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Safe drinking water for small low-income communities: the long road from violation to remediation

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Abstract

Small, low-income communities in the United States disproportionately lack access to safe drinking water (i.e. water that meets regulated quality standards). At a community level, the literature has broadly claimed that a major barrier to safe drinking water access is low technical, managerial, and financial (TMF) capacity. At a broader structural level, the environmental justice literature has shown that historical neglect of low-income communities of color has resulted in numerous water systems without the financial and political resources to meet water quality standards. This study investigates the contemporary processes by which distributive injustices persist in California's Central Valley. The study uses key informant interviews with a range of stakeholders, including employees at the state, county and community, non-profit organizations, and engineers, to understand why sustainable water quality solutions for small low-income communities remain such a challenge. The interviews are structured around a decision chain, which builds out the specific steps needed to go from a maximum contaminant level violation to remediation. The resulting decision chain makes visible the multiple steps at multiple stages with multiple actors that are needed to arrive at a solution to substandard water quality. It shows the numerous nodes at which progress can be stalled, and thus functions as a behind-the-scenes look at the (re)production of persistent inequalities. The complexity of the process shows why having the TMF capacity needed to get to a safe water system is not a reasonable expectation for most small community water systems. Inequalities are continually being produced and cemented, often by the very steps aimed towards remediation, thus making persistent disparities in safe drinking water access a *de facto* state-sanctioned process that compounds a discriminatory historical legacy.

1. Introduction: drinking water (in)justice in the US

Millions of people across the United States (US) lack reliable access to safe drinking water (Allaire *et al* 2018), and small, low-income communities are disproportionately affected (Switzer and Teodoro 2018). The Safe Drinking Water Act (SDWA), passed by the US Congress in 1974 and amended in 1986 and 1996, is designed to protect the drinking water of US residents served by public water systems (United States Environmental Protection Agency 2004). In this paper, we define 'safe drinking water' in accordance with the SDWA; it is water that meets federal and state water quality standards. However, public health goals for drinking water contaminants are lower than regulated quality goals, and there are unregulated contaminants with health concerns (United States Environmental Protection Agency 2020a). 'Safe drinking water' as measured and monitored in California is thus a regulatory, rather than a strictly public health, standard.

Regulatory agencies enforce community water systems' (CWSs) compliance with the SDWA (United States Environmental Protection Agency 2004). The specific regulatory agency responsible for a given CWS varies based on size and location. In California, for instance, the State Water Resources Control

Board is responsible for the majority of systems, with some counties responsible for small systems through local primacy agencies and the Environmental Protection Agency (EPA) responsible for systems on tribal lands (United States Environmental Protection Agency 2004, State Water Resources Control Board 2017). Despite ongoing efforts at the federal and state levels, lack of access to reliable and safe drinking water persists in low-income communities across the US. Over a 1000 CWSs are in violation of the SDWA (Mueller and Gasteyer 2021); these violations are more prevalent in rural, under-resourced areas (Patel *et al* 2020).

There is a vast literature on environmental (in)justice (EJ) that seeks to document and explain the lack of access to safe drinking water in the US. The bulk of this literature has focused on *distributive justice*—meaning inequitable access to vital resources across race and class—both generally (Sze and London 2008) and with respect to drinking water (Cory and Rahman 2009, Heaney *et al* 2011, Balazs *et al* 2012, Switzer and Teodoro 2018, Teodoro *et al* 2018). A smaller number of studies also show that minoritized communities may be subjected to *procedural* injustice—or inequitable access to participation in decision-making with respect to their water resources (Balazs and Lubell 2014, Rutt and Bluwstein 2017); and *recognitional injustice*—or unfairness in interpersonal interactions and treatment (e.g. Schlosberg 2004, Rall 2018). The 'snapshot' nature of the distributional injustices in the early EJ literature was critiqued as missing the role of historical discrimination and structural racism in the US; these histories have resulted in inequitable access to many resources, including safe drinking water (e.g. Pulido 1996, 2000).

Newer EJ research has, however, paid attention to structural-historical causes of distributive injustices with respect to drinking water in the US, showing why inequities persist despite efforts to meet the SDWA. High-level structural barriers to equitable access include historical settlement patterns and planning policies that reflected systemic discrimination towards people of color (e.g. Balazs and Ray 2014, London *et al* 2018, Meehan *et al* 2020). At the small-community level, the policy literature has broadly claimed that a major barrier to safe drinking water access is low technical, managerial and financial (TMF) capacity (United States Environmental Protection Agency 2011, State Water Resources Control Board 2015). On the other hand, critical EJ scholars have questioned the apolitical 'best practices' style of the policy literature, echoing structural-historical calls to understand how power dynamics actively prevent the mitigation of water injustices (e.g. Case 2017, Pellow 2017, Arce-Nazario 2018).

In this study, we delineate the steps needed to go from a maximum contaminant level (or MCL) violation to remediation for small rural water systems in California's San Joaquin Valley (SJV). We focus on arsenic, a tasteless, invisible and toxic groundwater contaminant commonly found in the SJV. Our work makes visible the multiple steps, multiple stages, and multiple actors that are needed to arrive at a solution to substandard water quality. It shows the numerous nodes of potential failure at which progress can be stalled, and thus functions as a behind-the-scenes look at the process of continuing (or reinforcing) injustices. By opening up the 'black box' of policies governing remediation, we show that, even without state intransigence, the state-sanctioned policy process itself is riddled with complexity and delays. We point out specific steps at which the remediation process may get stalled, and where greater efforts to move to the next steps are needed. To our knowledge, this is the first effort to break down the violation-to-remediation process into its obstacle-course nature on the ground.

The complexity of the remediation process that we discuss below indicates that the expectation of having the TMF capacity to get from an MCL violation to a safe water system is an unreasonable one for most small CWSs. We find that even key technical and political actors responsible for supporting these systems can be unaware of the complexities of remediating an MCL violation. Inequalities are thus continually being produced or cemented even as the policy intent is to remediate.

2. Background: the regulatory environment

The SDWA regulates several types of public water systems, including CWSs, which regularly serve communities of over 25 individuals or 15 service connections, for at least 60 d of the year (United States Environmental Protection Agency 2020b). CWSs have the responsibility under the SDWA to ensure delivery of safe drinking water (as per the definition in the Act) and to undertake any actions considered to be critical to that end (taking water samples, communicating with their customers as needed, etc) (United States Environmental Protection Agency 2004). To meet their responsibilities, the organizational structure of CWS typically consists of a manager who is responsible for billing, an operator who is responsible for the technical components of water system operation and maintenance, and a water board or other leadership that communicates with the public and completes other tasks needed to keep the water system in operation (Firestone 2009). In a large system with a strong tax base, these positions are filled by paid, technically qualified individuals. In small, low-income communities, all of these can be unpaid, volunteer positions, held by lay citizens with little training (Lohan 2017, Romero and Klein 2017).

The main SDWA violations issued by a regulatory agency to a CWS are: (a) health-based violations

(MCL exceedance, maximum residual disinfectant level exceedance, and treatment technique requirements), (b) monitoring and reporting violations, (c) public notice violations, and (d) other violations, such as not issuing a consumer confidence report (United States Environmental Protection Agency n.d.-b). Contaminants that result in MCL violations include inorganic chemicals, organic chemicals, disinfection by-products, and radionuclides (United States Environmental Protection Agency 2009). These contaminants, unless regulated, result in chronic and/or acute health risks, and originate from anthropogenic and/or geogenic sources (United States Environmental Protection Agency 2009). The EPA requires that a treatment solution be available and affordable before issuing a new regulation for a contaminant (United States Environmental Protection Agency n.d.-a).

The EPA considers the financial burdens on small systems when they raise the water quality standard for priority contaminants. When the EPA lowered the arsenic MCL from 50 to 10 μg l^{-1} in 2001 their science advisory board, the American Water Works Association, and several municipalities claimed that the justification of affordability of arsenic treatment technologies for small systems was not based on realistic assumptions and inclusive cost estimates (Congressional Research Service 2010). While the EPA did allow states to issue exemptions, giving extra time to small systems to meet the new arsenic MCL compliance deadline, the complexities of the exemption process resulted in few actually being granted (Congressional Research Service 2010).

In California's SJV, drinking water contaminants such as arsenic disproportionately impact low-income and minoritized communities, because they often lack access to affordable water quality solutions (Balazs *et al* 2012, State Water Resources Control Board 2015). Drying groundwater wells add further challenges to safe drinking water access in rural communities (Perrone and Jasechko 2017). California is working to increase access to drinking water that meets regulated quality standards, from declaring the Human Right to Water in 2012 to increasing funding for small water systems, for example, through the Safe and Affordable Funding for Equity and Resilience (SAFER) program (California Legislative Information 2012, State Water Resources Control Board 2020b). One component of the 1996 amendments to the SDWA requires states to ensure that CWSs have the TMF capacity to comply with regulated drinking water quality standards (State Water Resources Control Board 2020c). The application of the 1996 amendment requires CWSs to conduct a TMF capacity assessment when applying for funding, as well as when being formed or changing owners (State Water Resources Control Board 2020c). Technical assistance providers, contracted by the California State Water Resources Control Board, work

with small systems to help meet this requirement for high-enough TMF capacity (State Water Resources Control Board n.d.).

However, there are few examples on when and for what purpose a specific TMF capacity is called for, leaving the 'lack' of TMF capacity somewhat general in its characterization. The extent to which most small CWS are inherently short of basic system-operating skills versus the extent to which the process of remediation itself is an onerous one is also discussed in a rather general way (e.g. Green Nylen *et al* 2018). In other words, are reforms needed mainly at the community-capacity level, which has been the focus of much policy advocacy, or are they needed at the policy implementational level as well?

3. Methods

Our research objective was to uncover the specific steps needed for a CWS to proceed from receiving an MCL violation to achieving a mitigating solution. Key informant interviews are commonly used to understand institutional mandates and organizational structures (Lavrakas 2008); in these cases, the key informant is treated as a proxy for their organization or interest group. We conducted key informant interviews to understand the steps to remediation, including who is responsible for each step. We first developed a preliminary decision chain of steps starting from an MCL violation through to developing and maintaining a water quality solution. We used this preliminary chain as a way to focus our key informant interviews. In this way, our initial decision chain, drafted using the literature, was continually refined after each new interview. Each interviewee started from the decision chain as modified after the immediately preceding interviewee, and added new steps to it, pointed out alternative options at key steps, or explained where backsliding was possible. We did not prompt the respondents in any way during the interview but encouraged them to complete the decision chain as best they could.

We selected the MCL violation over others, because (a) it is the most common health-based violation category and (b) it often indicates the presence of water contaminants that disproportionately affect low-income communities in CA (e.g. arsenic, nitrate). The first author conducted interviews over a videoconferencing platform or by phone (due to SARS-CoV-2 (COVID-19) pandemic limitations) for an average of 60 min each (ranging from approximately 30 min to over 1.5 h per interview). We recorded and transcribed each interview, with informed consent from each interviewee. Our research protocol was approved for ethical practices by the University of California Berkeley (Protocol #2020-02-12974).

We selected interviewees based on their role as decision makers in the MCL-to-remediation process. We hypothesized that representative decision-makers

at all levels, from the community up to the state, were most likely to know the details of the process. We conducted 17 interviews in total, including employees at the following organizations: State Water Resources Control Board (including the Division of Drinking Water, Division of Financial Assistance, and Regional Water Board) (four interviews), engineering firms/water utility (three interviews), technical assistance providers (five interviews), environmental justice organizations (two interviews), and county agencies (one interview), as well as a president/operator of small water system (one interview). We also interviewed one community member who, as we knew from our previous interactions, was well-informed about local water problems and challenges to remediation. We did not interview any employees from the EPA; when asked, they stated they, as federal employees, were not authorized to do an interview. We stopped interviewing when we reached saturation, i.e. the decision chain looked as though plausible steps had been included, and additional potential respondents were unable to come up with additional steps or complications.

To analyze interviews, we coded open-ended interview transcripts to find emergent themes (Coffey and Atkinson 1996), initially following the constant comparative method for exploratory qualitative research (Glaser 1965). We focused on trying to understand the ways in which the decision steps proved challenging to carry out, and whether there were some steps that could take a long time to get resolved. We used MAXQDA software for the coding (MAXQDA 2021). The software allows researchers to conduct qualitative analysis on text, including attaching codes to sections of text for analysis and identifying emergent themes. We arrived at the final decision chain using the coded interview transcripts.
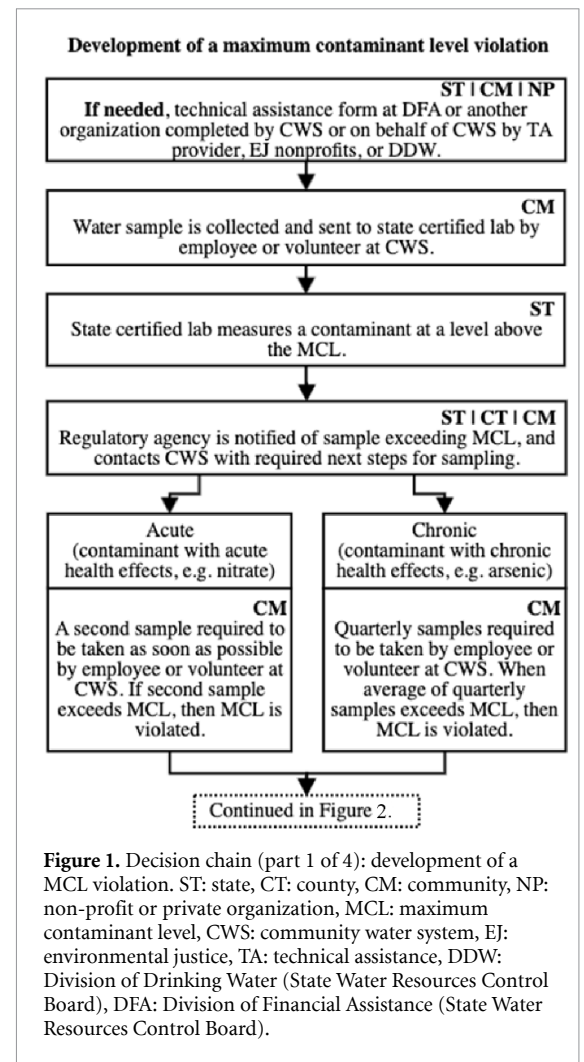
4. Results

4.1. Decision chain

The final decision chain we developed in collaboration with our respondents shows each step in developing a solution once an MCL violation has been issued. It has many steps and is therefore presented in four parts:

- development of a MCL violation (figure 1);
- development of a compliance order and applying for planning funds (figure 2);
- planning phase (figure 3);
- construction phase (figure 4).

In addition, table 1 shows the regular responsibilities expected of a CWS (i.e. the operator, president, board, or other employees and volunteers), whether or not there are any violations.

Each figure connects chronologically to the following one, starting with figure 1. Each step

Figure 1. Decision chain (part 1 of 4): development of a MCL violation. ST: state, CT: county, CM: community, NP: non-profit or private organization, MCL: maximum contaminant level, CWS: community water system, EJ: environmental justice, TA: technical assistance, DDW: Division of Drinking Water (State Water Resources Control Board), DFA: Division of Financial Assistance (State Water Resources Control Board).

represents an action that could stall or even fail, forcing the process to go back to the previous step. Steps that were more likely to take extra time or stop the process altogether, as reported by our interviewees, are noted as 'stall point' in the figures.

The institutional level(s) at which each step is expected to be carried out are presented on the decision chain in capital letters. Institution levels are State (ST), county (CT), community (CM), and non-profit or private organizations (NP). *State* includes state (CA) or federal (US) regulatory agencies (e.g. State Water Resources Control Board, EPA), and state or federal funding agencies (e.g. State Water Resources Control Board, US Department of Agriculture). *County* includes any county-level agencies, including local primacy agencies that serve as regulatory agencies for certain systems. *Community* includes general community members, the CWS, and any community leadership. *Non-profit* or *private* organizations include environmental justice NGOs, technical assistance providers, engineering firms, and any other private entities.

A step in the decision chain is sometimes split depending on whether the regulated contaminant results in acute or chronic health outcomes. Acute and chronic contaminants call for different water
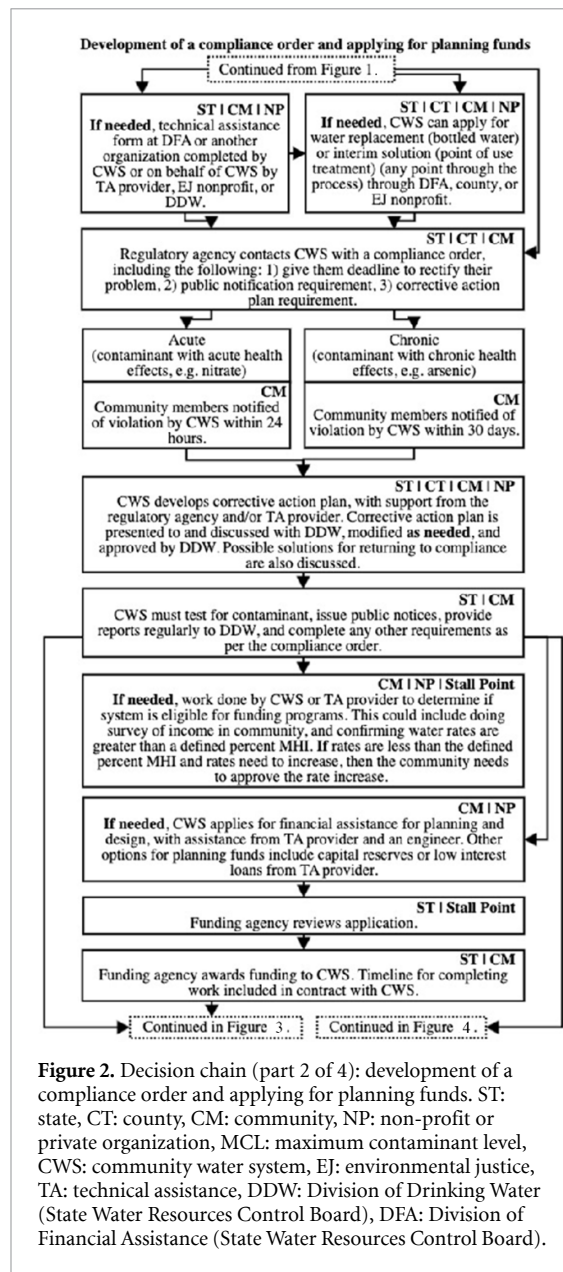
Figure 2. Decision chain (part 2 of 4): development of a compliance order and applying for planning funds. ST: state, CT: county, CM: community, NP: non-profit or private organization, MCL: maximum contaminant level, CWS: community water system, EJ: environmental justice, TA: technical assistance, DDW: Division of Drinking Water (State Water Resources Control Board), DFA: Division of Financial Assistance (State Water Resources Control Board).
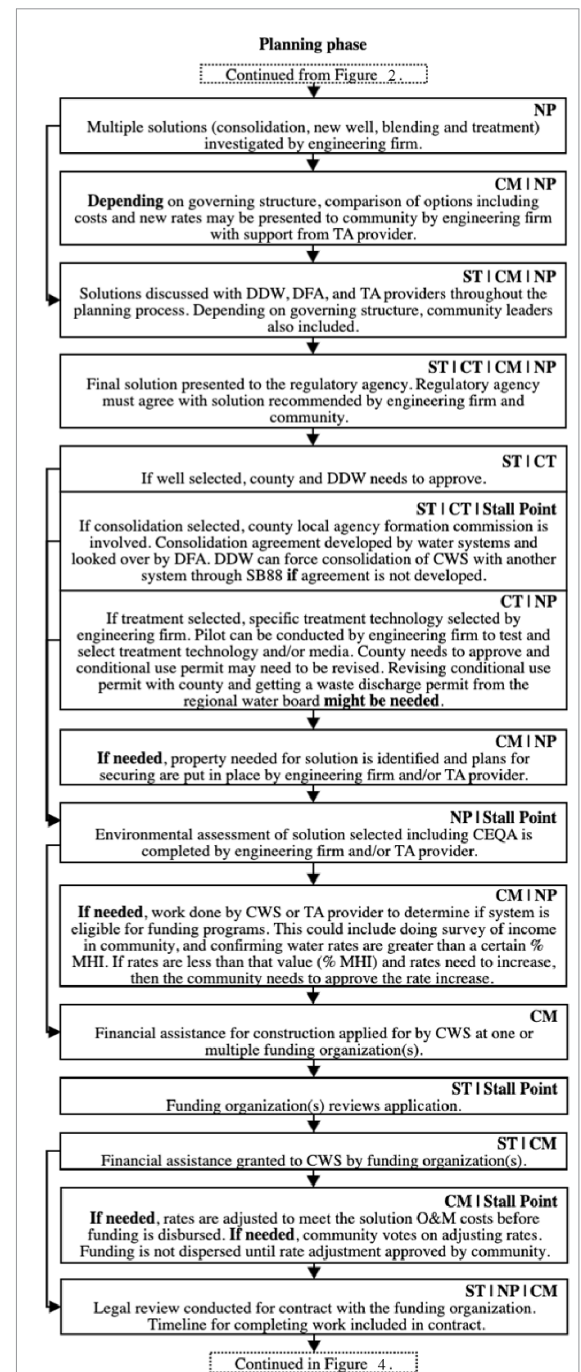

Figure 3. Decision chain (part 3 of 4): planning phase. ST: state, CT: county, CM: community, NP: non-profit or private organization, MCL: maximum contaminant level, CWS: community water system, TA: technical assistance, DDW: Division of Drinking Water (at the State Water Resources Control Board).

quality sampling strategies and frequencies (figure 1). We accounted for the different possible pathways within the chain by denoting some steps as optional, indicated either by arrows skipping over the step or by language such as 'if needed', 'depending' or 'can'.

The process to recognize a water quality problem and develop a solution is complex, as demonstrated through the number of steps and actors in the decision chain. Some interviewees even suggested that the process could go backwards at various points, with one claiming they hadn't seen a single system go straight through from MCL violation to solution. The process is also onerous, with many steps taking a significant amount of time, making them more likely to stall or altogether stop the process: 'I've been doing this 12 years, I don't know that I've seen any system go through…in a linear fashion. Or they're still going through it 12 years later' (Interviewee 11, Employee at Technical Assistance Provider).

Several interviewees suggested that the wait for funding applications to be reviewed could take multiple years: 'I'm not trying to hurt the state…But it frustrates the people and it frustrates us. Because you want the money fast. But the state says, hey, we've got this money, we want to use it correctly. You know, we're not going to toss it out the window' (Interview 1, Employee at Technical Assistance Provider). Other steps identified as taking significant time included environmental assessments, rate
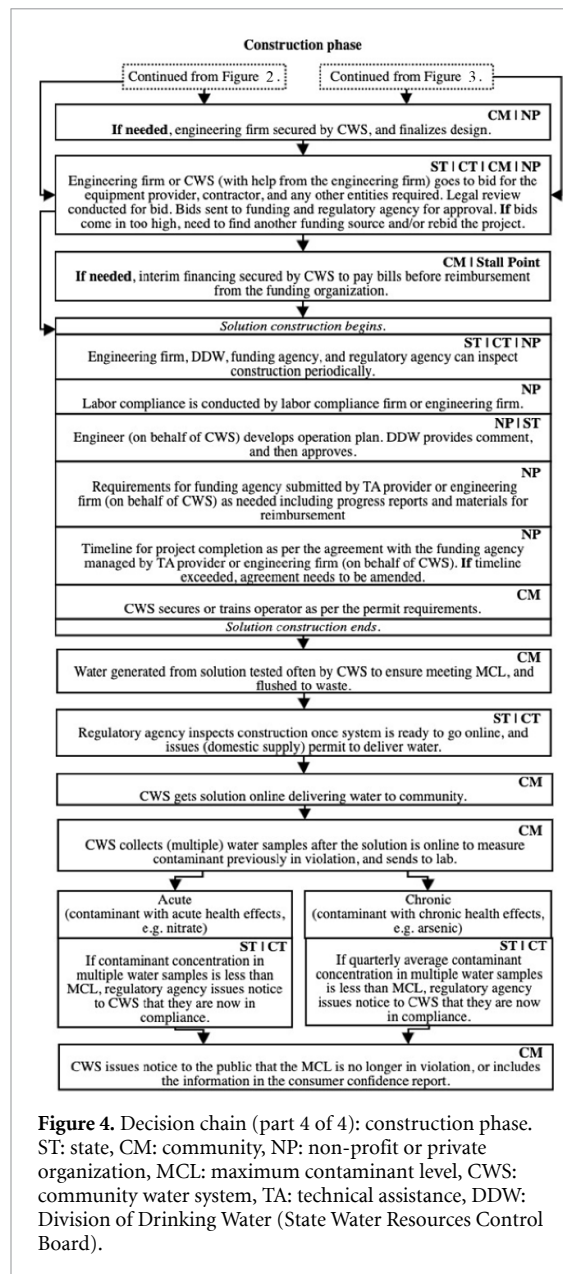
Figure 4. Decision chain (part 4 of 4): construction phase. ST: state, CM: community, NP: non-profit or private organization, MCL: maximum contaminant level, CWS: community water system, TA: technical assistance, DDW: Division of Drinking Water (State Water Resources Control Board).

Table 1. Regular actions needed to maintain the CWS.

Action to maintain CWS	stakeholders involved

CWS issues and collects water bills at a regular interval (monthly, bi-monthly, quarterly, etc). | **CM**

CWS sends yearly consumer confidence reports to customers. | **CM**

Depending on governing structure of CWS, water board meets as needed to inform the public on relevant related issues, conduct routine business, and enforce policy. | **CM**

CWS applies for emergency funds as needed (e.g. pump breaking). | **CM**

Operator does the following:

Weekly: Inspect well.

Monthly: Read meters (if the community has them) for billing purposes (or could be done by a volunteer).

Every 1–5 years: Clean storage tank, flush dead end lines, exercise and check valves.

As needed: Respond to customer complaints, supervise fixing or replacing broken equipment or piping, extend distribution line to new customers, take water samples as per detailed water system compliance schedules issued by DDW, manage cross connection control program. If treatment used, supervise media replacement, supervise waste management. | **CM**

State water board inspects entire water system every three years. | **ST**

ST: state, CM: community, CWS: community water system, DDW: Division of Drinking Water (State Water Resources Control Board).

increase approval by community members, developing consolidation agreements, securing interim financing, and putting together applications for funding and construction: 'a lot of systems even have trouble applying for funds in the first place. Like, it's just so complicated, they don't know what to do…They just stay in violation for years, or, you know, kind of fumble around' (Interviewee 3, Employee at Engineering Firm).

4.2. Emergent themes from open-ended interviews

Our interviews revealed three emergent themes that help explain how steps in the decision chain either progress towards a solution or lead to a stall. These themes were TMF capacity of CWS, capacity and resources of decision-making agencies, and the mutually reinforcing nature of state neglect, distrust in the state, and low community participation in state-led remediation efforts.

4.2.1. TMF capacity at the community level

The low TMF capacity within small CWS is a common theme in the environmental justice literature (e.g. Balazs *et al* 2012, Green Nylen *et al* 2018). For under-resourced systems staffed by volunteers and citizens without technical training, even the regular tasks of system maintenance, without MCL violations to address, could be challenging (see table 1). Studies have noted that regulators sometimes hold back from issuing MCL violations when they know that low-income community systems are struggling to comply with water quality standards and would only be burdened by further fines and fees (Ranganathan and Balazs 2015). Interviewees reported the difficulties that small systems encounter when trying to hire experienced people to operate and manage systems with the financial constraints in place. For example, the quote below illustrates the tension between the demands placed on small, low-income communities and their ability to meet them when they receive an MCL violation.

'Because of that lack of financial capacity, lack of experience and the money it takes to hire experienced people…that really leads water systems kind of down this tumultuous path of trying to stay in compliance—and comply with regulations which aren't necessarily easy to read and understand unless you're experienced' (Interviewee 10, Employee at State Water Board).

4.2.2. Capacity and resources of the professional decision makers (employees at the state, county, for profits, and technical assistance providers)

Attention in the water policy literature has often focused on the TMF capacity of the CWS. Our interviewees, however, pointed out clear limits to the capacity of professional decision makers (employees at the state, county, for profits, and technical assistance providers). Interviewees highlighted the difficulties with the number of items employees at regulatory agencies are expected to manage, staffing problems including understaffing and high turnover, and the number of subdivisions within agencies that create silos that are challenging to work across. Some also claimed that engineers and other professional decision-makers did not always design solutions with small, low-income communities in mind:

'You know, just a handful of attorneys and engineers have worked with the small water systems…they're not really looking at what's going to work for this community cost-wise, what's going to work, like, engineering-wise, maintenance-wise' (Interviewee 12, Employee at EJ Nonprofit).

Sometimes even the professional decision makers had different experiences and understandings of the process. For example, one stakeholder suggested that interim financing is needed only when a water system is not sending in invoices for materials that are reimbursable whereas another claimed that interim financing is a result of the requirements set by the state. The professionals themselves did not all know all the steps (that did not directly involve them) and the actors responsible for them from start to finish, yet small water systems and the low-income communities they serve are de facto expected to do so, or at least to navigate the numerous steps needed. TMF capacity at the community level is routinely raised as a barrier to MCL compliance, but we find that many of the necessary steps are out of the hands of the community in the first place.

4.2.3. State neglect, distrust of the state, and (lack of) community participation as a vicious cycle

The final emergent theme is the mutually reinforcing, and vicious, cycle of state neglect, distrust of the state, and (lack of) participation of the community in state-led mitigation efforts. We found that many stakeholders—beyond community leaders—thought that regulating agencies did not recognize, and even distrusted, community knowledge. In turn, community members distrusted those in power, and this distrust fuelled unwillingness to cooperate with state-led remediation efforts. Both these features combined to reduce the participation of the community in seeking solutions to water contamination, such as consolidation with larger systems: 'it can be really hard to let the local water board kind of cede control over its system to a neighboring system, even when there's

a better economy of scale' (Interviewee 9, Employee at State Water Board). The desire for local control, however, can lead to clashes with the State Water Board: 'the Water Board wants to push them to consolidate because it's the obvious solution. So there's some pushback' (Interviewee 5, Employee at Technical Assistance Provider).

In other instances, the experience of a water system president and operator with the public's engagement and interest in drinking water management was expressed as follows 'I used to hold board meetings once a month and on a set day and set time so that it was always available to people… I would show up to meetings by myself, nobody would show up. Yeah, I don't know, there's just no interest. The interest is when they turn the tap, does anything come out, then they might have an interest' (Interviewee 7, President and operator of small water system).

At the same time, community-based knowledge and decisions are not always trusted: 'I mean, besides the decades of neglect…there's just a general mistrust of community knowledge. It's just ignored. They're not believed' (Interviewee 6, Employee at EJ Nonprofit).

Distrust breeds disengagement. If the state agencies are seen as disrespectful of community knowledge or as ignoring the community's desire for local control, it is not surprising if communities become disengaged and distrustful (see also Mascarenhas 2007). The combination of neglect, distrust, and (low) participation can then lead to key decision steps stalling or stopping altogether.

5. Discussion

The results of this study, including the interviews and the decision chain, suggest that it is not reasonable to expect (most) small communities to have the TMF capacity required to get from an MCL violation to a safe water system. However, in many states such as California, TMF capacity is a legal requirement to proceed towards safe water, including getting access to funding. These requirements treat TMF capacity as a community characteristic, when it is better understood in relation to what is being asked of it. For small systems, what is being asked of them appears complex, expensive and non-transparent even to key decision-makers.

If and when TMF capacity is achieved by a small, low-income community in the legal sense (in California, through the State Water Resources Control Board TMF assessment) (State Water Resources Control Board 2020c), TMF capacity challenges can still persist. For example, reliance on volunteer staff, increasing regulatory burdens, the complicated number of steps and stakeholders, rising costs over time, (dis)economies of scale, historical and present-day neglect, and challenges in raising rates to cover costs

while staying affordable for low-income ratepayers, can bring about serious conflict between what is expected of small systems and what they can deliver.

The observation that few small low-income CWSs have the TMF capacity needed to deliver safe water to their users has led to a movement towards regionalization or consolidation; these options could make for a more viable basis for high TMF capacity as opposed to the system-by-system basis described in the SDWA (Balazs and Lubell 2014, Balazs and Ray 2014, London *et al* 2018, State Water Resources Control Board 2020a). Ongoing research is exploring these and other larger scale solutions. Short of a drastic reorganization, funding programs such as the SAFER program (est. 2019) (State Water Resources Control Board 2020b), can be an important part of developing financing solutions. However, on its own, implementing SAFER would not necessarily change the task list or speed up access to solutions, as many, but not all, the stall points we identified are related to increased funding alone. State-community relations, and a degree of confusion even among decision-makers about steps to remediation, also play a role. Greater attention should be paid in the policy literature to the capacities and resources of the decision-makers themselves.

In part to counteract the low levels of participation among low-income water users, some researchers have argued that community-led research, which is participatory by design, can give communities knowledge and voice, and increase the likelihood that they will demand a place at the table when state agencies are making decisions. In other words, they will demand more procedural justice from state authorities (e.g. Heaney *et al* 2011). Participatory, community-engaged research may be a promising route to environmental justice in the communities represented in this study. It is not a guarantee, however; the state often determines the parameters of participation, a tactic that maintains rather than transforms the status quo (Mascarenhas 2007, Pulido 2016).

The results of this study illustrate in detail the ongoing production process of distributive environmental injustice. In the case presented here, that of safe drinking water access in small, low-income communities in CA, the results demonstrate that the everyday processes through which environmental injustices persist are complicated and systemic. The results show the value of complementing explanations for persistent environmental injustices that are often reported in the literature (e.g. low community capacity, historic and present day racism), with how injustices are currently being produced (e.g. capacity of decision makers, number and clarity of necessary steps, trust and participation within the community). In particular, the presence of stall points along the

decision chain, often meant to encourage due diligence or community participation, can in practice prolong recognitional and distributional injustices. The key informant-based method of uncovering the many steps and actors to remediation is, we believe, likely to be useful to scholars and water managers well beyond our study site.

Uncovering this production process yields a more nuanced and critical understanding of persistent water injustices. We find that though critical EJ scholars have argued that the state machinery is often resistant to mitigative measures (see e.g. Pulido 1996, 2016), in the case of drinking water, the state-sanctioned process of remediation itself has become a barrier to distributional justice. In addition, the decision chain we developed is a practical tool for those trying to understand the details of the path to safer water and the actors involved in developing a water quality solution.

Our study has some limitations, many on account of the COVID-19 pandemic. First, we interviewed only one community member who, as we knew from our previous research experiences, was well-informed about local water problems and challenges to remediation. The pandemic forced us to conduct interviews over the phone; we were unable to interview more lay community members, many of whom were uncomfortable being interviewed over the internet or phone. We also did not interview any employees from the EPA; they said that, as federal employees, they were not authorized to do an interview for a research study. Under less extreme circumstances, we would have preferred to have interviewed a broader range of stakeholders.

6. Conclusion

This study uses California as a case study to explore the on-the-ground processes of developing and maintaining water quality solutions for small, low-income communities. To our knowledge, this is the first study to uncover all the necessary steps—what has to be done, when, and by whom—between a water system receiving an MCL violation and finally acquiring safe drinking water. Our results provide new insights on the persistence of distributive environmental injustice, how this is inadvertently and structurally (re)produced, and why community TMF capacity may not be a useful metric for understanding or overcoming persistent distributive injustices.

Data availability statement

The data generated and/or analyzed during the current study are not publicly available for legal/ethical reasons but are available from the corresponding author on reasonable request.

Acknowledgments

References

Allaire M, Wu H and Lall U 2018 National trends in drinking water quality violations *Proc. Natl Acad. Sci. USA* **115** 2078–83

Arce-Nazario J 2018 The science and politics of water quality *The Palgrave Handbook of Critical Physical Geography* ed R Lave, C Biermann and S N Lane (Cham: Springer International Publishing) pp 465–83

Balazs C L and Lubell M 2014 Social learning in an environmental justice context: a case study of integrated regional water management *Water Policy* **16** 97–120

Balazs C L, Morello-Frosch R, Hubbard A E and Ray I 2012 Environmental justice implications of arsenic contamination in California's San Joaquin Valley: a cross-sectional, cluster-design examining exposure and compliance in community drinking water systems *Environ. Health* **11** 84

Balazs C L and Ray I 2014 The drinking water disparities framework: on the origins and persistence of inequities in exposure *Am. J. Public Health* **104** 603–11

California Legislative Information 2012 Bill Text—AB-685 State water policy (available at: https://leginfo.legislature. ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB685 (accessed 11 September 2020))

Case R A 2017 Environmental oversight and the citizen activist: lessons from an oral history of activism surrounding Elmira, Ontario's 1989 water crisis *Community Dev.* **48** 86–104

Coffey A and Atkinson P 1996 Concepts and coding *Making Sense of Qualitative Data Complementary Research Strategies* (Thousand Oaks, CA: SAGE Publications) ch 2, pp 26–53

Congressional Research Service 2010 Arsenic in drinking water: regulatory developments and issues p 10

Cory D C and Rahman T 2009 Environmental justice and enforcement of the safe drinking water act: the Arizona arsenic experience *Ecol. Econ.* **68** 1825–37

Firestone L 2009 Guide to community drinking water advocacy

Glaser B G 1965 The constant comparative method of qualitative analysis *Soc. Probl.* **12** 436–45

Green Nylen N, Pannu C and Kiparsky M 2018 Learning from California's experience with small water system consolidations: a workshop synthesis (available at: https://escholarship.org/uc/item/9pd1702n#author (accessed 7 February 2021))

Heaney C, Wilson S, Wilson O, Cooper J, Bumpass N and Snipes M 2011 Use of community-owned and -managed research to assess the vulnerability of water and sewer services in marginalized and underserved environmental justice communities *J. Environ. Health* **74** 8–17

Lavrakas P 2008 *Encyclopedia of Survey Research Methods* (Thousand Oaks, CA: Sage Publications, Inc.) (available at: http://methods.sagepub.com/reference/encyclopedia-ofsurvey-research-methods)

Lohan T 2017 Systemic failure: why 1 million Californians lack safe drinking—water deeply (available at: www.newsdeeply. com/water/articles/2017/07/05/systemic-failure-why-1-million-californians-lack-safe-drinking-water (accessed 4 February 2019))

London J *et al* 2018 *The Struggle for Water Justice in California's San Joaquin Valley: A Focus on Disadvantaged Unincorporated Communities* (UC Davis Center for Regional Change, Commissioned by: Resources Legacy Fund, Water Foundation) (available at: https://regionalchange.ucdavis. edu/sites/g/files/dgvnsk986/files/inline-files/The% 20Struggle%20for%20Water%20Justice%20FULL% 20REPORT_0.pdf (accessed 13 January 2020))

Mascarenhas M 2007 Where the waters divide: first nations, tainted water and environmental justice in Canada *Local Environ.* **12** 565–77

MAXQDA 2021 MAXQDA | all-in-one tool for qualitative data analysis & mixed methods (available at: www.maxqda.com/ (accessed 8 January 2021))

Meehan K *et al* 2020 Exposing the myths of household water insecurity in the global north: a critical review *WIREs Water* **7** e1486

Mueller J T and Gasteyer S 2021 The widespread and unjust drinking water and clean water crisis in the United States *Nat. Commun.* **12** 3544

Patel A I, Hecht C E, Cradock A, Edwards M A and Ritchie L D 2020 Drinking water in the United States: implications of water safety, access, and consumption *Annu. Rev. Nutr.* **40** 345–73

Pellow D N 2017 What is critical environmental justice? *Wiley.com* (Wiley) (available at: www.wiley.com/en-us/What+is+ Critical+Environmental+Justice%3F-p-9781509525324)

Perrone D and Jasechko S 2017 Dry groundwater wells in the western United States *Environ. Res. Lett.* **12** 104002

Pulido L 1996 A critical review of the methodology of environmental racism research *Antipode* **28** 142–59

Pulido L 2000 Rethinking environmental racism: white privilege and urban development in Southern California *Ann. Assoc. Am. Geogr.* **90** 12–40

Pulido L 2016 Flint, environmental racism, and racial capitalism *Capital. Nat. Social.* **27** 1–16

Rall A 2018 Community organizing and the Detroit water struggle: report from the front lines *J. Prog. Human Serv.* **29** 103–29

Ranganathan M and Balazs C 2015 Water marginalization at the urban fringe: environmental justice and urban political ecology across the North–South divide *Urban Geogr.* **36** 403–23

Romero E D and Klein K 2017 They built it, but couldn't afford to run it—clean drinking water fight focuses on gaps in funding (available at: http://kvpr.org/post/they-built-it-couldn-t-afford-run-it-clean-drinking-water-fight-focuses-gaps-funding (accessed 26 April 2018))

Rutt R L and Bluwstein J 2017 Quests for justice and mechanisms of suppression in Flint, Michigan *Environ. Justice* **10** 27–35

Schlosberg D 2004 Reconceiving environmental justice: global movements and political theories *Environ. Polit.* **13** 517–40

State Water Resources Control Board Technical Assistance (TA) 2020 Funding program (available at: www.waterboards. ca.gov/water_issues/programs/grants_loans/proposition1/ docs/prop1_ta_fact_sheet.pdf (accessed 11 November 2020))

State Water Resources Control Board 2015 *Safe Drinking Water Plan for California: State Water Resources Control Board Report to the Legislature in Compliance with Health & Safety Code Section 116365* (available at: http://senv.senate. ca.gov/sites/senv.senate.ca.gov/files/sdwp_report_to_ legislature_2015.pdf)

State Water Resources Control Board 2017 Fact sheet frequently asked questions: public water system data on the human right to water portal (available at: www.waterboards. ca.gov/water_issues/programs/hr2w/docs/general/faqs.pdf (accessed 7 February 2021))

State Water Resources Control Board 2020a Drinking water partnerships and consolidation (available at: www.water boards.ca.gov/drinking_water/certlic/drinkingwater/ waterpartnership.html (accessed 5 November 2020))

State Water Resources Control Board 2020b SAFER drinking water (California State Water Resources Control Board) (available at: www.waterboards.ca.gov/safer/ (accessed 11 September 2020))

State Water Resources Control Board 2020c TMF—capacity development (available at: www.waterboards. ca.gov/drinking_water/certlic/drinkingwater/TMF.html (accessed 5 November 2020))

State Water Resources Control Board n.d.

Switzer D and Teodoro M P 2018 Class, race, ethnicity, and justice in safe drinking water compliance*: class, race, ethnicity, and drinking water compliance *Soc. Sci. Q.* **99** 524–35

Sze J and London J K 2008 Environmental justice at the crossroads *Sociol. Compass* **2** 1331–54

Teodoro M P, Haider M and Switzer D 2018 US environmental policy implementation on tribal lands: trust, neglect, and justice: US environmental policy implementation on tribal lands *Policy Stud. J.* **46** 37–59

United States Environmental Protection Agency 2004 Understanding the safe drinking water act (available at: www.epa.gov/sites/production/files/2015-04/documents/ epa816f04030.pdf (accessed 31 October 2017))

United States Environmental Protection Agency 2009 National primary drinking water regulations (available at: www.epa. gov/sites/production/files/2016-06/documents/npwdr_ complete_table.pdf (accessed 11 November 2020))

United States Environmental Protection Agency 2011 *National Characteristics of Drinking Water Systems Serving 10,000 or Fewer People* (US Environmental Protection Agency Office of Water) (available at: www.epa.gov/sites/production/ files/2015-12/documents/epa816r10022.pdf (accessed 6 September 2017))

United States Environmental Protection Agency 2020a How EPA regulates drinking water contaminants *US EPA* (available at: www.epa.gov/sdwa/how-epa-regulates-drinking-water- contaminants (accessed 11 November 2020))

United States Environmental Protection Agency 2020b Safe drinking water act (SDWA) resources and FAQs | ECHO | US EPA (available at: https://echo.epa.gov/help/sdwa-faqs (accessed 9 November 2020))