

Since 1970, the number of people living in California nearly doubled and now stands at more than 39 million people. The state's population is expected to continue increasing by about 500,000 people-per-year over the next two decades. Assuring an adequate supply of clean, safe affordable water to all current and future residents poses a significant resource management challenge. The need to deal with recurrent droughts makes the task more difficult. The possibility that climate change may increase the frequency, duration and severity of such droughts makes the task more urgent.

It is likely that water supply agencies will continue to employ on a wide array of strategies to meet the challenge. This includes: more efficient use of existing water supplies (conservation), greater reliance on recycled water, increasing stormwater capture and implementing more advanced technologies such as desalination. In 2009, the State Water Resources Control Board (SWRCB) established ambitious goals to affirm this effort:

- * Increase urban and industrial water conservation by 20%, compared to 2007.
- * Harvest 500,000 acre-feet/year more stormwater, compared to 2007.
- * Use 2 million more acre-feet/year of recycled water by 2030, compared to 2002.
- * Substitute as much recycled water for potable water as possible by 2030.

In the years since these goals were first adopted, California has experienced one of the worst droughts of the modern era. Consequently, state authorities enacted several new water resource management requirements including conservation mandates and measures to protect groundwater supplies. At the same time, acting pursuant to the Governor's direction, the SWRCB recently developed new permitting regulations designed to accelerate the use of recycled water throughout the state.

To support the project planning and permitting required to implement these statewide initiatives, the Southern California Salinity Coalition (SCSC), an association of water supply and recycled water agencies, needs to better understand the complex interrelationship between drought, conservation and recycled water quality. SCSC is particularly interested in evaluating the long-term trend for salinity in recycled water and assessing how periodic droughts and various conservation measures may influence these trends.

CSC is seeking a team of qualified technical consultants to aid in this effort by undertaking an investigation to characterize and quantify these relationships based on a series of case studies in the member agencies local service areas. SCSC has no particular policy outcome in mind but, rather, is looking for objective analysis to improve water resource management decisions across a broad spectrum of cross-connected issues. To that end, respondents should propose a Scope-of-Work designed to answer the following research questions for each of the case study service areas identified below.

Research Questions

- 1) How has indoor per-capita water use changed over time (approximately 1981-2016, depending on data availability)? Is there a discernable trend? If so, what are the water quality implications if that prior trend were to continue for the next 20 years?
- 2) How has the volume- weighted average concentration of TDS* in municipal influent and treated effluent changed over time? Is there a discernable trend? If so, what are the water quality implications if that prior trend were to continue for the next 20 years?
- 3) How has the residential/commercial per-capita "increment-of-use" for TDS changed over time? Is there a discernable trend? If so, what are the water quality implications if that prior trend were to continue for the next 20 years?
(Increment of Use = Average TDS in Final Effluent - Average TDS in Local Water Supply)
- 4) What proportion of the increase in average per-capita increment of use is attributable to widespread implementation of low flow plumbing fixtures and appliances?
- 5) What proportion of the increase in average per-capita increment of use (for TDS, chloride and sodium) is attributable to incremental installation of self-regenerating water softeners?
- 6) To what degree are fluctuations in the volume-weighted average concentration of TDS in recycled water correlated with variations in the volume-weighted average concentration of TDS in the wastewater influent (aka "raw sewage")?
- 7) To what degree are fluctuations in the volume-weighted average concentration of TDS in recycled water correlated with variations in the volume-weighted average concentration of TDS in the municipal water supply? What other factor(s) best explain the uncorrelated residuals?
- 8) To what degree are fluctuations in the volume-weighted average concentration of TDS in recycled water correlated with long-term meteorological (drought) cycles?
- 9) What affect, if any, did the state's mandatory conservation measures (2015-16), and the subsequent relaxation of these measures, have on average per capita indoor and outdoor water use?
- 10) What affect, if any, did the 2015-16 changes in average per-capita indoor water use have on the average concentration of TDS in wastewater influent and recycled water?
- 11) Based on the results produced for Questions #9, #10 & #11, what are the implications for the trends described in Questions #1, #2 & #3 if precipitation patterns over the next 20 years are "drier than normal" (i.e. in the range predicted by each agency's own planning estimates).
- 12) How does the volume-weighted average TDS concentration in recycled water, and the related increment-of- use, vary using a range of rolling averaging periods (e.g. 1, 5, 10, & 15 yrs.)?

*TDS = Total Dissolved Solids in milligrams-per-liter; may also be estimated by measuring specific conductance ($\mu\text{S}/\text{cm}$) and applying appropriate unit conversions.

Case Study Service Areas

- 1) San Diego Water Authority
- 2) Eastern Municipal Water District
- 3) Inland Empire Utilities Agency
- 4) LACSD/LADWP
- 5) Orange County Water District/Orange County Sanitation District
- 6) City of Riverside Utilities Dept.
- 7) City of San Bernardino Water Dept.

Data Analysis

Consultant is encouraged to use a combination of Engineering Analysis and Statistical Data Analysis to answer the research questions. Monthly water quality and flow data (principally drawn from prior DMR submissions) will be provided to the consultants for each of the case study service areas. Additional data characterizing the volume and salinity characteristics of imported water will be provided by Metropolitan Water District.

Consultant is also encouraged to cite other publically available scientific and technical data, including but not limited to the recent Salt and Nitrogen Management Plans (SNMP), to supplement their analysis corroborate their findings. The projections requested in Research Questions #1, #2, #3 and #11 are intended to evaluate the implications of potential climate change. Consultant is directed to rely on the same authoritative and credible scientific studies used by the case study agencies for their own water supply planning when preparing the aforementioned projections.

Responsive proposals must provide a detailed description of the data required, and the analyses the consultant intends to perform, to answer each of the primary research questions.

Deliverables

- 1) Detailed data request to participating agencies
- 2) Pilot case study of applied methodologies
- 3) Draft report (pilot case study and all remaining case studies)
- 4) Final report (approx. 100 pages)
- 5) CD-Rom (w/ all spreadsheet and databased files used in study project)

Project Management

SCSC will appoint a Technical Advisory Committee (TAC) to oversee completion of the study project. TAC will meet with the consultant monthly to coordinate project implementation. Ten such meetings are anticipated; half will be in-person and the other half will likely take place via teleconference.

Publication

The consultant is encouraged to disseminate results from the final report, in scholarly articles, papers or presentations with appropriate credit to and prior approval from SCSC and the National Water Research Institute (NWRI).

Preliminary Project Schedule

Task	Description	Due Date
1	Data request to participating agencies	Feb. 15, 2017
2	Data submitted by participating agencies	Feb. 28, 2017
3	Data preparation complete (QA/QC & merge)	Mar. 31, 2017
4	Complete pilot case study	Apr. 30, 2017
5	SCSC provides comments on pilot case study	May 15, 2017
6	Draft Report (all case studies)	July 31, 2017
7	SCSC provides comments on draft report	Aug. 31, 2017
8	Final Report	Oct. 31, 2017