City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 01: Peak Season Reduction

Project description: In progress

Status Update

We are in the process of revamping this CA to address concerns expressed by several WSAC members. At this point, we do not have a restructuring of this CA to share with WSAC. The Technical Team recognizes this is a WSAC priority and is working with the Conservation sub-committee to make sure this CA captures new ideas as well as current ones.

Incorporated WCAs: WCA-69: SCWD: Peak season reductions – 10%, 25% and 50%

Reliability Over Time (seasonal and inter-annual variability)		Seasonal variability - reductions during peak season
Costs and Savings	**Best Estimate**	**Comments**
30-Year Present Value Savings (MG)	In progress	10% peak reduction = 70 MG (0.4 MGD over 6 months) 25% peak reduction = 170 MG (0.9 MGD over 6 months) 50% peak reduction = 340 MG (1.9 MGD over 6 months)
30-Year Present Value Cost ($)	In progress	
30-Year PV Cost/30-Year PV Saved ($/MG)	In progress	
30-Year Average Savings (MG)	In progress	
30-Year Average Cost ($)	In progress	
Energy Saved (MWh)	In progress	Indication of energy saved for water NOT produced and delivered; Assumes 1.6KWh/1,000 G. Calculated using non-discounted water savings: 10% reduction saves 112 MWh/Y

Key Components

1 Intensify incentives (like full landscape make-overs	4 More ordinance restrictions like retrofit on resale and new codes (e.g., Retrofit landscapes with alternative sources only for landscape)
2 New regualtions with enforcement of programs (e.g., no turf in new homes) that reduce water use	5 Other possible measures
3 Water rationing/allocation pricing schemes	6

Implementation Requirements Summary

10% reduction with planned programs is achievable; 25% would be difficult and require a massive turf removal or replacement project; A 50% reduction in peak demand does not appear to be feasible without relying on short-term drought measures, and using the drought tool kit on a long term basis then leaves limited opportunity to further reduce use when another drought comes and water use must again be reduced.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	
Preliminary and Detailed Design	
Bidding, Construction, and Startup	
Total Duration of Estimated Implementation	many can be implemented quickly, if City and Water Department have resources

Issues to Resolve

Listed above. Also, economic hardship for landscape maintenance contractors, nurserries, etc.

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**

EVALUATION

Technical Feasibility

City residents likely to resist big change in type of landscape allowed; would be very expensive (tens of millions to possibly 175 million dollars). A related issue is "who would pay?" Also, could have detrimental impact on property values throughout the community.

(How feasible is this approach from a technical perspective? Widely used; demonstrated in field; promising in 3-5 years; promising in 6-10 years; more than 10 years)

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 01: Peak Season Reduction

Legal Feasibility

City may not have legal authority to mandate a certain type of landscape on private property, after water service has already been granted (existing customers). May require using very high rate blocks to effectively disincentivize outdoor irrigation.

(With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed: unambiguous yes; yes, but some ambiguities; can probably acquire; difficult to acquire; very unlikely to acquire)

Regulatory Feasibility

(Is this approach likely to receive easy, quick regulatory approval: easy and quick; slow but relatively sure; very slow, no regulatory change; up to 10

Political Feasibility

(What level of political support is this approach likely to have: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never)

Regional Water Benefits

(Would this approach or portfolio improve or provide opportunities for improving regional water stability: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only)

Local Economy

(How might this proposal affect Santa Cruz's economy, as reflected in local jobs: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs)

Energy

(How much energy will this approach require per MG of water? (Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note: 5, 4, 3, 2, 1)

Marine Ecosystem Health

(How would this approach affect marine ecosystem health: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population)

Freshwater and Riparian Health

(If this approach were implemented, how would it affect freshwater and riparian ecosystems: Plentiful healthier water, About as it is now, Degraded

Terrestrial Resources

(This criterion assesses whether or how a particular approach would affect the health of terrestrial ecosystems. No scale was created for this criterion, so one would need to be created if this criterion is to be used in future analyses.)

Environmental Profile

Will change the look of the City. Annual energy savings associated with reduced pumping and treating by SCWD, under the 25% reduction in demand, amounts to 272 MWh.

(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be: the environmental profile of this portfolio is acceptable without mitigation, the environmental profile of this portfolio is acceptable with appropriate and effective mitigation, the environmental profile of this portfolio is not acceptable and/or cannot be made acceptable even with effective mitigation)

Groundwater Resources

(How would this approach affect groundwater resources: Actively restores, Allows restoration, Does not affect, Degrades Resource, Depletes Resource)

Infrastructure Resilience

(How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly

Supply Reliability

(How much will this approach help the existing system to produce consistently: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable)

Scalability

(How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'approximately: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable)

Preserves Future Choices

(How well does this approach preserve future choices: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in)

Yield

(How much water will this approach save or produce: Worst - 17.00; Best - 1800.00)

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 01: Peak Season Reduction
Operational Flexibility (To what extent does this approach increase flexibility: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases)
Addresses Peak Season Demand (To what extent would this approach help address peak season demand: YES, MAYBE, NO)
Implementability (How implementable would this portfolio be: Readily implemented, Could be implemented with some challenges, Unlikely to be implemented)
Supply Diversity (How does this portfolio improve the robustness of the Santa Cruz water system: Portfolio significantly increases the diversity of Santa Cruz's supply portfolio, Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio, Portfolio does not increase the diversity of Santa Cruz's supply portfolio)
Sustainability (How sustainable are the actions included in this portfolio of measures: this portfolio is very sustainable, this portfolio is somewhat sustainable, this portfolio is not sustainable)

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City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 02: Water Neutral Development

Project description: A water neutral development program would ensure that as the community grows – as new housing is built, no new demand is created – demand would remain the same regardless of residential growth. One implementation mechanism to reach this objective is to create a new water neutral regulation. There are two primary components of a regulatory program designed to ensure demand remains constant under new growth: (1) developers are required to build new residential housing that uses a minimum amount of water and (2) developers are required to offset the amount of water still estimated to be needed. For example, even homes built with low water construction techniques would still require some water. The second component has been accomplished in other Northern California communities by requiring developers to save/reduce an amount of water within the existing service area equivalent to the amount of demand created in the new housing.
If water neutral development occurs through a regulatory implementation mechanism, some key issues arise. First, because this program requires new housing stock to include the most efficient fixtures available, the first component of the program may accelerate water savings available from new efficient fixtures that are already anticipated under plumbing and building codes. This may result in a double counting of savings included in other estimates developed of the potential savings from plumbing and building code programs. Second, there is likely to be a cap on how much water savings can be achieved over time, as opportunities for builders to meet the second component become both increasingly difficult to find and more expensive. Third, who pays becomes a key question; high costs may be imposed on builders, home buyers, and renters as water use offsets become increasingly difficult to achieve (possible impacts on affordable housing for low income residents).

Status Update
We have not made changes to this CA other than to slightly modify the project description. This CA has been investigated and discussed extensively at the Water Commission within the past year.

Incorporated WCAs: WCA-03: SCDA: Water-Neutral Development

Reliability Over Time (seasonal and inter-annual variability)

Costs and Savings	Best Estimate	Comments
30-Year Present Value Savings (MG)		
30-Year Present Value Cost ($)		
30-Year PV Cost/30-Year PV Saved ($/MG)		
30-Year Average Savings (MG)		
30-Year Average Cost ($)		
Energy Saved (MWh)		Indication of energy saved for water NOT produced and delivered; Assumes 1.6KWh/1,000 G. Calculated using non-discounted water savings.

Key Components

1 Developers will pay the City to do extra conservation measures to reduce the net new water needed for the development, essentially funding offsets with higher impact fees	4
2 New development customers will use less water due to high-efficiency fixtures and landscape elements	5
3 Existing customers will voluntarily save water and participate in developer-funded conservation measures offered by the City	6

Implementation Requirements Summary
Requires mandates and perhaps some program to facilitate financing of water saving efforts

Estimated Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	
Preliminary and Detailed Design	
Bidding, Construction, and Startup	
Total Duration of Estimated Implementation	

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 02: Water Neutral Development

Issues to Resolve

While costs are unknown at this time, they are likely to be highly variable and escalate with time as cost-effective opportunities for water savings decrease. Potntila water saving estimates are based on recent demand forecast for new accounts.

Compatible CAs	Comments	Incompatible CAs	Comments

EVALUATION

Technical Feasibility

Questions remain on the ability for builders to find and implement appropriate demand offsets.

(How feasible is this approach from a technical perspective? Widely used; demonstrated in field; promising in 3-5 years; promising in 6-10 years;

Legal Feasibility

Unknown. (With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed: unambiguous yes; yes, but some ambiguities; can probably acquire; difficult to acquire; very unlikely to acquire)

(With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed: unambiguous yes; yes, but some ambiguities; can probably acquire; difficult to acquire; very unlikely to acquire)

Regulatory Feasibility

It is uncertain if the city of Santa Cruz would create a new regulation to provide for water neutral development.

(Is this approach likely to receive easy, quick regulatory approval: easy and quick; slow but relatively sure; very slow, no regulatory change; up to 10 year new regulations; not feasible)

Political Feasibility

Unknown

(What level of political support is this approach likely to have: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never)

Regional Water Benefits

None

(Would this approach or portfolio improve or provide opportunities for improving regional water stability: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only)

Local Economy

Could create economic hardship for the local construction industry.

(How might this proposal affect Santa Cruz's economy, as reflected in local jobs: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs)

Energy

Unknown tradeoffs.

(How much energy will this approach require per MG of water? (Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note: 5, 4, 3, 2, 1)

Marine Ecosystem Health

Unknown tradeoffs.

(How would this approach affect marine ecosystem health: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population)

Freshwater and Riparian Health

Unknown tradeoffs.

(If this approach were implemented, how would it affect freshwater and riparian ecosystems: Plentiful healthier water, About as it is now, Degraded

Terrestrial Resources

Unknown tradeoffs.

(This criterion assesses whether or how a particular approach would affect the health of terrestrial ecosystems. No scale was created for this criterion, so one would need to be created if this criterion is to be used in future analyses.)

Environmental Profile

Unknown tradeoffs.

(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be: the environmental profile of this portfolio is acceptable without mitigation, the environmental profile of this portfolio is acceptable with appropriate

Groundwater Resources

(How would this approach affect groundwater resources: Actively restores, Allows restoration, Does not affect, Degrades Resource, Depletes Resource)

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 02: Water Neutral Development
Infrastructure Resilience (How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly degrades, Significantly degrades)
Supply Reliability (How much will this approach help the existing system to produce consistently: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable)
Scalability (How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'approximately: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable)
Preserves Future Choices (How well does this approach preserve future choices: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in)
Yield (How much water will this approach save or produce: Worst - 17.00; Best - 1800.00)
Operational Flexibility (To what extent does this approach increase flexibility: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases)
Addresses Peak Season Demand (To what extent would this approach help address peak season demand: YES, MAYBE, NO)
Implementability (How implementable would this portfolio be: Readily implemented, Could be implemented with some challenges, Unlikely to be implemented)
Supply Diversity (How does this portfolio improve the robustness of the Santa Cruz water system: Portfolio significantly increases the diversity of Santa Cruz's supply portfolio, Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio, Portfolio does not increase the diversity of Santa Cruz's supply portfolio)
Sustainability (How sustainable are the actions included in this portfolio of measures: this portfolio is very sustainable, this portfolio is somewhat sustainable, this portfolio is not sustainable)

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City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 03: Water Conservation Measures (Program C Rec)

Project description: This is the preliminary recommended program for the Water Conservation Master Plan. As part of the development of the Water Conservation Master Plan, the city developed several water conservation programs, which are composed of different suites of conservation measures. The various programs were evaluated by MWM using their Decision Support System Least Cost Planning Model (DSS Model). The various programs, A-D, built upon one another; and thus the outputs are cumulative. The demand savings associated with Program A and plumbing codes has been incorporated into the revised demand forecast. Thus, to estimate the incremental savings and costs associated with Program C rec, we subtracted out the saving and costs for Program A and the plumbing codes. We have also removed the administrative costs originally included in the cost estimates. We are in the process of developing a more detailed description of the program, in which we hope to explicitly include assumptions and inputs used for each measure included in the program; however, this is not available at this time. Based on output from the MWM model, the estimated ratio of indoor to outdoor savings is about 63% indoor and 37% outdoor.

Status Update

We are in the process of developing a more detailed description of the program, in which we hope to include assumptions and inputs used for each measure included in the program. We are also working with MWM to produce transparent examples of savings and costs associated with a number of representative measures. The model uses a 25-year timeframe from 2015 - 2040. Because some of the mesaures in C rec start in 2018, we have only included annual estimates from 2018 - 2040. We are also in the process of working with MWM to better estimate the costs and savings incremental to C Rec. The DSS model includes Program A in its estimates for Program C rec, and we have used a preliminary method for seperating those out.

Incorporated WCAs:

Reliability Over Time (seasonal and inter-annual variability) Ratio of indoor and outdoor savings is about 63/37.

Costs and Savings	Best Estimate	Comments
25-Year Present Value Savings (MG)	2,788	Lifetime of project is modeled as 25 years
25-Year Present Value Cost ($)	$23.1 M	Does not include administrative costs. Admin costs are an additional $2.05M
25-Year PV Cost/30-Year PV Saved ($/MG)	$ 8,301	
25-Year Average Savings (MG/yr)	173	2030 estimated savings are 210 MG
25-Year Average Cost ($/yr)	$1.31 M	2030 estimated costs are $1.66 M
Energy Saved (MWh)	6,318	Indication of energy saved for water NOT produced and delivered; Assumes 1.6KWh/1,000 G. Calculated using non-discounted water savings

Key Components

1 in process - program has many conservation measures	4		
2	5		
3	6		

Implementation Requirements Summary

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	
Preliminary and Detailed Design	
Bidding, Construction, and Startup	
Total Duration of Estimated Implementation	Program C can be implemented quickly, but requires large resource increase for Water Dept.

Issues to Resolve

as noted above, questions are being addressed to make the assumptions, inputs, and calculations/results of the analysis more transparent

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary			
Consolidated Alternative 03: Water Conservation Measures (Program C Rec)			
Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		Prog C Rec includes WaterSmart home reports as one of several measures. Thus, these two CA's can not be implemented simulateously. (double counting)	Some of the assumptions used in the DSS model runs are different than those used in the calcualtions for CA-04.

EVALUATION

Technical Feasibility

(How feasible is this approach from a technical perspective? Widely used; demonstrated in field; promising in 3-5 years; promising in 6-10 years;

Legal Feasibility

(With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as

Regulatory Feasibility

(Is this approach likely to receive easy, quick regulatory approval: easy and quick; slow but relatively sure; very slow, no regulatory change; up to 10

Political Feasibility

(What level of political support is this approach likely to have: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never)

Regional Water Benefits

(Would this approach or portfolio improve or provide opportunities for improving regional water stability: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only)

Local Economy

(How might this proposal affect Santa Cruz's economy, as reflected in local jobs: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs)

Energy

(How much energy will this approach require per MG of water? (Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note: 5, 4, 3, 2, 1)

Marine Ecosystem Health

(How would this approach affect marine ecosystem health: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population)

Freshwater and Riparian Health

(If this approach were implemented, how would it affect freshwater and riparian ecosystems: Plentiful healthier water, About as it is now, Degraded ecosystem health)

Terrestrial Resources

(This criterion assesses whether or how a particular approach would affect the health of terrestrial ecosystems. *No scale was created* for this criterion, so one would need to be created if this criterion is to be used in future analyses.)

Environmental Profile

(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be: the environmental profile of this portfolio is acceptable without mitigation, the environmental profile of this portfolio is acceptable with appropriate

Groundwater Resources

(How would this approach affect groundwater resources: Actively restores, Allows restoration, Does not affect, Degrades Resource, Depletes Resource)

Infrastructure Resilience

(How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 03: Water Conservation Measures (Program C Rec)

Supply Reliability

(How much will this approach help the existing system to produce consistently: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable)

Scalability

(How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'approximately: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable)

Preserves Future Choices

(How well does this approach preserve future choices: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in)

Yield

(How much water will this approach save or produce: Worst - 17.00; Best - 1800.00)

Operational Flexibility

(To what extent does this approach increase flexibility: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases)

Addresses Peak Season Demand

(To what extent would this approach help address peak season demand: YES, MAYBE, NO)

Implementability

(How implementable would this portfolio be: Readily implemented, Could be implemented with some challenges, Unlikely to be implemented

Supply Diversity

(How does this portfolio improve the robustness of the Santa Cruz water system: Portfolio significantly increases the diversity of Santa Cruz's supply portfolio, Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio, Portfolio does not increase the diversity of Santa Cruz's supply

Sustainability

(How sustainable are the actions included in this portfolio of measures: this portfolio is very sustainable, this portfolio is somewhat sustainable, this portfolio is not sustainable)

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City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 04: WaterSmart Home Water Reports

Project description: WaterSmart Software's Home Water Reports (HWRs) service. HWRs provide households with periodic information on their current water use and compare it to their past use, the average use of similar households, and the use of the most efficient similar households. This data is coupled with actionable information on ways to use water around the home more efficiently. HWRs aim to motivate households to reduce their water use through changes in behavior or adoption of more water efficient technology. The approach is based on research on social norms marketing coming out of the field of social psychology and for this reason we refer to these type of programs as social-norms-based (SNB) efficiency programs. While SNB efficiency programs have been broadly adopted by energy utilities across the United States in recent years, they are relativelyy new to water utilities. (text from Mitchell, 2013: Evaluation of East Bay Municipal Utility District's Pilot of WaterSmart Home Water Reports)

Status Update

We have updated our calculations using revised cost assumptions from MWM, which and presented as costs per report, rather than cost per water savings.

Incorporated WCAs: WCA-04: WaterSmart: Home Water Reports; WCA-16: Gratz: Maximize Conservation Behavior

Reliability Over Time (seasonal and inter-annual variability)

Costs and Savings	Best Estimate	Comments
30-Year Present Value Savings (MG)	770	
30-Year Present Value Cost ($)	$ 3,171,539	
30-Year PV Cost/30-Year PV Saved ($/MG)	$ 4,119	
30-Year Average Savings (MG per year)	37	
30-Year Average Cost ($ per year)	$ 151,529	
Energy Saved (MWh)	1,766	Indication of energy saved for water NOT produced and delivered; Assumes 1.6KWh/1,000 G. Calculated using non-discounted water savings

Key Components

1	4
2	5
3	6

Implementation Requirements Summary

Install WaterSmart software at the utility level.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	
Preliminary and Detailed Design	
Bidding, Construction, and Startup	
Total Duration of Estimated Implementation	

Issues to Resolve

Compatible CAs	Comments	Incompatible CAs	Comments

EVALUATION

Technical Feasibility

Analyses done for EBMUD indicated that low water users saved less water than high users. Since Santa Cruz households have relatively low water use and somewhat limited capacity for additonal cost-effective conservation, the estimated savings associated with this alternative are uncertain. A 3% savings is applied to Santa Cruz (compard to 5% in EBMUD).

(How feasible is this approach from a technical perspective? Widely used; demonstrated in field; promising in 3-5 years; promising in 6-10 years; more than 10 years)

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 04: WaterSmart Home Water Reports

Legal Feasibility

(With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed: unambiguous yes; yes, but some ambiguities; can probably acquire; difficult to acquire; very unlikely to acquire)

Regulatory Feasibility

(Is this approach likely to receive easy, quick regulatory approval: easy and quick; slow but relatively sure; very slow, no regulatory change; up to 10 year new regulations; not feasible)

Political Feasibility

(What level of political support is this approach likely to have: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never)

Regional Water Benefits

(Would this approach or portfolio improve or provide opportunities for improving regional water stability: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only)

Local Economy

(How might this proposal affect Santa Cruz's economy, as reflected in local jobs: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs)

Energy

(How much energy will this approach require per MG of water? (Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note: 5, 4, 3, 2, 1)

Marine Ecosystem Health

(How would this approach affect marine ecosystem health: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population)

Freshwater and Riparian Health

(If this approach were implemented, how would it affect freshwater and riparian ecosystems: Plentiful healthier water, About as it is now, Degraded ecosystem health)

Terrestrial Resources

(This criterion assesses whether or how a particular approach would affect the health of terrestrial ecosystems. No scale was created for this criterion, so one would need to be created if this criterion is to be used in future analyses.)

Environmental Profile

Annual energy savings (and associated carbon footprint reductions) amount to 59 MWh in 2030, due to reduced production and delivery of potable
(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be: the environmental profile of this portfolio is acceptable without mitigation, the environmental profile of this portfolio is acceptable with appropriate

Groundwater Resources

(How would this approach affect groundwater resources: Actively restores, Allows restoration, Does not affect, Degrades Resource, Depletes Resource)

Infrastructure Resilience

(How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly degrades, Significantly degrades)

Supply Reliability

(How much will this approach help the existing system to produce consistently: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable)

Scalability

(How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'approximately: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable)

Preserves Future Choices

(How well does this approach preserve future choices: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in)

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 04: WaterSmart Home Water Reports
Yield (How much water will this approach save or produce: Worst - 17.00; Best - 1800.00)
Operational Flexibility (To what extent does this approach increase flexibility: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases)
Addresses Peak Season Demand (To what extent would this approach help address peak season demand: YES, MAYBE, NO)
Implementability (How implementable would this portfolio be: Readily implemented, Could be implemented with some challenges, Unlikely to be implemented)
Supply Diversity (How does this portfolio improve the robustness of the Santa Cruz water system: Portfolio significantly increases the diversity of Santa Cruz's supply portfolio, Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio, Portfolio does not increase the diversity of Santa Cruz's supply portfolio)
Sustainability (How sustainable are the actions included in this portfolio of measures: this portfolio is very sustainable, this portfolio is somewhat sustainable, this portfolio is not sustainable)

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City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 05: Home Water Recycling

Project description: Several alternatives proposed to use graywater recycling in residential units to reduce potable water demands, especially for flushing toilets and landscape irrigation, including CA Plumbing Code compliant facilities and installation. This alternative would install Nexus eWater Home Water Recycling systems into new single family homes. The is the only current system certified (i.e., certified under NSF standard 350) for on-site residential graywater treatment that can be used for toilet flushing and outdoor irrigation. The system uses floatation, two stages of filtration, and UV disinfection; and is a patent-protected, proprietary process. It is a newly developed system, and is currently still in the piloting phase. This system requires professional installation, but once installed, it is automatic and operates with minimal homeowner management (or a third party management contract for periodic upkeep).

The initial cost is $5,700 per home ($4,500 for the treatment system and tanks, $1200 for installation in new home under construction), with estimated annual operating costs (including electric power and consumables) under $200 per year (using homeowner time), and higher costs if periodic maintence is contracted to a third party. After the 12 year lifespan, replacement costs are estimated at $2000.

The system can be adapted and installed in multi-family units, but current regulations preclude using graywater for toilet flushing in multi-family setting, thus restricting graywater use to outdoor irrigation. There is also potential to retrofit existing homes, but the process is currently under development and the plumbing and pumping requirements make retrofits considerably more complex and expensive. Thus, this alternative is evaluated here specifically for use in new single family residences.

This evaluation assumes potable water savings of 18,469 gallons per household per year based on data for per household toilet flushing and irrigation use levels in new single family homes, multiplied by number of new SFR homes anticipated added in future years.

Status Update

We have not changed any of the assumptions or inputs.

Incorporated WCAs: WCA-39: Garges: Residential Gray-Water; WCA-66: zNano: Onsite Water re-use; WCA-70: Home Water Recycling

Reliability Over Time (seasonal and inter-annual variability)

Costs and Savings	Best Estimate	Comments
30-Year Present Value Savings (*MG*)	229	approximately 15.5 MG/yr by 2030
30-Year Present Value Cost ($)	$7.8 M	
30-Year PV Cost/30-Year PV Saved ($/MG)	$34,061	
30-Year Average Savings (MG/yr)	11.9	annual per household water saved = 18,500 gallons
30-Year Average Cost ($/yr)	N/A	
Energy Saved (MWh)	571	Indication of energy saved for water NOT produced and delivered; Assumes 1.6KWh/1,000 G. Calculated using non-discounted water savings

Key Components

1 Assumes installation cost of $5,700 and annual operating costs of $200 per household; lifetime of 12 years, with 75% assumed capital cost to replace filter system elements every 12th year.	4 System treats water for use in outdoor irrigation (including spray and drip) and toilet flushing (single family only)
2 Currently focuses on single family new builds	5 During low irrigation season, excess (unused) treated water automatically goes to sewer system
3 Costs include connection to irrigation system, not irrigation system itself	6 System has 12-year lifetime with minimal maintenance

Implementation Requirements Summary

Requires professional installation and duel piping. Focus on new builds rather than retrofit.

Estimated Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	
Preliminary and Detailed Design	
Bidding, Construction, and Startup	
Total Duration of Estimated Implementation	

Issues to Resolve

Actual potable water savings need to be demonstrated with on-site monitoring (not yet done), or estimated using realistic water use estimates in Santa Cruz for seasonal single family irrigation needs and installation of highly efficient toilets. Estimates shown here of about 18,500 gallons per new household per year reflect these conditions.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 05: Home Water Recycling

Compatible CAs	Comments	Incompatible CAs	Comments

EVALUATION

Technical Feasibility

Technically feasible, but currently in place in only 3 homes in Southern California, as a pilot demonstration.

(How feasible is this approach from a technical perspective? Widely used; demonstrated in field; promising in 3-5 years; promising in 6-10 years; more than 10 years)

Legal Feasibility

Multi-family units are restricted from using the recycled graywater for toilet flushing under existing CA regulations. Water reuse regulations are in a state of flux, and graywater produced by this system may become permitted for toilet flushing in multi-family resdiences within a few years.

(With the required timeframe for this approach, are the necessary rights currently held in the form needed or feasible to acquire or modify as needed: unambiguous yes; yes, but some ambiguities; can probably acquire; difficult to acquire; very unlikely to acquire)

Regulatory Feasibility

(Is this approach likely to receive easy, quick regulatory approval: easy and quick; slow but relatively sure; very slow, no regulatory change; up to 10 year new regulations; not feasible)

Political Feasibility

(What level of political support is this approach likely to have: Enthusiasm now, Acceptable now, Active resistance now, Acceptable in 5 years, Acceptable in 10 years, Acceptable in 20 years, Likely never)

Regional Water Benefits

(Would this approach or portfolio improve or provide opportunities for improving regional water stability: Across County, 4 jurisdictions, 3 jurisdictions, 2 jurisdictions, SC Water only)

Local Economy

(How might this proposal affect Santa Cruz's economy, as reflected in local jobs: Positive local job, Slight positive, No effect, Slight negative, Negative for local jobs)

Energy

(How much energy will this approach require per MG of water? (Treating surface water, which the City rated as a 4, is about 1.5 kWhl1000 gallons, see accompanying note: 5, 4, 3, 2, 1)

Marine Ecosystem Health

(How would this approach affect marine ecosystem health: Positive effect, does not harm, may harm, cumulative harm, Sig harm to population)

Freshwater and Riparian Health

(If this approach were implemented, how would it affect freshwater and riparian ecosystems: Plentiful healthier water, About as it is now, Degraded ecosystem health)

Terrestrial Resources

(This criterion assesses whether or how a particular approach would affect the health of terrestrial ecosystems. No scale was created for this criterion, so one would need to be created if this criterion is to be used in future analyses.)

Environmental Profile

Annual energy use savings from reduced SCWD production and delivery of potable water amounts to about 25 MWh in 2030, less energy required to operate graywater treatment system and any associated in-home pumping.

(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be: the environmental profile of this portfolio is acceptable without mitigation, the environmental profile of this portfolio is acceptable with appropriate and effective mitigation, the environmental profile of this portfolio is not acceptable and/or cannot be made acceptable even with effective mitigation)

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 05: Home Water Recycling
Groundwater Resources (How would this approach affect groundwater resources: Actively restores, Allows restoration, Does not affect, Degrades Resource, Depletes Resource)
Infrastructure Resilience (How well would this approach contribute to the system's ability to withstand natural disasters and other disturbances? (The top of the scale is "meets most challenges well: Most challenges well, Many moderately well, Some somewhat, Few barely, Doesn't improve resilience, Slightly
Supply Reliability (How much will this approach help the existing system to produce consistently: Makes system sig more reliable, Somewhat more reliable, Slightly more reliable, No change, Makes system less reliable)
Scalability (How easily can this approach be scaled up within the overall system? (The tilde~ in the scale is shorthand for 'approximately: Scales up w no limit, Can scale to ~1BG gap, Can scale to ~650 MG gap, Can scale to ~ 300 MG gap, Not scalable)
Preserves Future Choices (How well does this approach preserve future choices: Increases choice, Somewhat increases choice, No effect, Reduces choice, City locked in)
Yield (How much water will this approach save or produce: Worst - 17.00; Best - 1800.00)
Operational Flexibility (To what extent does this approach increase flexibility: Greatly increases, Moderately increases, Somewhat increases, Does not increase, Decreases)
Addresses Peak Season Demand (To what extent would this approach help address peak season demand: YES, MAYBE, NO)
Implementability (How implementable would this portfolio be: Readily implemented, Could be implemented with some challenges, Unlikely to be implemented)
Supply Diversity (How does this portfolio improve the robustness of the Santa Cruz water system: Portfolio significantly increases the diversity of Santa Cruz's supply portfolio, Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio, Portfolio does not increase the diversity of Santa Cruz's supply portfolio)
Sustainability (How sustainable are the actions included in this portfolio of measures: this portfolio is very sustainable, this portfolio is somewhat sustainable, this portfolio is not sustainable)

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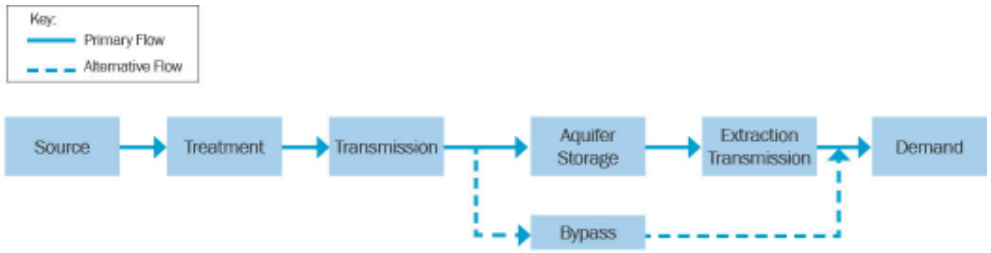
City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 07 - Deepwater Desalination

This alternative would desalt seawater withdrawn through a new deepwater intake system at Moss Landing, producing approximately 10,000 AFY at the facility start up and up to approximately 25,000 AFY in the future. From that annual production the City would purchase 550 MG through a "take-or-pay" agreement. SqCWD also would purchase a similar quantity. The City and SqCWD would share the transfer facilities to move the water up coast. In average and wet years the SqCWD would take the full allotment for its needs as well as conjunctive use and/or aquifer storage and recovery (ASR). In drought years the City would draw its share together with aquifer-stored water from SqCWD. The block diagram below presents this alternative schematically.
This alternative has several outstanding issues, e.g., environmental document completion, permitting through the California Coastal Commission, and public vote approving alternative implementation.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-07 DEEPWATER DESALINATION

Status Update
No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Description: Deepwater desalination for demands during dry periods.

Incorporated WCAs: WCA - 19 ("McGilvray: (11) Seawater Desal"), WCA - 36 ("Aqueous: Desalination [non-membrane]"), WCA - 37 ("Brown: Zero-Emission Wave Energy"), WCA- 67 ("Tanaka"), WCA- 72 ("Seawater Desalination - Deepwater Desalination").

Estimated Annual Yield (million gallons [MG]) [Yield will vary, adjusted later, depending upon results from Confluence modeling and findings from Pueblo regarding aquifer volume available for storage.]	550 (up to 1,100 MG in drought years)
Reliability Over Time (seasonal and inter-annual variability)	

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	52	
Annual O&M ($million)	3	
30-Year Present Value ($million)		
30-Year PV Cost/30-Year PV MG ($/MG)		
Total Annualized Cost ($million)		
Total Annualized Cost/Avg. Annual Yield ($/MG)		
Energy (MWh/MG)	13+	

Key Components

1. Deepwater marine intake and pipeline or tunnel to shore.	4. Brine storage and brine disposal pipeline.
2. Onshore pumping station.	5. Pump stations and pipelines for distribution/transmission.
3. Desalination facility.	6. Improvements to the City distribution system to transfer water from SqCWD.

Implementation Requirements Summary
Complete CEQA process. Develop interagency agreement. Obtain voter and City Council approval. Negotiate agreement with SqCWD and with project developer. Design, bid, build, and commission new facility.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	3
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	7

Issues to Resolve
Marine intake and discharge locations and permits. Site acquisition for new facilities. Finalization of pipeline routes and ROW acquisition. Creating long-term contract with project developer and with SqCWD.

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
CA-16, 17, and 18	City could capture and use winter flows in parallel with CA-07.	CA-10, 11, 12, and 13	City would not need to recycle if it purchased sufficient desalted water.
Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	N/A

Permitting Summary
Completion of CEQA process. California Coastal Commission approval.

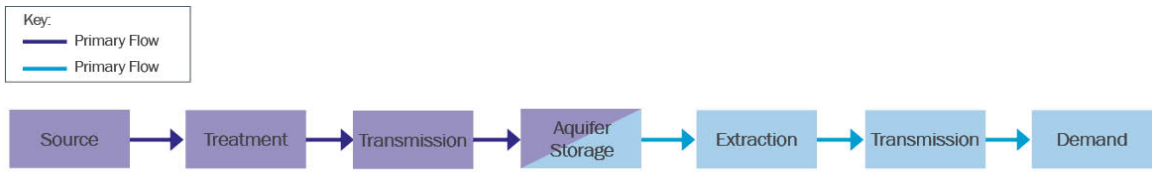
EVALUATION

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary Consolidated Alternative 07 - Deepwater Desalination
Technical Feasibility Widely used. Desal technology is widely used.
Legal Feasibility Yes, but some ambiguities.
Regulatory Feasibility Very slow, no regulatory change. Assumes that considerable time to complete the environmental and regulatory process will be needed.
Political Feasibility Active resistance now. Based on response to SCWD2 desal project, it is assumed there will be resistance but this may be overcome.
Regional Water Benefits 2 jurisdictions. Directly would impact SqCWD and SCWD.
Local Economy Positive local. Assumes a more stable water supply impacting a larger portion of the county will have a positive impact.
Energy 5 Desal facilities require considerable amounts of energy; pumping system will also require energy for this distance.
Marine Ecosystem Health May harm. Though deepwater desal is likely to have less negative impact on the marine environment, some negative impact is assumed.
Freshwater and Riparian Health About as it is now. Assume this ecosystem will not be modified since this alternative only fills the shortfall and does not reduce current diversions.
Terrestrial Resources TBD Scale for this criterion has not been developed.
Environmental Profile The environmental profile of this portfolio is acceptable with appropriate and effective mitigation. Assumes impacts would exist but could be mitigated.
Groundwater Resources Allows restoration. Assumes water City does not take during wet years could be used by SqCWD and the City for GW restoration.
Infrastructure Resilience Meets most challenges well. Assumes new infrastructure would be built to meet codes/regulations but prolonged power outages could impact system.
Supply Reliability Makes system significantly more reliable. Diversifies water supply portfolio with additional source not dependent on weather.
Scalability Can scale up ~650MG. Alternative notes 500MG but assumes this could be increased or decreased and is the range.
Preserves Future Choices Somewhat increases choice. Assumes City could take desal water in wet or average years to reduce diversions if agreements written with this flexibility.
Yield 500-1000 MG
Operational Flexibility Greatly increases . Does not rely on existing facilities to provide all water.
Addresses Peak Season Demand Yes
Implementability Could be implemented with some challenges. Requires overcoming environmental, interagency, community resistance hurdles.
Supply Diversity Portfolio greatly increases the diversity of Santa Cruz's supply portfolio. Adds additional source that is drought proof than current portfolio
Sustainability This portfolio is somewhat sustainable. Assumes aspects of desal (high energy, brine) are not "sustainable" but overall system is sustainable.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 10 - Water Reuse for Aquifer Recharge

This alternative would divert wastewater effluent for advanced treatment (i.e. to produce purified water) and groundwater replenishment. The purified water would be used to recharge depleted aquifers and store water for potable use during dry periods. The State Water Resources Control Board Department of Drinking Water allows addition of highly treated wastewater (purified water) to aquifers that will be later used for potable water demands ("groundwater recharge replenishment"). Current regulations require 2-month response retention time (travel time, about 500 feet) before extraction and use.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-10 WATER REUSE FOR AQUIFIER RECHARGE IPR

Status Update

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA - 44 ("McGilvray: (8) Tertiary Treatment, Re-use"), WCA - 62 ("Smallman: (17) Recycled Water"), WCA - 64 ("Weizs: Water Recycling").

Estimated Annual Yield (million gallons [MG])	1,330
Reliability Over Time (seasonal and inter-annual variability)	

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	191	
Annual O&M ($million)	8	
30-Year Present Value ($million)	516	
30-Year PV Cost/30 Year - PV MG ($/MG)	12,740	
Total Annualized Cost ($million)	15	
Total Annualized Cost/Avg. Annual Yield ($/MG)	11,000	
Energy (MWh/MG)	10	

Key Components

1. Treatment facilities to produce purified water.	4. Extraction wells.
2. New line maintenance facility to free space at WWTP for new treatment facilities	5. Return pump station(s) and pipeline(s) for returning water to City.
3. Pump station and pipeline(s) to convey water.	6

Implementation Requirements Summary

Identify aquifer recharge locations and treatment facility needs. Develop interagency agreement(s). Obtain regulatory approval. Obtain voter and City Council approval. Complete CEQA process. Acquire site(s) for pump station(s) and establish final pipeline routes. Design, bid, build, and commission new facilities.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	4
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	8

Issues to Resolve

Permitting and regulations; community resistance

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
All others.		CA-16	Possibly incompatible since sufficient recycled water would be available long term to fill aquifers.

Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	TBD, depends on the treatment systems and delivery method to the aquifer

Permitting Summary

Division of Drinking Water; ROW

EVALUATION

Technical Feasibility

Demonstrated in the field.
A similar system has been in operation in Orange County for many years.

Legal Feasibility

Yes, but some ambiguities.
Assumes treatment facilities located at City or other agency sites and pipes stay within public ROW; aquifer recharge may require obtaining land.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary
Consolidated Alternative 10 - Water Reuse for Aquifer Recharge

Regulatory Feasibility

Slow, no regulatory change.
Regulations are in place for recharging aquifers with recycled water; however, this system would be more complex given the number of agencies (regulatory and local) that would need to be involved.

Political Feasibility

Active resistance now.
Recent statements from public indicate current resistance to use of recycled water; however, it is assumed this could be overcome with an outreach program.

Regional Water Benefits

Across County.
Assumes recharge would occur in multiple locations to provide groundwater stability for county (reduce overdrafts and seawater intrusion).

Local Economy

Slight positive.
Assumes increased water supply stability would result in a more stable economy.

Energy

4
Assume only energy required for additional WW treatment beyond current level and pumping to aquifer recharge sites and extraction.

Marine Ecosystem Health

Does not harm; marine health should be maintained.

Freshwater and Riparian Health

About as it is now; freshwater and riparian health should be maintained.

Terrestrial Resources

N/A

Environmental Profile

The environmental profile of this portfolio is acceptable with appropriate and effective mitigation.
Assumes impacts would exist but could be mitigated.

Groundwater Resources

Actively restores.
Assumes not all water is recovered.

Infrastructure Resilience

Meets most challenges well.
New infrastructure with current seismic/building codes.

Supply Reliability

Makes system significantly more reliable.
Purified water production is not directly impacted/limited by drought and is "drought proof source".

Scalability

Can scale up to ~1BG gap.
Assumes enough WW available and WTP/storage capacities is available.

Preserves Future Choices

Reduces choice.
City would be locked into purified water; however, the size of the facilities could be scalable and done such that the system is only expanded if needed.

Yield

1,100 MG

Operational Flexibility

Moderately increases.
Relies on existing facilities to provide all water.

Addresses Peak Season Demand

Yes

Implementability

Could be implemented with some challenges.
Requires overcoming environmental, interagency, community resistance hurdles.

Supply Diversity

Portfolio significantly increases the diversity of Santa Cruz's supply portfolio.
Additional supply dependent on WW which is "drought proof".

Sustainability

This portfolio is somewhat sustainable.
Assume portfolio would still use surface water which can be viewed to be less sustainable; however, purified water is more sustainable.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary
Consolidated Alternative 11 - Water Reuse for Direct Potable

This alternative would divert wastewater effluent for advanced treatment (i.e. to produce purified water). The purified water would be combined with raw water and treated at the City of Santa Cruz's water treatment plant. The State Water Resources Control Board Department of Drinking Water is developing regulations to allow the use of the combination of highly treated wastewater (purified water) and raw water sources for potable water ("surface water augmentation"). The excess of purified water could be stored in aquifers to help restore and provide storage for potable water demands during dry periods.

Status Update

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA - 11 ("SCWD: Water Reuse"), WCA - 46 ("McKinney: Water Reuse"), WCA - 64 (" Weizs: Water Recycling").

Estimated Annual Yield (million gallons [MG])	1,330

Reliability Over Time (seasonal and inter-annual variability)

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	91	
Annual O&M ($million)	4	
30-Year Present Value ($million)	247	
30-Year PV Cost/30 Year - PV MG ($/MG)	6,100	
Total Annualized Cost ($million)	7	
Total Annualized Cost/Avg. Annual Yield ($/MG)	5,000	
Energy (MWh/MG)	6	

Key Components

1. Treatment facilities to produce purified water.
2. New line maintenance facility to free space at WTP for new treatment facilities
3. Pump station and pipeline(s) to convey water to WTP.
4. New or expanded WTP
5. Pump station(s) and pipeline(s) for connecting new WTP to City distribution.
6

Implementation Requirements Summary

Identify treatment facility needs. Obtain regulatory approval. Obtain voter and City Council approval. Complete CEQA process. Acquire site(s) for pump station(s) and establish final pipeline routes. Design, bid, build, and commission new facilities.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	5
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	9

Issues to Resolve

Permitting and regulations need to be finalized; community resistance

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		CA-16	Possibly incompatible since sufficient recycled water would be available long term to fill aquifers.

Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)

Permitting Summary

Division of Drinking Water; ROW

EVALUATION

Technical Feasibility

Promising in 3-5 years.
Treatment technologies are currently in state to produce highly purified water; however, proving a selected treatment system will likely take some time)once regulations allow).

Legal Feasibility

Yes, unambiguous.
Assumes treatment facilities located at City site(s) and pipes stay within public ROW.

Regulatory Feasibility

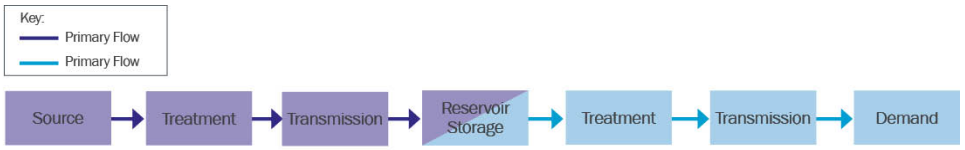
City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 11 - Water Reuse for Direct Potable
Slow, likely 5 years or more for new regulations. The requires regulatory change that is under development and likely to be implemented in the next 3 years.
Political Feasibility
Active resistance now. Recent statements from public indicate current resistance to use of recycled water; however, it is assumed this could be overcome with an outreach program.
Regional Water Benefits
SC Water only. DPR would only impact SC users.
Local Economy
Slight positive. Assumes increased water supply stability would result in a more stable economy.
Energy
4 Assume only energy required for additional WW treatment beyond current level and pumping to GHWTP.
Marine Ecosystem Health
Does not harm; marine health should be maintained.
Freshwater and Riparian Health
About as it is now; freshwater and riparian health should be maintained.
Terrestrial Resources
N/A
Environmental Profile
The environmental profile of this portfolio is acceptable with appropriate and effective mitigation. Assumes impacts would exist but could be mitigated.
Groundwater Resources
Does not affect.
Infrastructure Resilience
Meets most challenges well. New infrastructure with current seismic/building codes.
Supply Reliability
Makes system significantly more reliable. Purified water production is not directly impacted/limited by drought and is "drought proof source".
Scalability
Can scale up to ~1BG gap. Assumes enough WW available and WTP/storage capacities is available.
Preserves Future Choices
Reduces choice. City would be locked into purified water; however, the size of the facilities could be scalable and done such that the system is only expanded if needed.
Yield
1,300 MG
Operational Flexibility
Moderately increases.
Addresses Peak Season Demand
Yes
Implementability
Could be implemented with some challenges. Requires overcoming regulatory, environmental, interagency, community resistance hurdles.
Supply Diversity
Portfolio significantly increases the diversity of Santa Cruz's supply portfolio. Additional supply dependent on WW which is "drought proof".
Sustainability
This portfolio is somewhat sustainable. Assume portfolio would still use surface water which can be viewed to be less sustainable; however, purified water is more sustainable.

Consolidated Alternative 11 - Water Reuse for Direct Potable

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 12 - Water Reuse for Indirect Potable

This alternative for would divert wastewater effluent for advanced treatment (i.e. to produce purified water). The purified water would be stored in the Loch Lomond Reservoir for subsequent treatment for potable use. The Loch Lomond Bypass Tunnel would be added as well. Note that the State Water Resources Control Board Department of Drinking Water (DDW) is developing regulations to allow use of a combination of highly treated wastewater (purified water) and other raw water resources for potable water (either as an indirect or a direct source). The bypass tunnel will be added.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-12 WATER REUSE FOR INDIRECT POTABLE REUSE

Status Update

The Loch Lomond Bypass Tunnel has been added and continuing to fine tune components and costs.

Incorporated WCAs: WCA - 44 ("McGilvray: (8) Tertiary Treatment, Re-use"), WCA - 52 ("Paul: (17) Detention Tub String"), WCA - 62 ("Smallman: Recycled Water"), WCA - 64 ("Weizs: Water Recycling").

Estimated Annual Yield (million gallons [MG])	1,300
Reliability Over Time (seasonal and inter-annual variability)	

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	218	Assumes only treated water
Annual O&M ($million)	6	
30-Year Present Value ($million)	531	
30-Year PV Cost/30 Year - PV MG ($/MG)	13,000	
Total Annualized Cost ($million)	18	
Total Annualized Cost/Avg. Annual Yield ($/MG)	13,000	
Energy (MWh/MG)	10	

Key Components

1. Treatment facilities to produce purified water.	4
2. New line maintenance facility to free space at WWTP for new treatment facilities.	5
3. Pump station and pipeline(s) to convey water to Loch Lomond.	6

Implementation Requirements Summary

Identify treatment facility needs. Obtain regulatory approval. Obtain voter and City Council approval. Complete CEQA process. Acquire site(s) for pump station(s) and establish final pipeline routes. Design, bid, build, and commission new facilities.

Estimate Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	4
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	8

Issues to Resolve

Permitting and regulations need to be finalized; community resistance

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		CA-16	Possibly incompatible since sufficient recycled water would be available long term to fill aquifers.

Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	

Permitting Summary

Division of Drinking Water; ROW

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 12 - Water Reuse for Indirect Potable
EVALUATION
Technical Feasibility
Promising in 3-5 years. Treatment technologies are currently in state to produce highly purified water; however, proving a selected treatment system will likely take some time)once
Legal Feasibility
Yes, but some ambiguities. Assumes treatment facilities located at City or other agency sites and pipes stay within public ROW; aquifer recharge may require obtaining land.
Regulatory Feasibility
Very slow, up to 10 year new regulations. The requires regulatory change that is under development and likely to be implemented in the next 3 years.
Political Feasibility
Active resistance now. Recent statements from public indicate current resistance to use of recycled water; however, it is assumed this could be overcome with an outreach program.
Regional Water Benefits
SC Water only
Local Economy
Slight positive. Assumes increased water supply stability would result in a more stable economy.
Energy
4 Assume only energy required for additional WW treatment beyond current level and pumping to Loch Lomond.
Marine Ecosystem Health
Does not harm; marine health should be maintained
Freshwater and Riparian Health
About as it is now; freshwater and riparian health should be maintained
Terrestrial Resources
N/A
Environmental Profile
The environmental profile of this portfolio is acceptable with appropriate and effective mitigation. Assumes impacts would exist but could be mitigated.
Groundwater Resources
Allows restoration/Does not affect. This could be seen as allowing restoration by decreasing the amount of surface water diverted; does not directly impact restoration
Infrastructure Resilience
Meets most challenges well. New infrastructure with current seismic/building codes
Supply Reliability
Makes system significantly more reliable. Purified water production is not directly impacted/limited by drought and is "drought proof source".
Scalability
Can scale up to ~1BG gap Assumes enough WW available and WTP/storage capacities is available.
Preserves Future Choices
Reduces choice. City would be locked into purified water; however, the size of the facilities could be scalable and done such that the system is only expanded if needed. Could also provide the platform for DPR.

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 12 - Water Reuse for Indirect Potable
Yield
1,330 MG
Operational Flexibility
Moderately increases. Relies on existing facilities to provide all water.
Addresses Peak Season Demand
Yes
Implementability
Could be implemented with some challenges. Requires overcoming regulatory, environmental, interagency, community resistance hurdles.
Supply Diversity
Portfolio significantly increases the diversity of Santa Cruz's supply portfolio. Additional supply dependent on WW which is "drought proof".
Sustainability
This portfolio is somewhat sustainable. Assume portfolio would still use surface water which can be viewed to be less sustainable; however, purified water is more sustainable.

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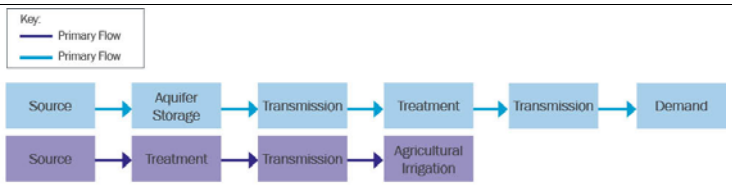
City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 13 - Water Reuse for Non-Potable

This alternative would produce filtered disinfected effluent (CA Title 22 unrestricted water) from the City Wastewater Treatment Plant (WWTP) at a rate of about 4.3 MGD. The City would pump the effluent north through a new pipeline aligned along the railroad right of way, with turnouts to irrigate up to about 1,300 acres on private land and on leased land owned by the California State Parks (CSP) and the United States Bureau of Land Management (BLM). This process is assumed to take place over 180 days per year and total water available for crop irrigation would be about 780 MG. The City would build 12 new 250-gpm extraction wells that discharge into new pipeline that in turn would connect to the existing City North Coast pipeline. The water would combine with diverted surface water from the City North Coast rights, for treatment at the GHWTP. In wet and average rainfall years, the City could ship excess potable water to SqCWD or SCWD for ASR. To develop space for new facilities within the WWTP site, the City would need to relocate its Line Maintenance Facility from the WWTP site to a new site on the West Side.

The alternative has several outstanding issues, e.g., legal agreements with CSP, BLM, and property owners and with irrigators, securing the right of way for the new delivery and return pipelines such as along the railroad ROW, geotechnical investigations for well construction, assessment of the groundwater basin to ensure that operation would not adversely affect the groundwater basin, permitting through the California Coastal Commission, preparation and approval of CEQA/NEPA documents (NEPA is included because the project includes BLM land), and location and purchase of new Line Maintenance Facility site.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA13 WATER REUSE FOR NON-POTABLE

Status Update

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA-09 ("Ripley: Reuse for Agriculture"), WCA - 40 ("Gratz: Recycled Water for Irrigation"), WCA - 41 ("McGilvray: (1) Recycled Water for Irrigation"), WCA - 45 ("McKinney: Additional Wells and WTPs"), WCA-64 ("Weizs: Water Recycling").

Estimated Annual Yield (million gallons [MG]) [Wet and average rainfall years.]	770
Reliability Over Time (seasonal and inter-annual variability)	

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	60	Only producing raw water for half the year
Annual O&M ($million)	2	
30-Year Present Value ($million)	160	
30-Year PV Cost/30 Year - PV MG ($/MG)	6,880	
Total Annualized Cost ($million)	2	
Total Annualized Cost/Avg. Annual Yield ($/MG)	3,000	
Energy (MWh/MG)	3	

Key Components

1. Tertiary Treatment (Title 22 unrestricted) or Complete Advanced Treatment at WWTP	4. Extraction wells (12 at 250 gpm each)
2. New line maintenance facility to free space at WWTP for new tertiary treatment	5. Return pipeline to connect to City's NC pipeline (about 8 miles).
3. Delivery pipeline (14 miles) to convey recycled water from WWTP to irrigators, aligned along railroad tracks	6. Storage Reservoir to equalize daily demands

Implementation Requirements Summary

Identify aquifer recharge locations and treatment facility needs. Develop user/share agreement(s). Obtain regulatory approval. Obtain voter and City Council approval. Complete CEQA process. Acquire site(s) for pump station(s) and establish final pipeline routes. Design, bid, build, and commission new facilities.

Estimated Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	4
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	8

Issues to Resolve

Permitting; community resistance

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		CA-16	Possibly incompatible since sufficient recycled water would be available long term to fill aquifers.

Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	<10

Permitting Summary

Division of Drinking Water; ROW

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 13 - Water Reuse for Non-Potable
EVALUATION
Technical Feasibility Widely used. Use of recycled water for crop irrigation with used throughout the state, with neighboring Monterey County having illustrated the safe practice in the mid 1990s.
Legal Feasibility Yes, but some ambiguities. Water rights and water transfer requirement; need to obtain land through easements or purchase for conveyance.
Regulatory Feasibility Slow but relatively sure. Recycled water for crop irrigation is an approved use from a regulatory perspective, but working through the regulations and environmental review will take some time.
Political Feasibility Active resistance now. Recent statements from public indicate current resistance to use of recycled water; however, it is assumed this could be overcome with an outreach program.
Regional Water Benefits SC Water only. Though ag would benefit, these are individual systems and not jurisdictional agencies.
Local Economy Slight positive. Assumes increased water supply stability would result in a more stable economy.
Energy 4 Assume only energy required for additional WW treatment beyond current level and pumping to North Coast users.
Marine Ecosystem Health May harm Some negative impact is assumed.
Freshwater and Riparian Health About as it is now; freshwater and riparian health should be maintained
Terrestrial Resources N/A
Environmental Profile The environmental profile of this portfolio is acceptable with appropriate and effective mitigation. Assumes impacts would exist but could be mitigated.
Groundwater Resources Does not affect. Assumes allowing to rest does not actually allow for restoration per criterion description.
Infrastructure Resilience Meets most challenges well. New infrastructure with current seismic/building codes.

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 13 - Water Reuse for Non-Potable
Supply Reliability Makes system significantly more reliable. Recycled water production is not directly impacted/limited by drought and is "drought proof source".
Scalability Can scale up to ~1BG gap. Assumes enough ww available and WTP/storage capacities is available.
Preserves Future Choices Increases choice. City would be locked into recycled water; however, the size of the facilities could be scalable and done such that the system is only expanded if needed and could ultimately have additional treatment for IPR/DPR if pursued at a later time.
Yield 500 MG
Operational Flexibility Moderately increases. Relies on existing facilities to provide all water.
Addresses Peak Season Demand Yes
Implementability Could be implemented with some challenges. Requires overcoming environmental, stakeholder, and community resistance hurdles.
Supply Diversity Portfolio significantly increases the diversity of Santa Cruz's supply portfolio. Additional supply dependent on ww which is "drought proof".
Sustainability This portfolio is somewhat sustainable. Assume portfolio would still use surface water which can be viewed to be less sustainable and now groundwater; however, purified water is more sustainable.
Issues to Resolve Permitting; community resistance

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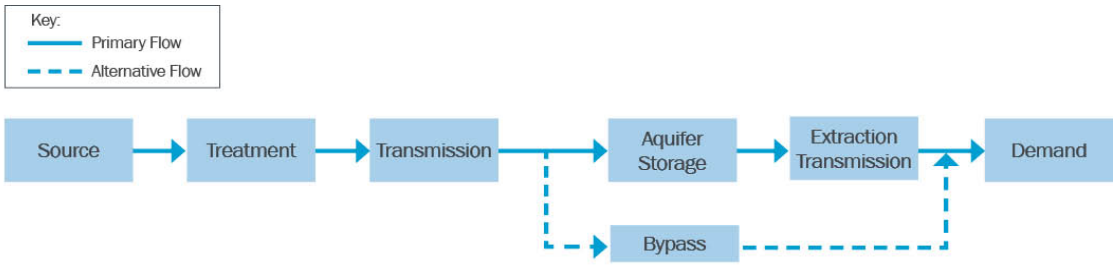
City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 15 - Desalination using Reverse Osmosis

This alternative would use seawater desalting through reverse osmosis to produce potable water at a City-owned facility. Excess water would be used for other water demands, such as conjunctive use, for example, transferred to SqCWD as potable water. SqCWD would use additional potable water for aquifer storage and recovery or for conjunctive use. SqCWD would return potable water to Santa Cruz, to make up for City shortfalls during droughts. Reverse osmosis is a proven technology, but has high capital and O&M costs. The block diagram below presents this alternative schematically. This alternative has several outstanding issues, e.g., environmental document completion, permitting through the California Coastal Commission, and public vote approving alternative implementation.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-15 DESALINATION USING REVERSE OSMOSIS

Status Update

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA - 19 ("McGilvray: (11) Seawater Desal"), WCA - 36 ("Aqueous: Desalination [non-membrane]"), WCA - 37 ("Brown: Zero-Emission Wave Energy"), WCA - 67 ("Tanaka").

Estimated Annual Yield (million gallons [MG]) [Yield will vary, adjusted later, depending upon results from Confluence modeling and findings from Pueblo regarding aquifer volume available for storage.]	550 (up to 1,100 MG in drought years)

Reliability Over Time (seasonal and inter-annual variability)

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	107	
Annual O&M ($million)	3	
30-Year Present Value ($million)	241	
30-Year PV Cost/30-Year PV MG ($/MG)	14,670	
Total Annualized Cost ($million)	8.6	
Total Annualized Cost/Avg. Annual Yield ($/MG)	16,000	
Energy (MWh/MG)	13	

Key Components

1. Onshore pumping station.	4. Pump stations and pipelines for distribution/transmission.
2. Desalination facility.	5. Improvements to the City distribution system to transfer water from SqCWD.
3. Brine storage and brine disposal pipeline.	6

Implementation Requirements Summary

Complete CEQA process. Obtain voter and City Council approval. Negotiate agreement with SqCWD and with project developer. Design, bid, build, and commission new facility.

Estimated Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	2
Preliminary and Detailed Design	1.5
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	5.5

Issues to Resolve

Marine intake and discharge locations and permits. Site acquisition for new facilities. Finalization of pipeline routes and ROW acquisition. Creating long-term contract with project developer and with SqCWD.

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
CA-16, 17, and 18	City could capture and use winter flows in parallel with CA-15	CA-10, 11, 12, and 13	City would not need to recycle if it purchased sufficient desalted water.

Capital Improvements Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)

Permitting Summary

Completion of CEQA process. California Coastal Commission approval.

EVALUATION

Technical Feasibility

Widely used.
Desal technology is widely used.

Legal Feasibility

Yes, but some ambiguities.
Water sharing agreement would need to be worked out with SqCWD; assumes facilities (pump stations, pipes, wells, etc.) would be located within Public ROW.

Regulatory Feasibility

Very slow, no regulatory change.
Assumes that considerable time to complete the environmental and regulatory process will be needed.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 15 - Desalination using Reverse Osmosis

Political Feasibility
Active resistance now.
Based on response to SCWD2 desal project, it is assumed there will be resistance but this may be overcome.

Regional Water Benefits
2 jurisdictions
Directly would impact SqCWD and SCWD.

Local Economy
Positive local.
Assumes a more stable water supply impacting a larger portion of the county will have a positive impact.

Energy
5
Desal facilities require considerable amounts of energy; pumping system will also require energy for this distance.

Marine Ecosystem Health
May harm.
Some negative impact is assumed.

Freshwater and Riparian Health
About as it is now.
Assume this ecosystem will not be modified since this alternative only fills the shortfall and does not reduce current diversions.

Terrestrial Resources
TBD
Scale for this criterion has not been developed

Environmental Profile
The environmental profile of this portfolio is acceptable with appropriate and effective mitigation.
Assumes impacts would exist but could be mitigated.

Groundwater Resources
Allows restoration.
Assumes water City does not take during wet years could be used by SqCWD and the City for GW restoration.

Infrastructure Resilience
Meets most challenges well.
Assumes new infrastructure would be built to meet codes/regulations but prolonged power outages could impact system.

Supply Reliability
Makes system significantly more reliable.
Diversifies water supply portfolio with additional source not dependent on weather.

Scalability
Can scale up ~650MG.
Alternative notes 500MG but assumes this could be increased or decreased and is the range.

Preserves Future Choices
Somewhat increases choice.
Assumes City could take desal water in wet or average years to reduce diversions if agreements written with this flexibility.

Yield
500-1000 MG

Operational Flexibility
Greatly increases .
Does not rely on existing facilities to provide all water.

Addresses Peak Season Demand
Yes

Implementability
Could be implemented with some challenges.
Requires overcoming environmental, interagency, community resistance hurdles.

Supply Diversity
Portfolio greatly increases the diversity of Santa Cruz's supply portfolio.
Adds additional source that is drought proof than current portfolio

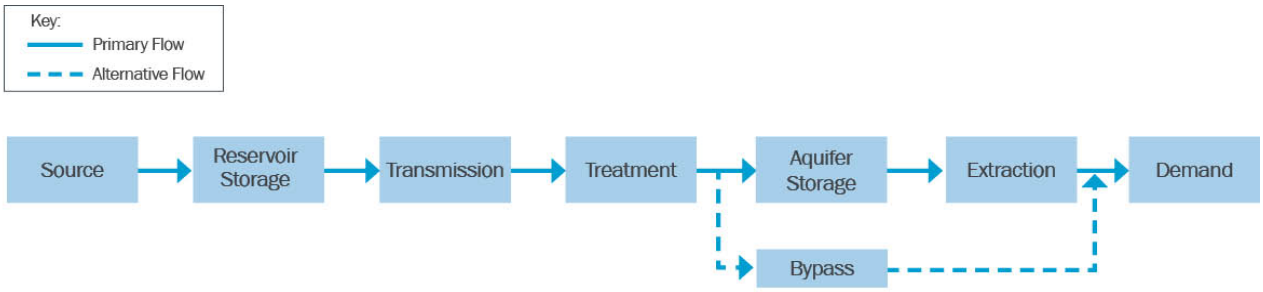
Sustainability
This portfolio is somewhat sustainable.
Assumes aspects of desal (high energy, brine) are not "sustainable" but overall system is sustainable.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 16 - Aquifer Restoration/Storage

This alternative would use treated water sold to the City to Soquel Creek County Water District (SqCWD) during normal and wet years. SqCWD would use the transferred water either for groundwater recharge through seven 250-gallon-per-minute (gpm) recharge wells, for conjunctive use (well field resting) recharge, or both. The City would take more water from its San Lorenzo River and/or Newell Creek diversions. Facilities would include Ranney collectors (CA-19) at the Felton Diversion, to insure that the Graham Hill Water Treatment Plant (GHWTP) could treat the diverted water continuously. During drought years the City would receive returned water (groundwater) from SqCWD. During a drought, the City also would pump its Live Oak Street wells year round since the recharged Purisima aquifer would yield available water without causing seawater intrusion. Potential yield would be 2 MGD from the Live Oak wells and 2.5 MGD from SqCWD; 4.5 MGD total. If the City used these sources for six months, total production, after deducting out a 1-MGD production allowance for the existing wells, would be about 560 MG annually. The Loch Lomond Bypass Tunnel would also be added.

This alternative has several outstanding issues, e.g., water rights (modification of place of use), assembling appropriate information to site injection wells, modeling the Purisima aquifer to project better potential performance, and agreement with SqCWD on how the alternative's water would be conveyed, shared and paid for. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-16 AQUIFIER RESTORATION/STORAGE

Status Update:

Eliminated CA-09 because this CA overlapped with CA-09 and was more comprehensive and complex. The Loch Lomond Bypass Tunnel has been added. Continuing to fine tuen components and costs.

Incorporated WCAs: WCA-08 ("Paul: (13) The Lochquifer Alternatives"), WCA - 28 ("Malone: Regional Water Exchanges"), WCA - 49 ("Paul: (14) Upgrade Water Intertie"), WCA - 59 ("SCDA: Enhance Existing Infrastructure"), WCA -10 ("SCDA: Regional Aquifer Restoration").

Estimated Annual Yield (million gallons [MG]) [Yield likely would be available only for a short drought of 3 or 4 years.]	560
Reliability Over Time (seasonal and inter-annual variability)	

Costs	**Best Estimate**	**Comments**
Capital Cost ($million)	34	Requires that the City implement either CA-17 or CA-19, in order to deliver required water reliably.
Annual O&M ($million)	2	
30-Year Present Value ($million)	95	
30-Year PV Cost/30-Year PV MG ($/MG)	3,480	
Total Annualized Cost ($million)	3	
Total Annualized Cost/Avg. Annual Yield ($/MG)	5,000	
Energy (MWh/MG)	3	

Key Components

1. Turbidity control facilities at Felton Diversion	4
2. Major upgrades to City distribution system for water transfer to SqCWD	5
3. Seven injection wells	6

Implementation Requirements Summary

Plan, design and permit turbidity reduction facilities at Felton. Prepare, circulation, and approve CEQA documents. Develop and enter into an agreements with SqCWD for water exchanges.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary
Consolidated Alternative 16 - Aquifer Restoration/Storage

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	2
Preliminary and Detailed Design	1.5
Bidding, Construction, and Startup	1.5
Total Duration of Estimated Implementation	5

Issues to Resolve

Site-specific geotechnical conditions; preferred siting for caisson and laterals; resolution of any water rights issues. Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; negotiate and execute contracts with property owners; bid and construct improvements; determine if new conservation easement over San Vicente quarry site would preclude development of any sort of reservoir.

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		N/A	

Capital Improvement Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	6

Permitting Summary

CEQA/NEPA compliance. Water rights issues for change of place of use and perfecting City water rights. CDFW and NMFS approvals for increased SLR diversions.

EVALUATION

Technical Feasibility
Demonstrated in field.

Legal Feasibility
Yes, but some ambiguities.
Water rights issues for change of place of use and perfecting City water rights

Regulatory Feasibility
Slow but relatively sure.

Political Feasibility
Acceptable in 5 years.

Regional Water Benefits
Across County.

Local Economy
Positive local job.

Energy
4

Marine Ecosystem Health
Cumulative harm.
Potential fisheries impacts. Construction impacts at Felton diversion and through City.

Freshwater and Riparian Health
Degraded ecosystem health.

Terrestrial Resources
N/A

Environmental Profile

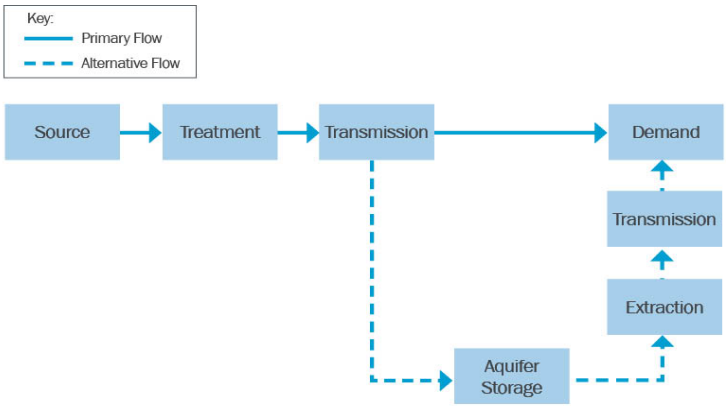
City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 16 - Aquifer Restoration/Storage
The environmental profile of this portfolio is acceptable with appropriate and effective mitigation.
Groundwater Resources Actively restores. Address groundwater overdraft/seawater intrusion and potential improved production from Live Oak wells.
Infrastructure Resilience Many moderately well.
Supply Reliability Makes system significantly more reliable.
Scalability Can scale up.
Preserves Future Choices Increases choice.
Yield 560 MG
Operational Flexibility Greatly increases.
Addresses Peak Season Demand Yes
Implementability Could be implemented.
Supply Diversity Significantly increases the diversity of Santa Cruz's supply portfolio.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 17 - Expand Treatment Capacity

This alternative would add a new 14-mgd water treatment plant (WTP) pretreatment for turbidity control, membrane filtration, and UV disinfection near the Tait Street Diversion to produce treated water that the City would pipe directly into the distribution system. The past analyses for this alternative indicate that the alternative would allow an annual water diversion increase of about 560 MG. Confluence modeling will determine actual potential yield.

The alternative has several outstanding issues, e.g., determine the final treatment train (MF would need pretreatment ahead of MF to remove elevated SLR turbidity concentration), preparation and approval of environmental documents, determination if water rights and diversion permits would need modifications (e.g., for transfer of water to ASR), and development of a plan to store and use diverted water beneficially. If the City would have excess water during normal or wet years, it might transfer extra water to Soquel Creek Water District (SqCWD) and/or Scotts Valley Water District (SVWD) but doing so would require agreements with the agencies and would trigger water rights permit modifications since the place of use would change. For example, see Lochquifer and SCDA alternatives for components needed to transfer water to SqCWD for storage and recovery. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-17 EXPANDED TREATMENT CAPACITY

Status Update:

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA-06 ("McKinney: Expanded Treatment Capacity"), WCA - 27 ("Malone: Enhanced Storage and Recharge").

Estimated Annual Yield (million gallons [MG])	Up to 977 MGY if City perfects its right to SLR diversion with **about 560 MGY in new water**. Availability of water may decrease substantially in drier years.

Reliability Over Time (seasonal and inter-annual variability)

Costs	**Best Estimate**	[redacted]	**Comments**
Capital Cost ($million)	58		Assumes only treated water
Annual O&M ($million)	4		
30-Year Present Value ($million)	203		
30-Year PV Cost/30-Year PV MG ($/MG)	2,000		
Total Annualized Cost ($million)	4		
Total Annualized Cost/Avg. Annual Yield ($/MG)	1,000		
Energy (MWh/MG)	3		

Key Components

1. Low head pumping to new MF WTP	4. UV Disinfection and conditioning.
2. Turbidity reduction system to protect MF system from high turbidity and potential fouling organic carbon.	5. Backwash and filter cleaning solution management systems.
3. Microfiltration (MF) process	6. Solids management (sewer discharge?).
7. Pump Station to transfer treated water to the City distribution system.	

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 17 - Expand Treatment Capacity

Implementation Requirements Summary

Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; bid and construct improvements and initiate operations.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	2
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation	6

Issues to Resolve

Right-sizing for new WTP; water rights issues; available flows versus any new fish bypass requirements; possible need for new pipelines for potable water and for excess water used for groundwater recharge. Possibility of using new MF WTP to replace GHWTP; possibility of using extra water for groundwater recharge if the City can resolve legal issues associated with water rights and reach agreement with other local agencies, e.g. SVWD and/or SqCWD.

Compatible CAs	Comments	Incompatible CAs	Comments

Capital Improvements Projects Not Needed	Comments	Capital Improvements Projects Needed	Comments

Required Land Area (acres)	1

Permitting Summary

CEQA/NEPA compliance; NWFS and CFDFW sign offs.

EVALUATION

Technical Feasibility

Widely used.

Legal Feasibility

Can probably acquire.

Actions to perfect water rights; potentially adjust diversion based upon HCP and revised, higher bypass need to be addressed.

Regulatory Feasibility

Slow but relatively sure.

Political Feasibility

Acceptable now.

Regional Water Benefits

3 jurisdictions.

Local Economy

Positive local job impact.

Energy

4

Marine Ecosystem Health

Cumulative harm.

Increased GHGs, thus site selection is crucial; salmonoid population.

City of Santa Cruz Water Supply Advisory Committee Solutions Phase -- Technical Summary
Consolidated Alternative 17 - Expand Treatment Capacity
Freshwater and Riparian Health About as it is now.
Terrestrial Resources N/A
Environmental Profile The environmental profile of this portfolio is acceptable with appropriate and effective mitigation.
Groundwater Resources Depletes resources. Possibly depletes; depends on future of water source availability.
Infrastructure Resilience Meets most challenges well. New infrastructure with current seismic/building codes.
Supply Reliability Moderate increase in supply reliability.
Scalability Can scale up.
Preserves Future Choices Increases choice.
Yield 560 MG
Operational Flexibility Greatly increases.
Addresses Peak Season Demand No
Implementability Could be implemented with some challenges.
Supply Diversity Somewhat increases the diversity of Santa Cruz's supply portfolio.
Sustainability This portfolio is somewhat sustainable.

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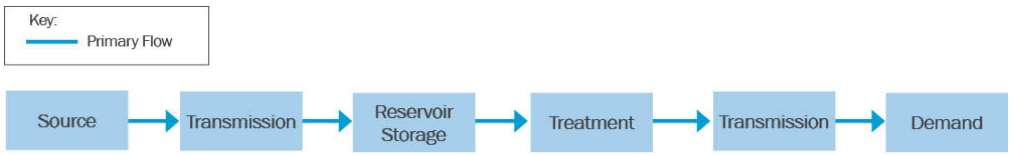
City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 18 - Off-Stream Water Storage

This alternative uses an increased Newell Creek dam height to increase storage in Loch Lomond 260 MG. The Loch Lomond Bypass Tunnel would be added as well. This alternative has several outstanding issues, e.g., water rights (new diversion location from which to fill the reservoir, routing of fill pipeline), geotechnical and construction issues associated with installing a liner on steep slopes over a porous karst formation, preparation and approval of environmental documents, California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) approvals for water diversions from streams with salmonid populations, and agreements with the landowner about ownership and operations. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-18 OFF-STREAM WATER STORAGE

Status Update

This CA is now the raising of the dam at Loch Lomond. Quarries were eliminated from this CA due to the possible geotechnical hazards the karst formations and potentially unstable quarry walls. Continuing to fine tune components and costs.

Incorporated WCAs: WCA-06 ("McKinney: Expanded Treatment Capacity"), WCA - 27 ("Malone: Enhanced Storage and Recharge").

Reliability Over Time (seasonal and inter-annual variability)

Estimated Annual Yield (million gallons [MG]) [Quarry reservoir would be dry after three drought years.]	260

Costs	**Best Estimate**	[redacted]	**Comments**
Capital Cost ($million)	155		
Annual O&M ($million)	1		
30-Year Present Value ($million)	315		
30-Year PV Cost/30-Year PV MG ($/MG)	41,060		
Total Annualized Cost ($million)	12		
Total Annualized Cost/Avg. Annual Yield ($/MG)	48,000		
Energy (MWh/MG)	12		

Key Components

1. Stabilize quarry rim to prevent landslides and protect proposed new facilities. Cleaned and recontoured quarry walls.	4. Pumping stations to draw water from other City North Coast water sources.
2. Impervious poly liner with supporting cushion layer, installed over chain link base to separate liner from remaining wall roughness.	5. Installation of Ranney collectors or new SLR WTP, so that City would use SLR water rights, allowing North Coast rights to fill new reservoir.
3. Directionally drilled inlet/outlet pipeline, connected to Liddell Springs pipeline.	6

Implementation Requirements Summary

Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; negotiate and execute contracts with property owners; bid and construct improvements; determine if new conservation easement over San Vicente quarry site would preclude development of any sort of reservoir.

Estimated Implementation Schedule (years)

Planning, Permitting, and Interagency Agreements	4
Preliminary and Detailed Design	2
Bidding, Construction, and Startup	2
Total Duration of Estimated Implementation Schedule	8

Issues to Resolve

Landownership and project compatibility with proposed easements; karst topography and geology; slopes, potential annual loss through leakage; legality of water appropriation and transfer; impact of variations in annual rainfall versus actual water production. Possibly use excess water produced by the Ranney collectors, after treatment, for groundwater recharge.

Compatible CAs	**Comments**	**Incompatible CAs**	**Comments**
		N/A	
Capital Improvement Projects Not Needed	**Comments**	**Capital Improvements Projects Needed**	**Comments**

Required Land Area (acres)	50+

Permitting Summary

Likely permits include stream bed alteration permit(s) from CA DF&W, CA Division of Safety of Dams, County building permits (s),Coastal permits, USACE (?), and NMFS (?)

EVALUATION

Technical Feasibility

Consolidated Alternative 18 - Off-Stream Water Storage

More than 10 years.

Legal Feasibility
Can probably acquire.
Water rights for diversion from existing stream flows; releases to maintain downstream flows; landownership and deed/land-use restrictions.

Regulatory Feasibility
Very slow.

Political Feasibility
Acceptable in 10 years.

Regional Water Benefits
Across County.

Local Economy
Positive local job.

Energy
4

Marine Ecosystem Health
Does not harm.
Remediation of limestone quarries, salmonoid population impacts and required bypass flows and other aquatic/land species, karst topography; potential energy use for pumping water into or out of storage reservoirs. Unknown impacts on other species around the reservoirs.

Freshwater and Riparian Health
Degraded ecosystem health.

Terrestrial Resources
N/A

Environmental Profile
The environmental profile of this portfolio is not acceptable and/or cannot be made acceptable even with effective mitigation).

Groundwater Resources
Does not affect; may help if significantly reduces groundwater withdrawal.

Infrastructure Resilience
Meets most challenges well.

Supply Reliability
Moderate increase in supply reliability.

Scalability
Not scalable; may be difficult to scale.

Preserves Future Choices
Reduces choice.

Yield
260 MG

Operational Flexibility
Moderately increases.

Addresses Peak Season Demand
Yes

Implementability
Could be implemented with some challenges.

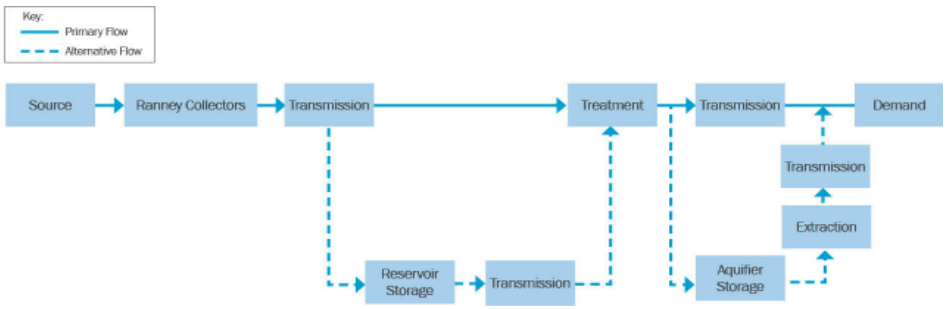
Supply Diversity
Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio.

Sustainability
This portfolio is somewhat sustainable.

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 19 -Ranney Collectors

This alternative would use Ranney collectors with a 12.9-mgd capacity (maximum capacity allowed under the current City of Santa Cruz [City] diversion permit) installed near the City's Felton diversion to draw water allocated under the City's existing water rights. Water drawn through the collectors would have greatly reduced turbidity. Much higher water quality would allow continuous refilling of Loch Lomond while also operating the GHWTP. More studies would be required to project increased diversion opportunity, however the increased diversion likely would be somewhat less than about 560 MG annually as projected for CA-17. The alternative has several outstanding issues, e.g., the City would need to conduct additional analyses for available flow, addressing any bypass requirements under the habitat conservation plan. The City would also need to determine its plan to store and use diverted water beneficially. If the City would have excess water during normal or wet years, the City might transfer extra water to Soquel Creek Water District (SqCWD) and/or Scotts Valley Water District (SVWD) but doing so would require agreements with the agencies and likely would trigger water rights permit modifications since the place of use would change. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-19 RANNEY COLLECTORS

Status Update:

No substantial changes since the March 2015 WSAC meetings, but continuing to fine tune components and cost estimates.

Incorporated WCAs: WCA-07 ("McKinney: Ranney Collectors on SLR"), WCA-42 ("McGilvray: (4,5) Upgrade Water Treatment"), WCA - 48 ("Paul: (12) Diversion Alternatives"), WCA-49 ("Paul: (14) Upgrade Water Intertie"), WCA-57 ("Paul: (23) Loch-Down Alternatives")

Estimated Annual Yield (million gallons [MG])			Up to 977 MGY if City perfects its right to SLR diversion with **about 560 MGY in new water.** Availability of water may decrease substantially in drier years.
Reliability Over Time (seasonal and inter-annual variability)			
Costs	**Best Estimate**	[redacted]	**Comments**
Capital Cost ($million)	17		Assumes only treated water
Annual O&M ($million)	1		
30-Year Present Value ($million)	63		
30-Year PV Cost/30-Year PV MG ($/MG)	520		
Total Annualized Cost ($million)	1		
Total Annualized Cost/Avg. Annual Yield ($/MG)	300		
Energy (MWh/MG)	4		

Key Components	
1. Ranney collectors installed by Felton Diversion.	4
2. New pipeline from Felton Pump Station to Loch Lomond.	5
3. Continuous refill of Loch Lomond.	6

Implementation Requirements Summary

Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; bid and construct improvements and initiate operations.

Estimated Implementation Schedule (years)	
Planning, Permitting, and Interagency Agreements	3
Preliminary and Detailed Design	1.5
Bidding, Construction, and Startup	1.5
Total Duration of Estimated Implementation Schedule	6

Issues to Resolve

Site-specific geotechnical conditions; preferred siting for caisson and laterals; resolution of any water rights issues. Possibly use excess water produced by the Ranney collectors, after treatment, for groundwater recharge.

Compatible CAs	Comments	Incompatible CAs	Comments

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 19 -Ranney Collectors

Capital Improvements Projects Not Needed	Comments	Capital Improvements Projects Needed	Comments

Required Land Area (acres) N/A

Permitting Summary
CEQA/NEPA compliance; NMFS and CFDFW sign offs.

EVALUATION

Technical Feasibility
Demonstrated in field.

Legal Feasibility
Yes, but some ambiguities.

Regulatory Feasibility
Slow but relatively sure.

Political Feasibility
Acceptable in 5 years.

Regional Water Benefits
Across County.

Local Economy
Positive local job.

Energy
4

Marine Ecosystem Health
Cumulative harm.

Freshwater and Riparian Health
Degraded ecosystem health.
Potential increased diversion and related adverse impacts on fishery.

Terrestrial Resources
N/A

Environmental Profile
The environmental profile of this portfolio is acceptable with appropriate and effective mitigation .

Groundwater Resources
Actively restores.

Infrastructure Resilience
Many moderately well.

Supply Reliability
Makes system significantly more reliable.

Scalability
Can scale up.

Preserves Future Choices
Increases choice.

Yield
560 MG

Operational Flexibility
Greatly increases.

Addresses Peak Season Demand
Yes

Implementability
Could be implemented.

Supply Diversity
Portfolio significantly increases the diversity of Santa Cruz's supply portfolio.

Sustainability
This portfolio is somewhat sustainable.