POTABLE REUSE FEASIBILITY STUDY

In 2014, the City of Santa Barbara (City) initiated a potable reuse feasibility study to meet requirements set forth by City Council and the Regional Water Quality Control Board. The study explored alternatives for replacing its desalination plant's permitted capacity of 10,000 acre-feet per year (AFY) with potable reuse or supplying 11,400 AFY of potable reuse for alternatives affecting the City's planned 1,400 AFY of non-potable reuse (NPR). Alternatives involved using indirect or direct potable reuse, both of which are described below.

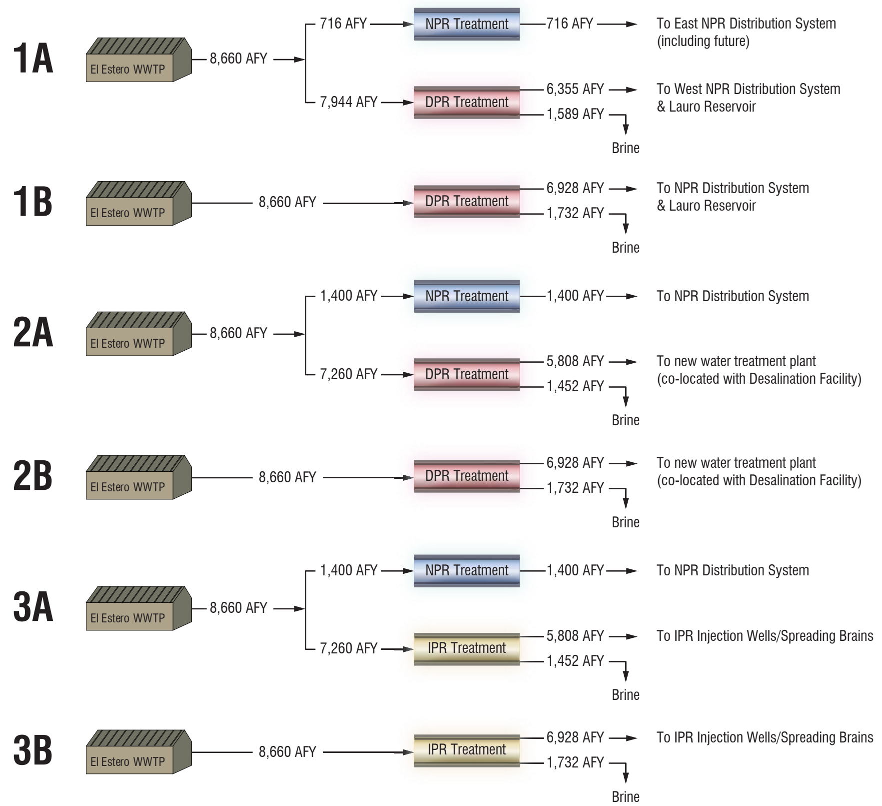
1) Indirect potable reuse (IPR): Advanced treated water is introduced into a groundwater aquifer and is then withdrawn for potable purposes.
2) Direct potable reuse (DPR): Advanced treated water is used to augment raw surface water supplies and is then re-treated as a surface water before being distributed for potable purposes.

To evaluate these alternatives, several criteria were established based on geotechnical, hydrogeological, and oceanographic factors as well as the presence of sensitive habitats and any design and construction constraints. Alternatives were then classified as "not feasible," "potentially feasible but does not meet current study goals," or "potentially feasible." Only "potentially feasible" alternatives would be evaluated further for their social, environmental, and economic feasibility.

The study included a technical advisory panel (TAP) to provide an independent, third part review of the feasibility evaluation at key intervals throughout the project duration. The TAP had the following three objectives: 1). Provide timely review of project work products by subject matter experts to advise and guide the study; 2). Facilitate input from project stakeholders that can be used to inform the City's comparison of alternatives; and 3). Create a record of the review and stakeholder process to be included as an appendix to the feasibility study report. The City retained the services of the National Water Research Institute (NWRI) to administer the TAP, including soliciting public comments and providing complete documentation of the technical review and comment process on the project website.

As presented in Figure 1, six alternatives (Alternatives 1A, 1B, 2A, 2B, 3A, and 3B) were identified for evaluation, all involving combinations of NPR, IPR, DPR, along with siting and layout of an advanced water treatment facility (AWTF). The maximum potential yield of potable reuse water that is technically feasible was identified for each alternative and is summarized in Table 1.

ALTERNATIVE NUMBER | FLOW DIAGRAM | DESCRIPTION NOTES



1A – Maximize NPR treatment & use Lauro Reservoir
- Only tertiary treated flow going east.
- DPR treat all flows going west.
- DPR treated flow sent to Lauro Reservoir.
- Alternative maximizes NPR treated flow.

1B – Maximize DPR by minimizing NPR & use Lauro Reservoir
- Title 22 system is removed, and all flow is DPR treated and sent to Lauro Reservoir.

2A – Maximize NPR treatment & use new WTP
- NPR system remains in place as is.
- Remaining flow is sent to DPR facility, and retreated at new WTP co-located with Desalination Facility.

2B – Maximize DPR by minimizing NPR & use new WTP
- NPR system is removed, and all flow is DPR treated and retreated at new WTP co-located with Desalination Facility.

3A – Maximize NPR treatment & use remaining flow for IPR
- NPR system remains in place.
- The remaining water is used for IPR and is injected/spread.

3B – Maximize IPR by minimizing NPR
- NPR system is removed, and all flow is IPR treated and sent to injection wells/spreading basins.

NOTES:
1. RO recovery is assumed to be 80% for treatment process involving RO membranes (i.e., IPR and DPR).

Figure 1
Final Summary of Potable Reuse Alternatives

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Table 1 Potential Maximum Yields of Alternatives

Alternative Number	Potential Maximum Yields (AFY)				
	NPR Yield	IPR Yield	DPR Yield	Desalination Yield	Total Yield
Alternative 1A	716	0	6,355	10,000	17,071
Alternative 1B	0	0	6,928	10,000	16,928
Alternative 2A	1,400	0	5,808	5,000(1)	12,208
Alternative 2B	0	0	6,928	5,000(1)	11,928
Alternative 3A	1,400	5,808	0	10,000	17,208
Alternative 3B	0	6,928	0	10,000	16,928

Note:

(1) As presented in Section 3.5.1, desalination yield is reduced because half of the site is used for new WTP that treats AWTF product water before distribution to the City's potable water system.

After evaluating the six alternatives for their technical feasibility, all were deemed either "not feasible" or "potentially feasible but doesn't meet the study goals." For a breakdown of the results and the reasons for them, consult Table 2.

Because an alternative must be deemed "potentially feasible" to pass this level of screening, no alternative was selected for further analysis of social, environmental, and economic factors. However, although the alternatives did not pass initial screening, the study did give the City valuable technical information for future water supply planning studies.

The State of California has standard regulations for indirect potable reuse; however, there are not currently standard regulations for direct potable reuse. This is an industry topic that continues to evolve. Recently, in accordance with California Water Code 13560-13569, the State released a December 2016 report entitled, "Investigation of the Feasibility of Developing Uniform Water Recycling Criteria". The general findings in the report were that standard regulations for direct potable reuse are attainable, but knowledge gaps exist and additional research is necessary to assure adequate public health protection prior to adoption of standard regulations. The City intends to track the State's progress in developing uniform regulations for direct potable reuse, as it may be a potentially feasible option for the City in the future.

Table 2 Potable Reuse Alternatives Initial Screening Results

	Initial Screening Criteria	Potable Reuse Alternative: Alternative 1A	Alternative 1B	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Geotechnical Hazards							
1	*Seismic Hazard*						
a.	Project facilities would cross a known fault line, or be exposed to a seismic hazard that could otherwise not be protected from loss by design	PF	PF	PF	PF	NF	PF
Hydrogeological Factors							
2	*Operation of groundwater replenishment facilities (i.e., injection wells or spreading basin) adversely impacts existing fresh water aquifers, local water supplies or existing water users*						
a.	Insufficient travel time (e.g., < 2 months) between groundwater replenishment point and other groundwater users	PF(4)	PF(4)	PF(4)	PF(4)	PF	PF
3	*Operation of groundwater replenishment facilities (i.e., injection wells or spreading basin) adversely impacts sensitive habitats such as marshlands, drainage areas, etc.*						
a.	Operation of facility adversely changes water quality of habitat (e.g., salt water habitat becomes fresh water)	PF(4)	PF(4)	PF(4)	PF(4)	PF(6)	PF(6)
4	*Insufficient storage space*						
a.	Groundwater basin lacks adequate storage capacity to receive 10,000 AFY (or 11,400 AFY) at build-out	PF(4)	PF(4)	PF(4)	PF(4)	PF*	PF*
b.	Groundwater replenishment of IPR water causes loss of ability to adequately manage the groundwater basin (e.g., artesian or flooding conditions, loss of stored water, etc.)	PF(4)	PF(4)	PF(4)	PF(4)	PF	PF
c.	Groundwater replenishment of IPR water does not result in an increase in total basin yield and overall yield of 10,000 AFY (or 11,400 AFY)	PF(4)	PF(4)	PF(4)	PF(4)	PF*	PF*
Oceanographic Factors							
5	*Sea level rise or tsunami hazard*						
a.	Oceanographic hazards make aspects of the project infrastructure vulnerable in a way that cannot be protected and/or would prevent the City from being able to receive funding or insurance for this concept	PF	PF	PF	PF	PF	PF

Initial Screening Criteria		Potable Reuse Alternative Alternative 1A	Alternative 1B	Alternative 2A	Alternative 2B	Alternative 3A	Alternative 3B
Presence of Sensitive Habitats							
7	*Habitat creation*						
a.	Facility creates habitat that is unsustainable (i.e., requires continued discharge by IPR or DPR facility) or adversely affects local ecosystem	PF	PF	PF	PF	PF	PF
Design and Construction Constraints							
7	*Adequate Capacity*						
a.	Availability of effluent needed to produce 10,000 AFY (or 11,400 AFY) of recycled water at build-out	PF*	PF*	PF*	PF*	PF*	PF*
b.	IPR or DPR production capacity and/or aquifer losses result in less than 10,000 AFY (or 11,400 AFY) of production at build-out	PF*	PF*	PF*	PF*	PF*	PF*
8	*Lack of adequate land required for IPR or DPR treatment facilities or groundwater replenishment facilities*						
a.	Surface area needed for footprint of IPR or DPR treatment facilities or groundwater replenishment facilities is greater than what is available.	PF	PF	PF	PF	PF	PF
b.	Requires condemnation of property for new injection well facilities.	PF(4)	PF(4)	PF(4)	PF(4)	PF	PF
Passes Initial Screening? Yes (Y) or No (N)		**N**	**N**	**N**	**N**	**N**	**N**
Regulations Exist in CA? Yes (Y) or No (N)[6]		**N(7)**	**N(7)**	**N(7)**	**N(7)**	**Y**	**Y**

Notes:

(1) NF = Not Feasible.
(2) PF = Potentially Feasible.
(3) PF* = Potentially Feasible, but does not meet current study goals.
(4) Potentially feasible because alternative does not include an IPR component. Thus, this initial screening criteria is not applicable.
(5) Additional study will be required to locate groundwater replenishment wells at locations that will not adversely affect sensitive areas or other users.
(6) Do standard regulations exist in the state of California currently to implement the alternative?
(7) Although regulations do not exist in California, DDW has stated that they will review DPR projects on a "case by case" basis. Refer to Section 3.2.2 for additional discussion.