CORONA ENVIRONMENTAL CONSULTING

To: Water Foundation
From: Tarrah Henrie and Chad Seidel, Corona Environmental Consulting
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Re: Cost analysis of California drinking water system mergers

In 2012, Assembly Bill 685 added Section 106.3 to the California Water Code: "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." In July 2019, Governor Newsom signed Senate Bill 200, which established an ongoing funding to fulfill the state's promise of the Human Right to Water.

While there are at least 285 water systems that violate drinking water standards on California's Human Right to Water website, this number does not capture the total number of water systems that are struggling and are at risk of failing in the future. Many of these systems are small and their customers are economically disadvantaged. This analysis seeks to quantify the needs of non-compliant and struggling water systems and determine the capital (one-time) cost of physically consolidating struggling water systems with successful systems that can deliver safe water to customers (hereafter referred to as "mergers").

This project is a first step toward understanding the viability and potential costs of water system mergers. The findings can help the State Water Board prioritize investments of the Safe and Affordable Drinking Water Fund and determine the cost-effectiveness of mergers across a variety of scenarios. This project supports a broader statewide assessment of total costs to ensure safe water for all that is currently underway and provides recommendations on areas for further analysis and research.

Key Findings

The water systems that were evaluated in this project are shown on a map in Figure 1. Because locational data is unavailable for state small water systems and private domestic wells, those two categories could not be evaluated for merger potential. Below is a summary of the key findings of this project:

- About 35 percent to 45 percent of small systems (with a population less than 3,300) that violate drinking water standards could potentially be physically merged with nearby larger systems that comply with all drinking water standards.
- The capital costs to merge small systems that currently violate drinking water standards with nearby systems that comply with standards ranges from $140 million to $211 million.
- Mergers between systems less than a quarter of a mile apart are the most cost-effective. As shown in Figure 2, approximately 38 of the more than 285 systems violating drinking water standards could be merged with nearby compliant systems at a cost between $19 million and $25 million.
- The costs to merge small systems with total coliform violations, a measure of bacterial contamination not captured in the estimate of systems in violation above, with nearby systems that comply range from $173 million to $223 million.
- The costs to merge small systems with 1,2,3-TCP contamination, assuming that large systems that are currently in violation will come into compliance, range from $107 million to $124 million.
- The costs to merge small systems with hexavalent chromium [Cr(VI)], a compound that is not currently regulated and therefore not captured in the estimate of systems in violation above, with nearby systems that are assumed to come into compliance range from $121 million to $190 million.
- The cost to merge all very small systems (with a population less than 500) is $2.88 billion to $3.55 billion.
- The cost to merge all small systems (with a population less than 3,300) is $3.31 billion to $5.47 billion.

- *Figure 1. Map of drinking water systems evaluated in this project.*

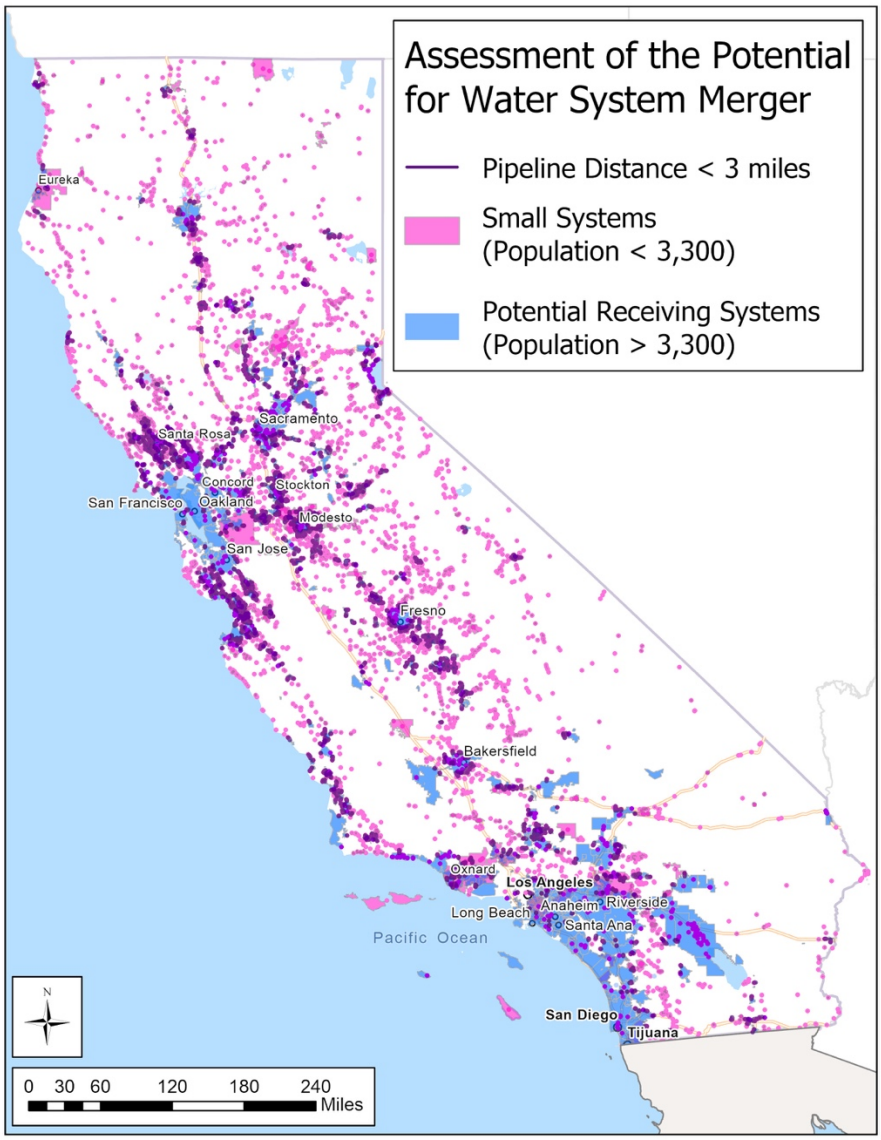
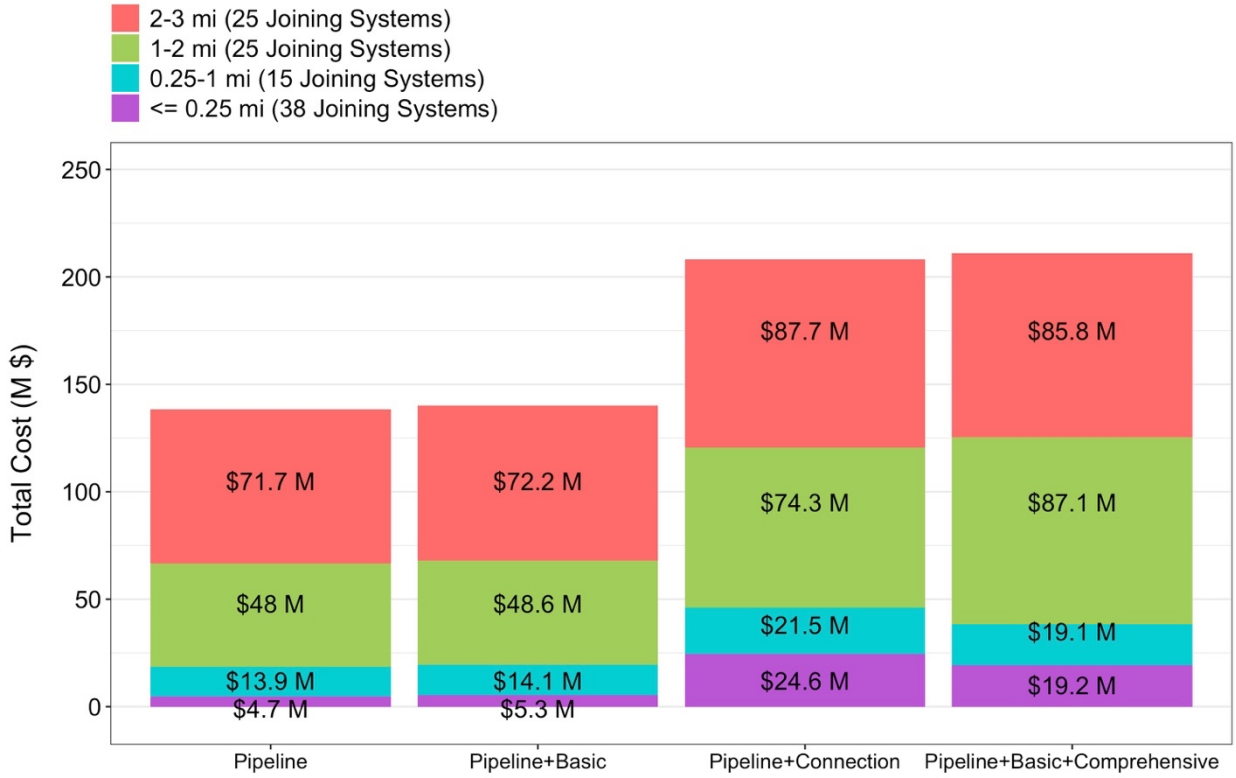


Figure 2. Small systems in violation merger costs.



Methodology and Data Sources

This section outlines our methodology, including the six scenarios evaluated and related cost assumptions. Please refer to the caveats and assumptions section at the end for additional details about the methodology.

Data sources include:

- Human Right to Water (HR2W) Portal
  - List of compliant and non-compliant systems
- California Environmental Health Tracking Program (CEHTP)
  - System service areas
- California State Water Resources Control Board (SWRCB) Geotracker
  - Well locations for Non-Community Water Systems
- United States Environmental Protection Agency Safe Drinking Water Information System (SDWIS) and SWRCB Division of Drinking Water data
  - Water system inventory
  - Additional water system and water quality data

We used GIS to conduct network analysis, and the shortest path along the roadway system was determined between potential receiving systems and potential joining systems. Water system boundary data was accessed via the Water Boundary tool on the Tracking California website. Boundary shapes were repaired and wholesale systems were removed pursuant to a protocol developed by Amanda Fencl, with the University of California at Davis. Mergers with a pipeline length over 3 miles were not considered feasible.

The six different scenarios that we evaluated are outlined in Table 1.

Table 1. Scenarios.

Scenarios	Role	Population	Compliance Status
Scenario 1 – Small systems in Violation	Joining	<3300	In violation
	Receiving	>3300	Compliant
Scenario 2 – All Small Systems	Joining	<3300	All systems
	Receiving	>3300	Compliant
Scenario 3 – All Very Small Systems	Joining	<500	All systems
	Receiving	>3300	Compliant
Scenario 4 – Total Coliform Violations	Joining	<3300	TC violations
	Receiving	>3300	Compliant
Scenario 5 - 1,2,3-TCP	Joining	<3300	All systems
	Receiving	>3300	Assumed to come into compliance
Scenario 6 - Cr(VI)	Joining	<3300	Cr(VI) > 10 ppb
	Receiving	>3300	Assumed to come into compliance

TC = total coliform
TCP = trichloropropane
Cr(VI) = hexavalent chromium

Cost assumptions

Pipeline Cost

A pipeline cost of $206 per foot was used based on cost estimates from California Water Service. This cost is reasonable for the Central Valley, but it does not reflect costs in more expensive areas such as Los Angeles and the Bay Area, or within a city.

Basic Cost

The costs outlined below are the minimum necessary costs beyond the pipeline for a merger. It is unlikely that this would be enough funding for a typical merger.

- $5000/system for service line for joining systems within receiving boundary
- $233/meter (per connection)
- Backflow prevention
    - $500 for most non-community water systems (NCWS)
    - $1,500 for community water systems (CWS)
        - Assumes 3 small assemblies

- $10,000 per system, for systems with population > 250/conn

Connection Fee

An assumption of $10,000 per connection was applied to all joining system sizes. Actual connection fees vary widely across the state. A connection fee is a mechanism for charging new customers for the infrastructure associated with water service. This could be a fair method of reimbursement to the receiving system.

Comprehensive Cost

Another way of looking at the cost for a merger is to account for the missing or dated infrastructure that will be needed to bring the joining system up to industry standards. Below are the cost assumptions applied in the comprehensive cost:

- $100,000 for well destruction or pipeline split for large schools
- Additional costs for systems serving a population > 500:
  - $250,000 Storage tank
  - $50,000 Land for tank
  - $150,000 Boosters
  - $250,000 Backup power
  - $82,000 New well pump
  - $100,000 SCADA
  - $1,500,000, New well for every 1500 people
  - $16,480/connection for main replacement

This cost estimate does not include main replacement for systems with a population of under 500 people, which may substantially under estimate the cost of merger.

Estimated Costs of Water System Merger by Scenario

Table 2 through Table 5 show the estimated costs of merger under the different cost assumptions. The higher cost assumptions in the "Pipeline + Connection Fee and the Pipeline + Basic + Comprehensive Costs" are the most conservative set of assumptions under most scenarios.

Table 2. Scenario 1 - Small Systems in Violation Cost

Distance between Systems	# Systems	Pipeline Cost	Pipeline + Basic Costs	Pipeline + Connection Fee	Pipeline + Basic + Comprehensive Costs
≤ 0.25 mi	38	$4.7 M	$5.3 M	$25 M	$19 M
0.25 - 1 mi	15	$13.9 M	$14 M	$22 M	$19 M
1 - 2 mi	25	$48 M	$49 M	$74 M	$87 M
2 - 3 mi	25	$72 M	$72 M	$88 M	$86 M
Total	**103**	**$138 M**	**$140 M**	**$208 M**	**$211 M**

Table 3. Scenario 2 – All Small Systems Costs

Distance	# Systems	Pipeline Cost	Pipeline + Basic Costs	Pipeline + Connection Fee	Pipeline + Basic + Comprehensive Costs
≤ 0.25 mi	1,188	$0.10 B	$0.12 B	$0.73 B	$0.88 B
0.25 - 1 mi	640	$0.55 B	$0.56 B	$0.93 B	$1.06 B
1 - 2 mi	651	$1.16 B	$1.16 B	$1.50 B	$1.61 B
2 - 3 mi	502	$1.46 B	$1.47 B	$1.79 B	$1.93 B
Total	**2,981**	**$3.26 B**	**$3.31 B**	**$4.95 B**	**$5.47 B**

Table 4. Scenario 3 – All Very Small Systems Costs

Distance	# Systems	Pipeline Cost	Pipeline + Basic Costs	Pipeline + Connection Fee
≤ 0.25 mi	1,036	$0.09 B	$0.1 B	$0.38 B
0.25 - 1 mi	560	$0.48 B	$0.49 B	$0.64 B
1 - 2 mi	585	$1.03 B	$1.04 B	$1.17 B
2 - 3 mi	433	$1.25 B	$1.26 B	$1.36 B
Total	**2,614**	**$2.85 B**	**$2.88 B**	**$3.55 B**

Table 5. Scenarios 4 through 6 – Total Coliform Violations, 1,2,3-TCP, and Cr(VI) Costs, not including other contaminants

Additions[1]		Added Mergers	Pipeline + Basic Costs	Pipeline + Connection Fee	Pipeline + Basic + Comprehensive Costs
Scenario 4	**TCR[2]**	138	$173 M	$214 M	$223 M
Scenario 5	**TCP[3]**	58	$107 M	$117 M	$124 M
Scenario 6	**Cr(VI)[4]**	115	$121 M	$190 M	$185 M

[1] "Additions" refers to additional mergers beyond those captured in Scenario 1.
[2] Scenario 4: Small water systems (population < 3,300) with coliform violations.
[3] Scenario 5: Includes larger systems (population > 3,300) with 1,2,3-TCP violations as potential receiving systems (adds 13 potential receiving systems).
[4] Scenario 6: Small water systems (population < 3,300) with Cr(VI) above 10 µg/L.

Areas for Future Research

Filling Data Gaps

- This project does not include state small water systems. The locations of those systems are not currently available.
- Information on the proportion of small systems that need complete main replacement is not currently available.
- It is possible individual wells could be connected to water systems with these potential mergers. There is no complete list of wells that serve residences, therefore private wells could not be included in this project. For wells not on a potential merger route, point of use or point of entry treatment is likely to be a more cost-effective solution.
- Water system boundary data accuracy should be improved. Some of the boundaries are areas of influence rather than the actual current water system boundary.
- Additional research is needed to determine the range and average of connection fees across the state.

Assessing Potential Barriers to Physical Mergers

- Clusters of small systems that are more than 3 miles from a potential receiving system warrant further investigation.
- Economically Disadvantaged Communities (DACs) and Severely Disadvantaged Communities (SDACs) are included as receiving systems in this analysis. In reality, SDACs may not be able to receive systems. At time of this project, a list of SDACs vs DACs is not available.
- Determine how the future pipeline replacement cost could be paid for.
- Some mergers have not happened because of local politics. It would be beneficial to explore the political and economic limitations to merger and determine how those barriers could be overcome.
- The full cost to the receiving system of taking a small struggling system is not accounted for in this study. It is frequently time consuming to address the technical, managerial, and financial deficiencies in the joining systems. Further research is needed to quantify that cost.
- Administrative fees, such as Local Agency Formation Commission (LAFCO) or Public Utilities Commission (PUC) fees have not been included. Additional research is needed to determine how much should be included for those costs.

Caveats and Assumptions

1. The cost estimates listed herein are rough estimates of the one-time capital costs for merger, based on the provided assumptions. Actual costs may vary from system to system and will depend on site specific details.
2. Accuracy of cost estimates Class V^+ (+100%/-50%).
3. The possible pipeline path along roadways was determined through network analysis using Street Map Premium and ArcGIS Pro. The actual feasibility of the pathways would need to be investigated on a site by site basis and associated distances for necessary pipeline for system connections are subject to change accordingly.
4. Ongoing operations and maintenance (O&M) costs are not included in this analysis.
5. Each receiving system has sufficient water to supply joining system.
6. Each joining system is willing and able to pay the water rates of its receiving system.
7. 1,000-foot additional pipeline was added as a buffer into the boundary of receiving systems when the joining system is located outside of its boundary.
8. If the system was geolocated by address, it may be incorrect. For some systems this administrative address may not be in the actual water system.
9. The Cr(VI) scenario includes any well that has a detection over 10 µg/L since 2009 rather than being over 10 µg/L on an annual average. Sources were screened on status [including only Active Raw (AR), Active Treated (AT), Active Untreated (AU), Combined Raw (CR), and Purchased Treated (PU)]. This analysis reflects occurrence rather than distributed water and is not necessarily indicative of a system that would classify as out of compliance if the MCL were 10 µg/L.
10. For main replacement costs, each connection is assumed to be a 0.5 acre parcel with 80 ft road frontage (based on examination of rural systems in the Central Valley). Distance of pipeline for main replacement per connection is the length along roadway.
11. SDWIS small systems do not include State Small Water Systems (SSWS). SSWS serve at least five (5), but not more than fourteen (14) service connections and do not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year. Most SSWS are supervised at the County level. This analysis does not include SSWS.
12. The following text is included in the disclosure statement provided upon entry to the HR2W portal, indicating exclusion of SSWSs and private domestic wells: "Data contained on this website represents the information available on community and non-transient non-community (specifically schools and day cares) public drinking water systems that are regulated by the State Water Resources Control Board (State Water Board) or Local Primacy Agency (LPA). Please note that the State Water Board's regulatory authority does not include water systems that are defined as "state small water systems", "local state small water systems" or private domestic wells." (https://www.arcgis.com/apps/webappviewer/index.html?id=573c97635cc747b8bb73cf1c8706fc22)

References

Tracking California, Public Health Institute. Water Boundary Tool. Accessed [5/15/2019] from www.trackingcalifornia.org/water.

Human Right to Water (HR2W) Portal, California State Water Resources Control Board (SWRCB), https://www.waterboards.ca.gov/water_issues/programs/hr2w/index.html

GAMA, Groundwater Information System, California Water Boards, https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/Default.asp.

Division of Drinking Water (DDW) Database, DDW SWRCB, https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/EDTlibrary.html.

United States Environmental Protection Agency (U.S. EPA) Safe Drinking Water Information System (SDWIS), https://www3.epa.gov/enviro/facts/sdwis/search.html.

Environmental Systems Research Institute (ESRI), Street Map Premium for ArcGIS Pro.