to make the case "that's not important here" (as you might for Block 5) or if your cost deviates from the costs in technical reports (for instance if you think your 'flexed' block is more cost-effective).

I anticipate that in lieu recharge energy costs will be modest for the total annual energy of the program. This energy cost will decline once target level of storage is reached.

The energy cost of injection wells is higher due to the need to pressurize the water injected.