Standardization vs. Situatedness: A Grey Literature Meta-Synthesis of How Guidance for Alaska's Water Infrastructure Management Varies by Government Level

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ABSTRACT:

The success of water system operation, maintenance, and management (OMM) critically depends on the local workforce. Extreme environmental conditions, limited financial resources, challenging supply chains and increased technological requirements especially challenge the workforce to deliver equitably and reliably such OMM services in Alaska. To better understand these challenges, this paper presents a meta-synthesis of the grey literature regarding water system management in Alaska, with a particular focus on workforce development and OMM regulation. This synthesis was conducted based upon qualitatively coding 49 documents that were representative of the full corpus of 183 documents identified on this topic. While prior work tends to focus on a single regulatory level (national or state), this meta-synthesis reveals important differences that occur between regulatory levels of government. More specifically, we find federal and state government focus more on standardization ("one size fits all"), while regional and local government focus more on situatedness ("tailoring for every circumstance"). This may have equity implications for water utilities in Alaska and other Arctic regions where national and state standards drastically differ and overlook local needs. We find that this theme of standardization versus situatedness may generalize to other state water systems, especially those with similar conditions as Alaska (such as Wyoming and Montana), as well as in other sectors in Alaska beyond water (such as environmental management, nursing, and aviation). Given the multi-level governance of water system OMM, these findings suggest that training materials and programs, certification processes, financial support, and policy decisions could be more effective if they consider more the local context in which these water systems are situated, especially when local conditions markedly differ from national norms. Such an approach may help better ensure more reliable and equitable access to safe drinking water in extreme settings such as those in Alaska and in the Arctic, more generally.

1. INTRODUCTION

Operating, maintaining, and managing (OMM) water collection, treatment, and distribution systems is a challenging issue globally and is a perennial issue in some areas of the United States. Recent work has found that within the U.S., there are nearly 500,000 households which still lack complete plumbing; more than 1,000 community water systems that are in "serious" violation of the Safe Drinking Water Act; and more than 21,000 Clean Water Act permittees that are in Significant Noncompliance (Mueller and Gasteyer 2021). These service gaps predominantly impact low-income, minority and housing-insecure communities (Deitz and Meehan 2019; Meehan et al. 2020; Mueller and Gasteyer 2021; Wescoat et al. 2007). These burdens are especially heavy for indigenous communities in the United States with Alaska Native and American Indian people representing the largest percentage of households with demonstrated lack of access (Gasteyer et al. 2016). Alaska Native households are 3.7 times more likely to not have complete plumbing over other households in the United States (Deitz and Meehan 2019).

Acute workforce challenges, especially in rural areas, contribute to these inequitable water service gaps and bring into question the ability to balance national regulations with the needs of local context. The State of the Water Industry Report from 2023 highlights that "talent attraction and retention" is the 12th most critical concern in the water sector (AWWA 2023). This issue is further intensified by the COVID-19 Great Resignation during which a national skills shortage has left most public utilities understaffed and ill-equipped to recover fully from the pandemic (Ferguson 2023). These challenges of gaps in workforce skill sets (Grigg 2006), are only further exacerbated for small utilities in rural areas. Rural utilities face heightened challenges with young people leaving rural areas in pursuit of better opportunities in urban areas (Kot et al. 2011). Rural utilities are also challenged by limited staff sizes, which make responding to emergencies ever more difficult. Furthermore, the expectations for workers employed at small and rural

67 utilities often reaches beyond the standard expectations for such a position in urban areas (DeNileon and
68 Stubbart 2005).

69 In the Arctic, an extreme case of rural and remote contexts, these workforce challenges are especially
70 acute. While there are several root causes for this gap in water services including aging infrastructure,
71 arctic conditions, and spatial remoteness, issues pertaining to workforce are an especially salient concern
72 for water service provision (Spearing et al. 2022b). According to data from the Bureau of Labor Statistics
73 as of March 2023, Alaska had the highest rate of job openings per total nonfarm jobs of any state (US
74 Bureau of Labor Statistics 2023). In Anchorage, the largest city in Alaska, the lack of available labor force
75 and the declining population for six years running are blamed for constraining the economic recovery
76 following the COVID-19 pandemic (Anchorage Economic Development Corporation 2023). Confounding
77 the more general workforce shortage in Alaska is a gap in certified operators available to manage water
78 systems and a perennially difficult set of environmental challenges (Spearing et al. 2022b). These factors
79 put Alaska communities at high-risk in terms of having reliable access to safe drinking water. Rural
80 communities in Alaska arguably face a greater hurdle than most other similar rural utilities due to a
81 comparably high worker shortage and overall a lower percentage of labor force participation than past
82 historic trends in the state, with aforementioned job openings hitting record highs in 2023 (Alaska
83 Department of Labor and Workforce Development 2023).

84 Current estimates find that there are over 30 unserved communities, where 45% or more homes are
85 not served by in-home systems (AK DEC 2022), and the current water infrastructure grade assigned to the
86 water infrastructure in Alaska is a D (ASCE 2021). Water service provision is of acute interest in our area
87 of study - the Yukon–Kuskokwim (YK) Delta region of Alaska. As of 2018, only 56% of households in the
88 region had access to piped water (Fuente et al. 2022), and such household plumbing access is decreasing
89 over time (Brown et al. 2022). The rest of the population relies on a form of hauled water service, where

water is moved in trucks or by ATV to the household, or traditional collection practices such as packing ice or collecting rainwater.

Addressing these systemic gaps in water service throughout Alaska, but specifically within the YK Delta, requires a concentrated effort from multiple levels of regulatory government, some of which have been underway for many years and some of which have just started. Historic levels of investment are being made at the federal and state level. In conjunction with the Bipartisan Infrastructure Law, $65 million has been allocated to Alaska's two State Revolving Fund programs, and the Environmental Protection Agency (EPA) has committed $20 million USD to support the state of Alaska's proposed plan for key drinking water projects (Corcoran 2022). $3.5 billion is being made available for the Indian Health Services sanitation facilities (Edgmon 2022), and an additional $2.76 billion is being made available for investment in water and wastewater infrastructure through the EPA's State Water Revolving Funds program (Lisa Murkowski Press Release 2022). At the regional and local level, such investments focused on improving water infrastructure has been underway for a long time. Historic investments of $300 million from the state for sanitation projects supported by Village Safe Water (VSW) Program between 1972 and 1994, and $537 million of combined federal funds and $240 million from the State of Alaska given to VSW by 2005 (Marino et al. 2009) have sought to support and strengthen water infrastructure over time.

To better understand this multi-level trend, our study undertakes a meta-synthesis of gray literature documentation to understand how different governmental levels, ranging from federal to local agencies, respond to water workforce challenges in Alaska. We focus on government agencies as they are the authoritative body for which workforce training and credentialling takes place in the water sector. This study takes a novel approach by unpacking each level of government separately and comparing their foci. We will explain the Alaska context that led us to depart from the convention of measuring government monolithically (or as a single level taking precedence), and what our analysis reveals in terms of the ways

different levels of government manage training and certification for water system OMM. We then assess the generalizability of our findings. While our analysis is conducted for the case of water systems in Alaska, we show that our key propositions may be applicable for other non-water sectors within Alaska and for the water system management in other states with similar rural population and climate profiles. Finally, we consider what can be done to better traverse these differing approaches to uphold the role of standardization as is prevailing in the regulation that governs Alaska water system OMM, but in a way that recognizes how to achieve these standards will differ across local settings, especially extreme ones.

2. POINT OF DEPARTURE

The key point of departure is that prior work predominantly focuses on the credentialling processes for water operators managing "standard" systems (i.e., water systems working within conventional operational ranges). However, U.S. rural water systems markedly differ from those used in more urban areas. We choose to focus our analysis on the context of Alaska specifically, but we show that this trend is also valid for other states with high prevalence of rural utilities. Key contextual differences for the case of Alaska include but are not limited to the size of population centers served (Eschenbach et al. 1989), extreme environmental conditions experienced (Birchall and Bonnett 2020), funding resources available (Taylor et al. 2020), populations lacking plumbed service (Mueller and Gasteyer 2021), challenges surrounding supply chain (George 2022), and maintenance approaches in light of climate change based challenges (Melvin et al. 2017). These differences between systems used in Alaska compared to most of the contiguous U.S. mean that rural utilities and operators in Alaska face a significantly different set of hurdles than operators in many other states. Therefore unsurprisingly, Alaska has a "dismally low rate of passing the exams", at least partially due to operators facing challenges not found in the contiguous United States (Alaska Native Tribal Health Consortium 2022a). This raises the question: is the national certification process aligned or appropriate for the Alaska

context and other similar rural contexts which have drastically different conditions than is typically certified? Ultimately, this is a critical question to ask because in order to obtain federal funding to support the operation of water treatment systems, the system must have a certified operator. However, because Alaska uses the same national certification process that is based on contiguous U.S. systems, operators in Alaska are inherently disadvantaged as they must obtain a certification that is often misaligned to the operational needs of their water systems to acquire the full set of federal funding.

In order to assess how materials vary between national credentialling and training tailored to the specific requirements of Alaska water systems, this paper asks: what is the primary areas of focus for each level of government when training operators for water OMM and to what extent is such material presented in contextually relevant ways? In order to explore these ideas, the paper seeks to: 1) characterize what grey literature is currently available on the certification and training process for water system OMM within the context of Alaska's water utilities, 2) how the local social context is considered in these materials, 3) and then assess how these findings are valid across different contexts (varying by sector and geography).

We focus on analyzing the available grey literature, which we define as materials written and published by stakeholder organizations that are outside of the traditional academic publishing channels (i.e., journal or book publications and working papers). The reason for not including the academic literature in this analysis is two-fold. First, while such literature presents cutting edge insights, it does not often focus explicitly on the direct requirements for how to manage water distribution systems in ways that the grey literature is designed to do (Adams et al. 2017). Secondly, in emphasizing the grey literature, this also allows us to more evenly assess and include non-traditional sets of materials focused on indigenous knowledge and teaching, which are largely absent in the academic literature. Therefore given our focus on implementation rather than analysis of practices and the desire to more holistically

incorporate diverse perspectives, including indigenous ones, we made the choice to focus on the gray literature as our core corpus for synthesis.

3. LITERATURE AND EMPIRICAL CONTEXT

3.1. The Role of Certifying Water Operators in the US

The Safe Drinking Water Act (SDWA), established in 1974, enabled the Environmental Protection Agency (EPA) to set enforceable standards for drinking water quality. By establishing these standards, it provides avenues for oversight to ensure states, local authorities, and water suppliers meet those standards. To achieve the benchmark quality goals, several funding mechanisms were also developed. Section 1452 of the SDWA establishes a Drinking Water State Revolving Loan Fund (DWSRF), which is used to make low interest loans and provide other forms of financial support, such as grants, to eligible water systems (EPA 2013). As a further sub-set of that legislation, the Drinking Water Infrastructure Grant Tribal Set-Aside (DWIG-TSA) program allocates funds specifically intended for building infrastructure which addresses the most pressing public health needs of tribes and Alaska Native Villages (EPA 2013). However, in order to be eligible for this funding, Section 1419(b) outlines that each state must have adopted and be implementing a training program which "meets the requirements of EPA's Guidelines for the Certification (and Recertification) of Operators of Community and Nontransient Noncommunity Public Water Systems (64 Fed. Reg. 5915)" (EPA 2016). The requirements for what this looks like differs by state and depends on whether the funding is being received by a Tribal group. In general, expectations include having a certified operator "at the appropriate level to operate the public water system", some form of enforcement approach, a plan for certification renewal, and a budgeting system (EPA 2013, 2016). If the state does not have these components in place, the EPA is within its legal rights to withhold up to 20% of the funding a state would otherwise have access to under the DWSRF program (EPA 2016). While this study primarily focuses on the water sector specifically, there is a rich set of literature which explores the benefits and drawbacks of certification programs across relevant fields including healthcare (Gebbie and

183 Turnock 2006; Lichtveld and Cioffi 2003); engineering (Kelly 2007; Tripp 2002); and education (Hansen
184 2011; Randall and Zirkle 2005), to name a few.

185 **3.2. The Empirical Context of Alaska**

186 Of the 185 rural communities in Alaska, there are 31 unserved communities where less than 55%
187 of homes are served by a water or sewer utility, leaving community members reliant on central washing
188 points and honey buckets. Of these 31 underserved communities, up to 17 of the communities run a fee-
189 based utility which uses closed-haul water and sewer systems (Hickel et al. 2018; Rosen et al. 2023). In
190 the remaining 143 rural communities, the infrastructure in place is rapidly deteriorating due to
191 environmental degradation and aging. Considering these challenges, much of rural Alaska could be strong
192 beneficiaries of the DWIG-TSA and have already been identified as recipients of the newly available
193 Infrastructure Investment and Jobs Act funding. However, while investing in the capital infrastructure
194 investment is the first critical step needed to connect these underserved communities, one of the key
195 concerns now is how to make the investments sustainable into the future (Rosen 2023). One such
196 challenge is identifying and retaining trained operators who can fulfill the certification requirements
197 needed to secure the full set of funding (Alaska Native Tribal Health Consortium 2022a; Black and McBean
198 2017; Murphy et al. 2015; Neegan Burnside Ltd 2011).

199 **3.3. The Skills and Workforce Gap in Alaska**

200 Challenges for rural and remote communities in the Alaska context span a range of issues from
201 access to educational resources to autonomy over project operations. Educationally, there are social and
202 financial barriers for sending operators from remote villages to urban centers for training and inadequate
203 access to the educational components required for certification (Alaska Native Tribal Health Consortium
204 2022a). These include the relatively high cost of flying an operator-in-training into a larger city to complete
205 the training and the compounded impact of having to take time off of work to do so. This is made further

challenging by the differences in educational approaches which are used in rural communities which place higher emphasis on traditional methods of knowledge sharing (Barnhardt 2007). Financially, lack of adequate institutional support and funding for water system OMM harms long-term operation (Murphy et al. 2015), and insufficient budgets make retaining qualified operators difficult (Neegan Burnside Ltd 2011). Further, a lack of community engagement and ownership over the design and maintenance of a community's own system makes system management challenging (Black and McBean 2017).

While specific investigation into such questions is limited, Black and McBean (2017) conducted a series of semi-structured interviews with 23 operators and community members including First Nations communities in Ontario, Saskatchewan, Alberta, and British Columbia. The study found that the topmost issue for ensuring quality water systems is the provision of consistent financial support. They found that 48% of the respondents felt they had received adequate training to ensure safe provision of drinking water, while 91% felt confident in the day-to-day operation of the community treatment plant. However, 61% of the respondents felt that certification should be mandatory, while only 26% approved of an opt-in approach for certification. Sixty-one percent (61%) had concerns about the level of education being a barrier for community members to obtain certification credentials, and only 35% trusted an operator who was not certified but had been working in the plant for a long time. In addition to financial hardship, Black and McBean (2017) found that the topics of "liability" and "high-pressure" were recurring concerns associated with the certification process. Black and McBean (2017) outline the importance of involving Indigenous peoples in a "collaborative, nation-to-nation" approach when designing training and certification programs that impact Indigenous peoples. While this study addresses many key aspects of the certification process for water system management in the Arctic, their study does not explore how well suited the certifications are for the communities using them.

3.4. Assessing the Gap

What these existing studies reveal but do not explicitly investigate is the differing foci around water system OMM in Indigenous communities, depending on regulatory boundaries and how this appears in the documentation geared towards operators and end-users of the systems themselves. At the federal and state level, while there are set-aside funding sources for specific communities, the focus is still on a standard set of operator guidelines that determine funding eligibility to ensure equivalent water standards across the U.S. However, at the regional and local level, the focus seemingly shifts to more local needs of systems and users, and, therefore, the operators who need to manage these context-specific aspects of the systems. A more systematic analysis of how these different foci across government levels interact and may ultimately impact operator certification must be understood, especially given the federalist system that oversees water system OMM in the U.S.

4. METHODS

4.1. Using a Meta-Synthesis Approach

To systematically analyze our archival data, we conduct a meta-synthesis of the grey literature pertaining to water system OMM in Alaska to characterize the available materials and their content. Using a meta-synthesis approach (Noblit and Hare 1988), paired with a qualitative coding scheme (Saldaña 2013; Spearing et al. 2022a), we characterize the existing grey literature pertaining to water operator training in Alaska and the emerging technical and social themes highlighted in each grey literature document. In order to assess the technical rigor of the grey literature, we use the American Board of Certification "Need to Know" criteria (American Board of Certification 2019) as a starting point for our coding framework in terms of the required technical knowledge for credentialling. We then iterate our coding approach to understand how these credentialing requirements are contextualized within the social setting of Alaska. We use the results from the qualitative coding to explore how the materials presented by each governmental level vary in the content and type of information delivered on operator training in Alaska.

Meta-syntheses are a subset of qualitative research which focuses on conducting a systemic review of qualitative literature (Lachal et al. 2017), whereby the objective is not to test a prior theory but rather to assess past qualitative work in order to build new theory (Rutgers University Library 2023). This is in contrast to a similar, but different, method called meta-analysis which focuses on a quantitative synthesis of existing literature with the objective of assessing the consensus of findings in the prior literature (Haidich 2010). While meta-synthesis approaches have been historically used to assess literature in health fields (France et al. 2019), such as those applied to a variety of different medical-related studies (Delicate et al. 2018; Lashewicz et al. 2019; Sáinz-Ruiz et al. 2021; Thomas and Harden 2008; Zhu et al. 2019), they have also been applied in the fields of education (Douglas et al. 2022; Gordon et al. 2022) and psychology (Button et al. 2017). Closer to our context, this method has been applied to infrastructure projects such as assessing the social impacts of dams (Kirchherr et al. 2016), the efficacy of development projects (Suich 2010), and, to assess the sustainability of rural water systems (Armanios 2012). We selected meta-synthesis as our methodological approach due to the limited prior work available, and therefore the need to build theory around how multiple government levels coordinate (or not) around water system OMM. To that end, based on our investigation, this is the first systematic review of operator training and certification grey literature with a specific focus on how the technical and social aspects of the work are geared towards the audience and context of Alaska. By characterizing what literature exists in this space and how the pieces interact with both social and technical considerations, we can gain insight into how current water OMM approaches adequately address (or not) the Alaska context.

We have chosen to focus on grey literature for this analysis as this set of documentation predominantly focuses on actionable procedures and guidelines for the OMM of water infrastructure systems and is directly geared towards use by operators and end-users. Throughout our exploration of the academic literature in this space, we saw more focus placed on cutting-edge methods for OMM and analysis around gaps in the space, but we could not find any studies based in the materials aimed towards

operator and end-user requirements specifically, which was the key motivation for this study. Several studies have recently highlighted the value in analyzing grey literature and have specifically encouraged their consideration. These studies highlight that including grey literature helps bridge the divide between academic and public discourse (Benzies et al. 2006; Rothstein and Hopewell 2009), allows for direct focus on the materials predominantly used by non-academic stakeholders of interest (Adams et al. 2016; Albino et al. 2011), and considers the knowledge of practitioners who are not necessarily in the academic space but are directly involved with system management (Brammer et al. 2011). Past studies have used grey literature to assess trends and concepts that might not yet be present in the academic space but are relevant in the operational context (Adams et al. 2016; Kaval 2011; Peloza and Yachnin 2008). Some research institutes, such as The Cochrane Handbook for Systematic Reviews of Interventions and the Institute of Medicine Standards for Systematic Review explicitly call out the need to consider grey literature (Eden et al. 2011; Higgins and Green 2011). The grey literature offers key insights into how different levels of government are communicating expectations and guidance to operators and end-users on the management of potable water systems and by studying the grey literature specifically, we can better assess the key themes and trends in those communications, which can inform advancements in the academic discourse.

4.2. Creating the Corpus

While there is no "gold standard" for how to collect and consider grey literature within the academic space (Godin et al. 2015), there have been a series of proposed best practices for doing so. We follow the set proposed by Godin et al. which highlights the following four steps of collection: (1) grey literature databases, (2) customized Google search engines, (3) targeted websites, and (4) consultation with content experts (Godin et al. 2015, Methods section). As highlighted by the authors, the combination of these four key approaches are used to reduce the risk of omitting key documents from the literature search and serve to comprehensively cover the space.

Our first step to conducting the meta-synthesis was the creation of the literature corpus. We generated our initial corpus of grey literature articles pertaining to OMM of water systems in Alaska via a three-step-process. First, the initial dataset of grey literature was collected using a snowball method. There is a debate surrounding the sampling methods used when conducting a meta-synthesis between exhaustive sampling and expansive sampling (Finfgeld-Connett and Johnson 2013). For this work, we prioritized an expansive sampling procedure to ensure we were capturing the diverse perspectives of a large range of stakeholders across all mediums of written communication. By design, our sampling approach is based on finding relative differences between governmental levels rather than capturing exact counts of all grey literature documents in this space. For these reasons, we err on the side of expansive sampling that better captures breadth rather than exhaustive sampling that better captures depth. Documentation collection started by using Google's search engine to search for the following keywords: water, operations, maintenance, management, training, certification, Alaska, YK Delta. No limits were set around publication dates and searches were not restricted to any particular discipline. The database search was conducted between February and May of 2022. Prior studies note such a keyword-based search is more conducive to the collection of grey literature, as opposed to academic literature (Atkins et al. 2008). Following this keyword search on Google, we tabulated all the stakeholders relevant to the OMM space in Alaska that appeared in the results. The final list appears in Table 1.

Using this set of identified stakeholders, we then snowball searched through their websites and other online presence to find any additional materials relevant to OMM in Alaska. We added this stakeholder-based search because we found the keyword search alone did not adequately capture all materials actually available on each stakeholder's website. Once the initial set of resources were collected, the third and final step was to share the grey literature corpus with the research team's Project Advisory Board, comprised of seven local subject matter experts spanning state, regional and local agencies involved in the provision of water. They assessed the completeness of the list and recommended further

stakeholders and documents. This included additional documents that the Advisory Board provided that were not available openly to the general public such as training materials only provided in private classes. This step ensured our final corpus was not modality-biased (i.e., only online materials). In addition to checking the grey literature that was included in the corpus for consideration, we also presented the key results from our rounds of qualitative coding to the advisory board in order to validate our findings and iterated on their feedback in subsequent rounds of data analysis.

The final corpus consisted of 183 documents. These documents ranged from training manuals published by the American Boards of Certification (ABC) to in-home water system treatment guidance published by the Alaska Department of Environmental Conservation (AK DEC) to information pamphlets on the health implications of poor water quality published by the Yukon-Kuskokwim Health Corporation (YKHC). To conduct the qualitative content analysis, we then selected a sub-set of the corpus to analyze, as is the standard practice in this space (Delicate et al. 2018; France et al. 2019). As per our expansive sampling aims, we wanted to ensure our subsample reflected the breadth of organizations involved in OMM in Alaska and not heavily weighted towards stakeholders with more presence in our full corpus. To do this, we did the following: (i) we included in our subsample all the documents from any organization with less than 5 documents in our full corpus; (ii) included at least 5 documents from any organizations with less than 25 documents in our full corpus, and (iii) included 20% of all the documents from any organization with more than 25 documents in our full corpus. Two authors screened and added a document in the subsample based on the following inclusion criteria:

- *Focus*: direct relevance to the OMM field, training and certification, or rural arctic conditions when relevant
- *Duplication*: avoidance of any duplicate or highly similar documentation (such as multiple chapters of any given training material)

- *Spread:* ensuring the documents were as close to representative of the materials provided from each stakeholder

From this selection process, a total of forty-nine documents were qualitatively coded. Of the selected documents, there were 24 documents from federal agencies (e.g. ABC, AWWA and EPA), 18 documents from state agencies (AK DEC and AFE), 5 documents from regional agencies (e.g. YRITWC) and 2 from local agencies (e.g. ONC and Bethel City Council). Figure 1 depicts a PRISMA diagram which summarizes the selection of each set of documents. Appendix A displays the final set of documents included in the analysis. All documents included in the first assessment were obtained from publicly available resources or were provided by the Project Advisory Board.

4.3. Qualitative Coding Scheme

For this study, we used a hybrid process of inductive and deductive thematic analysis (Fereday and Muir-Cochrane 2006). For the technical components, we used a deductive coding structure as these are well defined and often mandatory requirements for water system OMM in the U.S. In particular, these technical considerations included assessing what stage of the water distribution process the document focuses on followed by an assessment of how the "Need to Know" criteria established by the American Board of Certification was presented in the material (American Board of Certification 2019). For the social components, we used an indictive coding structure as there is no definitive consensus in the prior literature as to what social factors ought to be of focus for water system OMM. Thus, we allowed these themes to emerge from several coding iterations. These social considerations included aspects of system operations and management, relevance of the document towards the established audience of the piece, and other aspects related to taking the certification tests. These social considerations were discussed between the coding researchers and finalized as the codes hit saturation, or the point at which the no substantive additional information is being found when compared to those documents coded previously (Saunders et al. 2018). The coding scheme was reviewed by two members of the research team and

achieved a kappa intercoder reliability score of 0.81 across a subset of codes checked, which is typically viewed as having substantial agreement for qualitative work (McHugh 2012). Table 2 provides the primary codes and definitions established through this coding process while Appendix B displays the full coding dictionary.

As a reminder in alignment with our choice to engage in more expansive than exhaustive sampling, codes were assessed as presence within a document, rather than other used metrics such as frequency. For all metrics presented in the paper, we show a numerical value for the presence of a code in a document. In contrast to using a frequency metric which shows how often a theme appears in any given document, we were interested in exploring if the given technical and/or social themes were mentioned at all in the document. Given the scope and context of the research question we asked, we were seeking to understanding how governmental levels differed on the content the presented, rather than the weighting they gave to the content they presented.

4.4. METHODOLOGICAL LIMITATIONS

While we believe we have taken the best approach for this analysis, we recognize these choices come with limitations. Grey literature in general, and particularly within this space, is hard to systematically find (Adams et al. 2016). However, Noblit and Hare note that the search does not have to be exhaustive, but rather the best approach is the one that best captures the diversity of perspectives and views within the space (Noblit and Hare 1988). This is why we chose an expansive rather than exhausting sampling process, and even then, our sample size is larger than most other papers using this approach. The average corpus of other papers in this space ranges from 12 (Delicate et al. 2018) to 57 (France et al. 2019).

This work primarily focuses on written grey literature, which focuses on a single modality of knowledge transfer. This may introduce bias as we could not capture here any documentation which is informally kept, advice passed by word of mouth or other forms of documentation. Furthermore, our

approach relies primarily on publicly available grey literature sources. We tried to address this by supplementing the sets of documents with resources provided by a board of experts, but this could still potentially provide space for bias as the individuals that agreed to advise the work likely share similar interests in Alaska. Future work could expand the perspective of such a search to incorporate consideration of academic literature, books, videos, and other forms of knowledge sharing and could make use of tools such as machine learning to further expand the research findings from such work. However given our focus on regulatory requirements that impact water system OMM, we felt these literature sources were out of scope.

5. RESULTS AND KEY FINDINGS

5.1. Presence of Information Pertaining to Social Considerations

5.1.1. Operators and End Users

The first prominent variation across governmental levels that we observed was the primary audience that each document was geared towards. One of the basic meta-data codes we applied to each document was a code assessing which audiences were explicitly addressed in the document of interest. As seen in Table 3, for documents which made their content geared specifically towards operators, we find that local documents had a much higher presence rate (50%) compared to federal documents (20%) and state documents (17%). An example of such a quotation comes from the ABC guide from 2000 which states that “the purpose of this guidebook is to help operators of very small water systems serving a maximum population of 100 understand the provisions and purpose of the Final Guidelines for the Certification and Recertification of the Operators of Community and Nontransient Noncommunity Public Water Systems.” We find that local documents geared their documents towards end-users more often as well (50%) compared to state documents (20%). An example of a regional document contextualizing the document comes from the Yukon River Inter-Tribal Watershed Council YRITWC which states “Is this manual for YOU! This manual is designed to give you a basic understanding of the need for safe drinking

water and ways to ensure that water used for common domestic purposes is safe clean drinking water." This suggests that local documentation, in the space related to OMM of water systems, have a larger priority in publishing documents specifically focusing on their own operators and end-users.

5.1.2. The Certification Process

The second theme for which we uncovered variation across governmental levels was discussion pertaining to the certification and training processes. When assessing the mention of, or reference to, the certification and training process, we see a clear division in the materials provided by federal and state agencies in the sample of documents analyzed compared to the regional and local documentation. Table 4 shows the summarized presence values for codes throughout these documents. Across regional and local documentation, we find no presence of codes pertaining to any of the certification process. Within the federal documents, we see an emphasis placed on the operator exam design (25%) and exam content covered (30%). We see this represented in a federal document from the American Board of Certifications which states "Just as water distribution operator job duties vary in their complexity, so will the questions you are asked on the exam. Some will be more simple and routine, whereas others will be more complex, or cognitively demanding" (Association of Boards of Certification n.d.). We also see this at the state level in a document from the Alaska Department of Environmental Conservation which states "The exam consists of 50 multiple-choice questions. You will have 2 hours to complete the exam. You will be given a formula sheet to use during the exam. Copy of the formula sheet (PDF). A description of the type of questions that will be on the exam (PDF)" (Alaska Department of Environmental Conservation Division of Water 2022a). We also see that experience requirements (8%), previous educational requirements (8%), benefits of certification (16%) and the need for study tactics (13%) are present in a relatively limited number of federal documents. We see examples related to continuing education from the American Water Works Association which states "continuing education measured by recognized units, such as contact hours or continuing education units (CEUs), is essential to the development and sustained

competence of all operators and should be required for certification renewal". An AWWA also states "Do not let your past define your future…Those that have the most success in their careers are the ones that do not let their past define their future" (American Water Works Association n.d.), in reference to the benefits of certification. State documents have a higher presence of discussion on required prerequisite experiences (22%) and previous educational considerations (22%). The exam cost is only present across state documentation (17%), as reflected by this quote from AK DEC "Operators pay just an exam fee when registering for exams!" (Alaska Department of Environmental Conservation Division of Water 2022b). This suggests that national standards, as well as the certification and training processes to help operators earn compliance to those standards, were a priority at the state and federal levels of government. While the federal government is focused on more general education and tactics for success, state government seems to tailor their approach more to the infrastructure available and composition of their local workforce.

The general lack of documentation publicly available (or easily searchable) at the regional and local level discussing the certification process is particularly important to note due to the challenges associated with obtaining funding for systems which lack a certified operator. While just over 15% of the documents we analyzed from the federal and state levels mentioned the application process for getting certified, none of the regional nor local documents mention the process. The test is administered at the federal level in adherence with the state requirements, so we would expect the presence of documentation geared towards successfully taking the test to be higher at the federal levels. Yet, we see discussion of such testing and certification at the state level, even though they do not administer the testing. The lack of available information focused on training and certification at both the local and regional level suggest several avenues for exploration. The first possibility is simply that local and regional agencies do not see the need to provide further clarification to what they see as already adequately covered in federal documentation. However, when discussing the technical considerations, this seems

less likely to be the case. The second possibility is that local systems diverge significantly from the standard system for which federal certification and training is most applicable. Given such divergence, local government may not feel such certification is adequately relevant for managing a local water system. Even though local agencies may know certifying a local operator to federal standards is necessary to procure funding, they may lack the capacity to provide materials that systematically translate local systems to the federal systems of focus in certification and training. We will unpack this further in subsequent findings and in the Discussion.

5.2. Presence of Information Pertaining to Technical Considerations

5.2.1. Overview

When considering the technical elements present throughout the grey literature, there were four primary categories which we deductively coded for based off of the ABC Need to Know Criteria which include stage in the water collection and distribution process, administrative considerations, discussion pertinent to operating system itself, and discussion about water quality implications. Table 5 shows the aggregation of these technical consideration across the full sample of documents analyzed. Interestingly, the regional documentation had the highest prevalence of identifying a specific stage in the water process which the documentation was geared towards (80%). This seems to be a local focus as well with 50% of their documentation also identifying a specific stage in the water process, indicated by a label in the title or specifically called out in the documentation. We see this trend hold generally across the other categories as well with regional documentation including details on demonstrative considerations (40%), operating system details (60%) and water quality (20%). This specificity may facilitate improved understanding of what aspect of the water system is being presented. Within both operating system considerations and some administrative considerations, regional and local level documents had higher code presence. As per prior findings, this suggests local and regional authorities are potentially filling gaps in federal and state documentation. More specifically, there is potentially recognition of the need to

discuss the nuances of local water systems vis-à-vis the more standard systems that are of focus in state and federal documentation.

5.2.2. Administrative Considerations

Table 6 shows the coding presence for administrative considerations. Within the administrative consideration codes, we see several interesting trends emerge. Regional (40%) and local (50%) documentation have a higher prevalence of discussing the financial threats to a system, whereas there are no state documents coded mentioning such issues, and only 4% of federal documents mention financial threats as a concern. We see the emphasis on financial threats highlighted in a quote from the Bethel City Council which states "The City must have a score of 60 or greater out of 100 points in order to be approved for funding from the Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (DEC)" (Bethel City Council 2021). This same trend holds when discussing worker safety and threats and security for the water systems. Regional and local documents continue to show higher frequencies for compliance to existing guidelines, although not to the same extent across the sample. There is only one category within technical considerations where the federal documents show a higher code presence and that is for administrative procedures (20%), which makes sense given they are the authority most directly responsible for establishing and administering water system requirements.

Table 7 shows the threats and security code in detail. As we would expect to see, regional and local documents show higher overall prevalence across the various codes. When discussing the threats posed by climate and the environment, we see a 60% and 50% code presence, respectively, and we see a 20% code presence for hazardous materials and the threats of system break-downs at the regional level; for example, YRITWC states "Earthquakes and floods sometimes cause fuel tanks to fall or float from their supporting structures" (The Yukon River Intertribal Watershed Council 2019). It is also interesting to note that the threat of cyber security breaches is only present in federal documents with a presence of 4%.

In totality, our findings suggest that local and regional authorities seek to balance standardized requirements with localized needs. Given the extensive discussions around financing, this suggests local and regional authorities are aware of the needs to comply with federal mandates to ensure funding. However, they also seek to elaborate upon the nuances between local systems and standardized systems per federal mandates. Perhaps this is to fill gaps between standard administrative processes and local needs of local systems and workforce.

5.2.3. Physical System

When analyzing the code presence across the management of the physical system, we see another interesting trend emerge. Table 8 shows the specific codes outlined under the broader umbrella of the operating system. We see the mention of system components and design mentioned with low frequency in federal and state documents, with the highest federal document category focuses in equipment operations (28%) ad equipment maintenance (24%). There is a high code presence for system monitoring (40%, 50%), maintenance (60%, 50%), and operations (40%, 50%) across regional and local documentation respectively. This again attests to potential nuances between local systems and the standardized systems from federal mandates.

We find that regional and local level documents have a heavy emphasis on practical applications of running and operating water systems daily. This includes a higher emphasis placed on administrative considerations and the technical considerations for operating a system. We find a higher frequency of context setting and establishing relevance throughout local and regional documentation. These findings encourage us to consider what materials are provided for training and certification and what is expected knowledge on the test. This also raises the question of whether certification should be more context aware and sensitive for the regions where it is being applied. Perhaps local and regional authorities place

such emphasis to fill gaps in the federal and state documentation that is less sensitive to the operational context.

5.3. Results Summary and Core Propositions

In synthesizing across findings, we have uncovered an understudied tension between *standardization ("one size fits all")* and *situatedness ("tailored to every circumstance")*. This tension is especially acute in the Arctic context. Arctic water systems and their accompanying workforce must operate in conditions that are far from the conventional setting given their extreme climate and spatial remoteness. However, to ensure standard quality and to secure funding, compliance and training systems that are more standardized may be misaligned with the systems in the Alaska context.

Taking our findings and this core tension, as well as linking these ideas to prior literature studying the relationship between certification and cultural context (Schelwald and Reijerkerk 2012), our study reveals two core propositions (shown in Figure 2):

- Proposition 1: As the regulatory level of the document author becomes spatially larger (i.e., moves towards state and federal documents), standardization of the process is prioritized over tailoring to the context.
- Proposition 2: This tension between standardization and contextualization will become more acute following the degree to which local systems operate outside of typical ranges and tolerances.

Base off of our meta-synthesis, we pose that this may manifest along two primary avenues that can serve as sub-propositions to these core propositions:

- Social translation: (a) state and federal documentation will implicitly assume average measures of skills, community make-up, size of city and workforce when preparing guidelines; (b) regional

and local documentation will assume a more bespoke configuration unique to their social context and needs.

- Technical translation: (a) state and federal governments will assume typical water quality needs and therefore typical contaminant treatment needs; (b) local and regional governments will assume more atypical water quality needs and therefore consider more esoteric treatment needs and traditions.

To summarize the key findings of our meta-synthesis, we present our findings in Table 9.

6. SCOPING POLICY ANALYSIS TO ASSESS TRENDS BEYOND THE GREY LITERATURE

While our work up to this point predominantly focuses on the themes identified from our meta-synthesis of water system operations, maintenance and management, as identified in the grey literature, her we are interested in understanding the generalizability of our propositions. To this end, we explore two additional avenues. The first is focused on assessing generalizability across sectors within Alaska in order to understand if these are water system specific findings or if the concept of Standardization vs Situatedness is a challenge in other sectors. We present three motivated cases across the requirements for environmental needs assessments to apply for federal funding, the push for a nursing compact for cross-state boundary license recognition, and the lack of situated regulation for aviation management.

The second is focused on assessing generalizability across states within the water sector. We conduct a basic correlational analysis across all 50 states to assess what factors are associated with states which adopt the use of the ABC Need to Know Criteria. We find that broadly states which adopt their own Need to Know Criteria are associated with more rural states, states that spend more on their utilities broadly, and their water utilities specifically. However, we find for the extreme cases, which include Alaska, Wyoming and Montana, all three states still use ABC's Need to Know criteria which suggests that there is a lack of situated policymaking occurring to adapt federal regulations to their own context.

6.1. Generalizability Across Other Sectors within Alaska

We start with assessing generalizability across sectors within Alaska. Here we present three case studies that highlight similar standardization versus situatedness challenges in the context as we observe in water. The first focuses on the specific requirements of including an environmental impact statement (EIS) to be eligible to receive some federal grants. This was an issue highlighted at the Rights, Resilience and Community-Led Climate Adaptation Workshop held in Anchorage in 2023 with a statement summarizing the sentiment "the problem is federal policies and regulations that don't fit Alaska's unique terrain and climate" (Estus 2023). Under the National Environmental Protection Act, grants that are expected to have "a significant impact on the quality of the human environment" will be expected to have an EIS (EPA 2023). However, many of the tools and resources used to inform EIS assessments are inadequate for the context of Alaska due to the rapidly changing environmental landscape and the large scope of remote terrain which is challenging to appropriately capture in databases. This in turn negatively impacts the ability of communities to be eligible for funding. In this context, while the federal government has standard expectations for conducting an EIS based off of existing survey data, such standardization when applied to Alaska has the potential to do more harm than good.

The second example focuses on the stance that the Alaska Nurses Association expressed in response to a move towards establishing a Nurse Licensure Compact (NLC) (National Counsel of State Boards of Nursing 2023). The NLC aims to "expand access to nursing care and nurse mobility across the U.S.". However, the Alaska Nurses Association highlights several critical concerns about this compact when applied to the context of Alaska. They broadly summarize their position in the following way: "the Nurse Licensure Compact: a Bad Fit for Alaska" (The Alaska Nurses Association 2023). Their arguments against the move include a loss of decision-making power at the state level, loss of context awareness in making the care for Alaska-specific health concerns more challenging, and that such a national approach will not

fix the key local issue of workforce gaps. The Unions statement concludes be arguing that a "'One-Size-Fits-All'" Nurse Licensure Compact is a Bad Fit for Alaska" (The Alaska Nurses Association 2023).

Finally, we consider the context of aviation legislation, and specifically the mandatory use of Automatic Dependent Surveillance-Broadcast (ADS-B) systems. In this case, because Alaska is an "uncontrolled airspace", pilots are not mandated to use an ADS-B (Larsen 2020). In part due to the hazardous terrain, challenging weather conditions and limited communication methods available in Alaska, the state suffers the highest aviation accident rate in the U.S. (Alaska Department of Transport and Public Facilities n.d.). Without the consideration of the local environmental and geographic challenges and adjusting these requirements for the fact that Alaska airspace is not controlled, the current Federal regulation does not adequately meet the needs of Alaska pilots. In order to address these challenges, the state has been working with the Federal Aviation Agency (FAA) to develop regulations which better fit the context of Alaska's flying conditions.

From these three case studies, we see that the challenges associated with taking standardized policies and applying them to a situated context may be challenging in other sectors as well. We find this to align with our first proposition. Furthermore, we find that the extreme conditions of the Alaska environment, for all three cases, may have contributed to a feeling that such existing national regulatory standards had the potential to do more harm than good. In the scenario of requiring EIS to receive Federal funding, the lack of accurate data about the Alaska context makes creating an accurate EIS challenging, thereby harming the overall ability of communities to be able to apply for grants. For the context of the NLC, according to the Alaska Nurses Association, the national agreement is likely to detrimentally impact Alaska health, decrease revenue for local nurses and will not fix the workforce shortage, only serving to hurt the jobs of local nurses. And finally, the extreme environment and the fact that the aviation space is not controlled in Alaska means that the existing regulations do not even most aviation incidents in Alaska and pilots are being harmed as a result. Table 10 summarizes these case findings and suggest that our theory

holds across different infrastructure systems within the context of Alaska. To further ascertain these synergies, future work could conduct additional meta-syntheses of these sectors in Alaska and in other states.

6.2. Generalizability Across Other States within Water Sector

While we have established some avenues for generalizability when comparing to other certification processes within Alaska via specific case examples, we now run a correlational policy analysis across the other 50 states to assess if these findings for needing an improved set of situated approaches for Alaska's water OMM sector hold, in a purely correlational manner, for the water systems of other states. For this, we use the base context of what is required to become a certified operator in other states. As we discuss above, the requirements to become a certified operator vary by state (American Water Works Association 2018). All 50 states have an established set of criteria for what is required to qualify for certification which has been reviewed and approved by the EPA. Some of these requirements include taking and passing an exam, having demonstrable educational achievements and on-the-job training, and expectations around what certification renewal consists of. While the EPA's documentation states that "the type of operator training necessary for each classification level in each state is best determined by the state" (American Water Works Association 2018), we argue there are several states which would benefit from having their own certification process which have not yet established it. To assess this question, we conduct a Pearson's correlational assessment to understand, using a simplistic mechanism, the differences in these states across several categorical variables including the density of the population (ACS 2021), the percentage of the population living in rural areas (World Population Review 2024) and the revenue created and managed by local government within the state as applied to water utilities (US Census Bureau 2021) to highlight any categorical variables which emerge. Figure 3 presents a correlation matrix which highlights how these variables interact with each other, while Appendix C presents where the raw data was pulled with regards to what states adopt what ABC criteria (American Water Works Association 2018).

Let's start by defining our key variables. ABC means that the state, according to the American Water Works Association, uses the ABC criteria produced at the Federal level for their certification and licensure process. Own Criteria means that the state has elected to create their own certification process, tailored to the context of their own state. There are a total of 9 states where the use of federal vs. own state examination processes were unknown or unclear. We then include variables for total population in the state, population density, the percentage of people living in rural areas within the state, and utility expenditure. When looking at general trends, we see that states which have not yet identified a clear use of a federal or state-based criteria for their exams have a correlational relationship with the percent of the population living in rural areas. While only representing a correlational relationship, which is not indicative of a causal trend, this is an interesting commentary on the relationship between rurality and the use of a contextualized testing process for certification.

While it is valuable to look at the context of this across the full set of United States, we are specifically interested in the context of Alaska and other states similar to Alaska. For this comparison, we have selected the states of Wyoming and Montana. Both of these states are statistically similar to Alaska in several key factors. After Alaska, Wyoming and Montana have the lowest population density in the United States (US Census Bureau 2020). Qualitatively speaking, both states have primarily rural landscapes and are known for their resource-based industries and outdoor sport appeal. Quantitatively speaking, all three states are comparable along several key demographic variables. All three states have statistically similar rates of high school educational attainment in their populations over the age of 25, percentage of people who fall below the poverty level in the last 12 months, the percent of children that don't have health insurance, and the percentage of people employed in the manufacturing industry (US Census Bureau 2022).

Now, let's compare the trends of these three states. We assess the regulations each state has adopted for the water operator training process and find that each of all three states use the Federal certification

process but align with several of the key variables of states that establish their own criteria including the cost of utilities and the amount of money spent on water utilities in particular. While each state re-affirms the need to assess their local context when preparing to manage a water system in their state (American Water Works Association 2018), we argue that the lack of state-specific certification processes may be misaligned with their more extreme and esoteric contextual needs. For example, Alaska "Uses ABC's 2012 New Standardized Exam Need-to-Know Criteria", but "Recommends studying the Alaska Drinking Water Regulations as opposed to the Federal Regulations". Wyoming states "Examinations are linked to ABC NTKC and study guides are available" while Montana states "Montana has revised its classification system to incorporate key provisions of the ABC system, yet still preserve Montana-specific requirements" (American Water Works Association 2018). This helps explore and extend the generalizability of our arguments in that the situatedness – standardization tension we observe in Alaska seems present in water operator training and certification guidelines across the U.S., and especially in similar other states (i.e., Wyoming and Montana).

7. DISCUSSION

Our study centrally asks, is the national certification process for water system OMM aligned or appropriate for the Alaska context and even for other similar rural contexts? To answer this question, we conducted a meta-synthesis that sought to better capture neglected variation across government levels more directly as applied to water system OMM. This allowed for the uncovering of key differences between how federal, state, regional, and local governments attend to social and technical considerations in water systems. In particular, we find that the prior literature misses a key tension across government levels when it comes to water system OMM, namely the tension between standardized approaches that apply universally and situated approaches that vary locally. These tensions between standardization and situatedness is especially acute in extreme settings such as Alaska where the local system is markedly different than the typical standard system.

These differences are also especially challenging as they are do not take into account markedly different indigenous practices. Current OMM practices are based on Westernized engineering knowledge, which expect a minimum formal education level (Alaska Department of Environmental Conservation n.d.), and assume this training can take place over extended time periods for content absorption (Alaska Native Tribal Health Consortium 2022a). However, the formal education level of many Alaska communities does not match the formal education level in the contiguous United States, and the time allocated for completing certification training is limited to windows during which tribal subsistence activities (i.e., hunting and gathering) are not occurring. Furthermore, for individuals that do obtain the necessary certification, they are typically drawn to more urban, higher-paying jobs (Alaska Department of Labor and Workforce Development 2023). While Western knowledge prioritizes compartmentalized learning taught in the context of a classroom, indigenous knowledge emanates comes from "direct experience in the natural world" (Barnhardt and Kawagley 2005). Our study suggests that such standardized approaches may not even be fit for purpose when introduced in such indigenous settings. This reveals a divide between the way that training and credentialing for OMM of water systems in Alaska is assessed versus the time constraints and pedagogical needs of the Indigenous communities needing such training.

In exploring the nuances across regulatory levels of government, we make several key contributions. While previous literature notes technical, social, and environmental factors are crucial to sustainable water systems (Armanios 2012; Kaminsky and Javernick-Will 2014), these works implicitly assume either all governmental levels are equally aware of these factors or that a single level takes precedence. In understanding this standardization-situatedness tension, we argue that only in a multi-level effort can systems meet universally accepted needs while also being flexible to nuances of their local social context.

8. POLICY IMPLICATIONS AND RECOMMENDATIONS

There key policy implication that stems from this work pertains to the unprecedented amounts of funding currently (in 2023) being made available from the EPA and the Infrastructure Investment and Jobs Act (IIJA) for rural Alaska water systems. The EPA has committed $20 million USD to support the state of Alaska's proposed plan for key drinking water projects, and the IIJA/Bipartisan Infrastructure Law includes allocations of $65 million to Alaska's two State Revolving Fund programs (Corcoran 2022). Furthermore, $3.5 billion is being made available for the Indian Health Services sanitation facilities (Edgmon 2022), and an additional $2.76 billion is being made available for investment in water and wastewater infrastructure through the EPA's State Water Revolving Funds program (Lisa Murkowski Press Release 2022). This is compared to historic investments of $300 million from the state for sanitation projects supported by Village Safe Water (VSW) Program between 1972 and 1994, and $537 million of combined federal funds and $240 million from the State of Alaska given to VSW by 2005 (Marino et al. 2009).

In light of the nearly $7B in financing that has been allocated for water and wastewater systems in Alaska in the coming decades under the IIJA, our study argues for a more multi-level regulatory perspective around who receives financing and for what facets. Our work suggests that relying solely on the federal government's understanding of Alaska systems may overlook key aspects of Alaska systems which require nuanced investment strategies. While historically the biggest hurdle to addressing gaps in infrastructure provision in Alaska has been a lack of funding, the historic funding being made available through the IIJA shifts this focus to how to maintain and operate the infrastructure in the long-term, and in ways that align with the unique needs and capabilities of Alaska water systems. As a start and at the bare minimum, perhaps some of this funding could be used to create more tailored training materials that better account for Alaska's unique environmental conditions and indigenous knowledge systems.

9. CONCLUSION AND FUTURE WORK

This study is motivated by the need to understand how we can address workforce challenges that are especially acute and severe in rural communities, using the case of Alaska specifically to explore this relationship. This led to the need to uncover how different levels of regulatory government communicate about technical and social considerations around water. Through a meta-synthesis of the grey literature across different governmental levels, we unpacked a key tension between standardization and situatedness. State and federal authorities tend to prioritize standardization, while local and regional authorities prioritize situatedness. For a state like Alaska where the local water system operates outside typical ranges, this tension becomes more drastic and salient. From our findings, we subsequently propose propositions around this core standardization-situatedness tension. We see this as having important policy implications, namely the need to have a consultative approach across levels of regulatory government for how funding ought to be allocated. However, more importantly, we also recognize this is only the start of the work needed to more comprehensively capture the dynamics across governmental levels as they pertain to water system OMM. In particular, future work should conduct more qualitative interviews and surveys of water operators and end users to better anchor these propositions in the grey literature to actual local voice. This is also an exciting opportunity that also lends itself to more novel methods such as natural language processing that can discern patterns in qualitative data, especially when quantitative data is sparse as is often the case in such extreme settings as these. Future exploration could also explore the key mechanisms behind the root causes for such structured differences for available funding at both federal and local levels.

APPENDIXES:

Appendix A: Final Set of Documents Included in Analysis

Appendix A details the final set of documents included in the corpus that was manually coded by the authors.

Agency	Document	Year of Publication
ABC	VSWS Guidebook	2000
ABC	Validating Your Certification Exam	2013
ABC	Guide Collect Class I	2018
ABC	Guide Collect Class II	2018
ABC	Guide Distr Class II	2018
ABC	Guide Treat Class I	2018
ABC	Guide Waste Treat Class I	2018
ABC	Certification Process	2019
AFE	Environmental Technician Work Process and Related Instruction	2018
AFE	Alaska Connect Information	2022
AFE	Environmental Technician Apprenticeship Information	2022
AFE	Environmental Worker Training	2022
AK DEC	Operator's Guide for Small Treated Public Water Systems in Alaska	2002
AK DEC	Well Owner's Guide for Small Untreated Public Water Systems in Alaska	2002
AK DEC	Introduction to Small Water Systems Ch1	2009
AK DEC	Introduction to Small Water Systems Ch9	2009
AK DEC	Alaska Water and Wastewater Operator Certification & Training	2016
AK DEC	Operator Certification Program Report for State Fiscal Year 2021	2021
AK DEC	Capacity Development	2022
AK DEC	How to Get Certified as a Water Operator	2022
AK DEC	More About the Operator Training & Certification Program	2022
AK DEC	Operator Certification Compliance Guidance During COVID	2022
AK DEC	Small Water System Certification	2022
AK DEC	Alaska Water and Wastewater System Operators Requirements	nd

AK DEC	Bethel Heights Water Distribution System	nd
AK DEC	How DEC Determines Eligibility For Provisional Certification	nd
AWWA	Findings of the Effective Utility Management Review	2016
AWWA	Managing Cyanotoxins in Drinking Water-Technical Guidance Manual	2016
AWWA	Communicating Source Water Protections-Consumer Confidence Reports-Literature Review	2018
AWWA	Operator Licensing Requirements Across the US	2018
AWWA	Cybersecurity Risk & Responsibility in the Water Sector	2019
AWWA	Water Operator Certification Explained	2019
AWWA	Water Utility Manager's Guide to Community Stewardship	2019
AWWA	Operator Certification Statement	2022
AWWA	WSO WPP Get the Job	nd
AWWA	WSO WPP Study Tactics	nd
BCC	Bethel City Council_2021_Water & Sewer Report	2021
DCRA	RUBA Training Courses	2018
EPA	Operator Certification Guidelines Implementation Guidance	2000
EPA	Rural and Small Systems Guidebook	2016
EPA	Summary of State Operator Certification Programs	2016
EPA	Water Systems Partnerships Meeting Summary	2017
EPA	Learn about Capacity Development	2021
ONC	Clean Water Makes a Healthy Home - Financing Infrastructure Investment in Bethel, AK	2022
YRITWC	Safe Drinking Water and Sanitary Manual	2019
YRITWC	Template Emergency Response Plan	nd
YRITWC	Aquatic Buffer Ordinance	nd
YRITWC	Drinking Water Improvement Program	nd
YRITWC	Water Quality Protection of Water Source and Traditional Water Sources ES	nd

Appendix B: Coding Dictionary

Appendix B outlines the coding dictionary used for the application of the qualitative coding scheme.

CODE	DEFINITION
Document Properties	
Geopolitical Scope	*The level of regulatory government that published the document.*
Federal	*The national government of the United States.*
State	*State-based governments which provide oversight to a single state.*
Regional	*A regional form of government which provides oversight to a subset of a state.*
Local	*A local form of government the city level.*
Audience	*The group of people that the document is intended to inform.*
Operators-in-training	*An individual who is pursuing training to become a certified water operator.*
System Operators	*An individual who is licensed and operating a water treatment and distribution system.*
Community Members	*An individual who lives in the community receiving treated water.*
Technical Considerations	
Stage in the Water Process	*The stage of water treatment that the document targets.*
Not Stage Specific	*The document does not identify or make specific which stage of water treatment the document is referring to.*
Source Water	*Addresses where the water is initially coming from.*
Potable Water Treatment	*Addresses the process of treating and making ready for consumption potable water.*
Potable Water Distribution	*Addresses the process of getting potable water from the utility to the end-user.*
Wastewater Collection	*Addresses the process of aggregating grey and black water.*
Wastewater Treatment	*Addressers the process of treating and making ready for release water.*

CODE		DEFINITION
	Water Storage	*Addresses a utility's storage system.*
	End-Users Storage System	*Addresses an end user's personal storage system.*
Administrative Considerations		*Items that concern administrative needs, including paperwork, planning, and other "back of house" tasks*
	Administrative Processes	*Actions and procedures related to record-keeping. Examples: billing, human resources, time keeping, overhead tracking, company management, etc.*
	Compliance	*Tasks related to water quality regulations and permitting requirements from the water operator's side. Examples: compliance paperwork, filing compliance forms, tracking deliverables, interacting with inspectors.*
	Strategic Planning	*Practices pertaining to future planning, including best management practices, gold standards, and strategic planning. Examples: budgeting for future expansions, hiring specialists).*
	Funding	*Discussion of financing, spending, and other costs considerations. Examples: funding from government entities for system operations.*
	Worker Safety	*Procedures to ensure the safety of workers and the security of the water system. Examples: PPE requirements, staffing requirements, worker health*
Water Quality		*Considerations of water contaminants and cleanliness*
	Testing	*Processes for testing potable water quality.*
	Laboratory	*Formal water quality testing in a laboratory, chemical analysis. Conducted by a specialist.*
	Field	*Conducted during routine checks and maintenance, more back of the envelope. Conducted by an operator.*
	At-home	*Conducted by end-user, not mandatory.*
	Effluent at the conclusion of the treatment process	*Considerations of the quality of treated effluent water leaving the water treatment plant, entering the distribution portion of the system.*

CODE		DEFINITION
	Biological	*E.g.: Viruses, bacteria, zoological contaminants, organic compounds.*
	Chemical	*E.g.: Nitrous oxide, rust.*
	Physical properties	*E.g.: Turbidity, pH, temperature.*
Water received by the end-user		*Considerations of the quality of water received at the tap for the end-users.*
	Biological	*E.g.: Viruses, bacteria, zoological contaminants, organic compounds.*
	Chemical	*E.g.: Nitrous oxide, rust.*
	Physical properties	*E.g.: Turbidity, pH, temperature.*
Treatment Process		*The process of water treatment, including flocculation, tanks, equipment*
Operating System		*Considerations of the water system equipment*
Equipment Installation		*Instructions for creating new water systems*
Equipment Operations		*Procedures for operating the water treatment and distribution infrastructure system.*
Equipment Maintenance		*Procedures for maintaining the integrity of the water treatment system, including routine maintenance and repairs.*
System Components		*A breakdown of each material or piece of a system*
System Monitoring		*Tells us if maintenance is needed – about the integrity. Measuring processes occurring in water utility (uses devises), humidity sensors, water level measurements.*
Threats and Security		*Anything that threatens the daily operations of the water system, both physically and operationally.*
Climate and Environment		*Flooding, landslides, freezing, extreme weather events, erosion, change in landscape, changes in water supply patterns.*
Cybersecurity		*Cyber hacks, ransom ware, hostage data.*

CODE			DEFINITION
	System Breakdown		*Rusting, lead-based paints, mold, corrosion.*
	Hazardous Materials		*Chemical spills, asbestos.*
Background			*Information which helps inform, train or educate the user on why a process is designed like it is, what the technical/engineering-based/physics reason is*
Social Considerations			
Certification			*Pertaining to the process of earning certification to become a certified water operator.*
	Application Process		*Provides details on how to apply for exams and certification.*
	Benefits of Certification		*Explains why pursuing certification is of value to the individual and the community.*
	Accessibility of Material		*Where is the material stored/available?*
		In-Person Training	*Provided at an in-person training.*
		Library	*Found in a publicly available library.*
		Online	*Found online.*
	Cost Considerations		*The cost incurred by the individual pursuing the certification and the affordability of this cost.*
	Continuing Education Requirements		*Details the requirements for maintaining certification.*
	Experience Requirements		*Details the experiences required for achieving certification.*
	Previous Education Considerations		*Education credential required and education paths to get certified.*
	Study Tactics		*Advice for how to prepare and study for the test itself, strategies.*
Consequences of Poor Management			*Detrimental impacts of mismanaged water utilities on population and the environment.*

CODE	DEFINITION
Collaboration	*The importance of cross-systems collaboration and disciplines.*
Water Governance	*How different levels of government interact and deal with policy and regulation related issues*
Federal policies, regulations	*Acts, laws, policies.*
State policies, regulations	*How these policies and regulations are implemented at the state level.*
Tribal governance	*How tribal policies interact with federal policies.*
Community Outreach	*Considerations of how water systems can interface with and interact with the communities they are serving.*
Water System Stakeholders	*Discussion of who will be impacted by the water system.*
Environmental Attorneys	*Lawyers who are responsible for defending the water systems.*
End-Users	*People who are receiving water from the water systems.*
Relevance	*How is the content covered in the document made relevant to the context it is addressing or the individual using the materials.*
To environment	*Materials that are better suited for the Alaska environment.*
To operator	*Materials that are tailored for operators in Alaska.*
Positive implications	*Positive assumptions about the backgrounds, interests of, skills of operators that are getting certified.*
Negative implications	*Negative assumptions about the backgrounds, interests of, skills of operators that are getting certified, condescending, tone sounds like being talked down to.*
To end user	*Information directed towards household management of water and interacting with the water system.*
COVID-19	*Any aspects relevant to the COVID-19 Pandemic*

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Appendix C:

Appendix C presents the raw data explaining which states use what form of certification guidelines (American Water Works Association 2018)

State	Reciprocity		Certification in addition to Treatment		Established Need-to-Know Criteria					
	Water	Wastewater	Distribution	Collection Systems	ABC		Own criteria		No or unsure	
					W	WW	W	WW	W	WW
1. AL	YES	YES	YES	YES					X	X
2. AK	YES	YES	YES	YES	X	X				
3. AZ	YES	YES	YES	YES	X	X				
4. AR	YES	YES	YES	NO	X					X
5. CA	YES	YES	YES	YES			X	X		
6. CO	YES	YES	YES	YES			X	X		
7. CT	YES	YES	YES	Voluntary			X			X
8. DE	YES	YES	NO	NO				X	X	
9. FL	NO	NO	YES	NO			X	X		
10. GA	YES	YES	YES	YES	X	X				
11. HI	YES	YES	YES	NO	X	X				
12. ID	YES	YES	YES	YES	X	X				
13. IL	YES	YES	YES	YES				X	X	
14. IN	YES	YES	YES	NO					X	X
15. IA	YES	YES	YES	NO	X	X				
16. KS	YES	YES	YES	NO			X	X		
17. KY	YES	YES	YES	YES			X	X		
18. LA	YES	YES	YES	YES			X	X		
19. ME	YES	YES	YES	NO			X	X		
20. MD	YES	YES	YES	YES	X					X
21. MA	YES	YES	YES	Voluntary		X	X			
22. MI	YES	YES	YES	NO			X	X		
23. MN	YES	YES	NO	YES			X	X		
24. MS	YES	YES	NO	Voluntary				X	X	
25. MO	YES	YES	YES	NO			X	X		
26. MT	YES	YES	YES	YES	X	X				
27. NE	NO	YES	YES	NO		X	X			
28. NV	YES	YES	YES	Voluntary	X	X	X	X		
29. NH	YES	YES	YES	NO			X	X		
30. NJ	YES	YES	YES	YES			X	X		
31. NM	YES	YES	YES	YES			X	X		
32. NY	YES	YES	YES	Voluntary		X	X	X		

33. NC	YES	YES	YES	YES				X	X	
34. ND	YES	YES	YES	YES					X	X
35. OH	YES	YES	YES	YES	X	X				
36. OK	NO	NO	YES	YES			X	X		
37. OR	YES	YES	YES	YES	X	X	X			
38. PA	YES	YES	YES	YES			X	X		
39. RI	YES	YES	YES	NO	X	X		X		
40. SC	YES	YES	YES	Voluntary	X	X				
41. SD	YES	YES	YES	YES	X	X		X		
42. TN	YES	YES	YES	YES		X	X	X		
43. TX	YES	YES	YES	YES			X	X		
44. UT	YES	YES	YES	YES		X	X			
45. VT	YES	YES	YES	Voluntary					X	X
46. VA	YES	YES	NO	NO	X	X				
47. WA	YES	YES	YES	Voluntary	X	X		X		
48. WV	YES	YES	YES	YES					X	X
49. WI	YES	YES	YES	YES			X	X		
50. WY	YES	YES	YES	YES	X	X	X	X		
TOTALS 50	**YES – 47 NO -- 3**	**YES – 48 NO -- 2**	**YES – 46 NO -- 4**	**YES – 28 NO – 15 VOL – 7**	**18**	**21**	**26**	**28**	**9**	**8**

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778 All data, models, and code generated or used during the study appear in the submitted article.

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TABLES:

Table 1: Select stakeholders for Alaska water systems represented in corpus, organized alphabetically. While not necessarily the full set of stakeholders in this space, these were the key stakeholders identified using the open text search and were then verified by the group of advisors.

Organization	Geopolitical scope
Alaska Department of Environmental Conservation (AK DEC)	State
Alaska Department of Transportation and Public Facilities (AK DOT & PF)	State
Alaska Division of Environmental Health (AK DEH)	State
Alaska Division of Water	State
Alaska Forum on the Environment (AFE)	State
Alaska Native Tribal Health Consortium (ANTHC)	Regional/Tribal
Alaska Rural Utility Collaborative (ARUC)	Regional/Tribal
Alaska Spill Prevention and Response	State
Alaska Water Wastewater Management Association	State
American Water Works Association (AWWA)	National
Association of Boards of Certification (ABC)	National
Association of General Contractors (AGC)	National
Association of Metropolitan Water Agencies	National
Association of State and Interstate Water Pollution Control Administrators	National
Association of State Drinking Water Administrators	National
Bethel City Council (BCC)	Local
Bethel Finance Committee	Local
Bethel Planning Commission	Local
Bethel Public Works Committee	Local
Carpe Diem West's Healthy Headwaters Alliance	Regional/Tribal
City of Bethel	Local
Community Parks and Recreation Committee	Local
United States Department of Agriculture (USDA)	National
Department of Consumer and Regulatory Affairs (DCRA)	National

Department of the Interior (DOI)	National
EPA's National Drinking Water Advisory Council	National
Indian Health Service (HIS)	National
National Association of Clean Water Agencies	National
National Association of Water Companies	National
National Drinking Water Advisory Council	National
National Rural Water Association	National
Orutsararmiut Native Council (ONC)	Local
Rural Community Assistance Corp	National
Source Water Collaborative	National
Environmental Protection Agency (EPA)	National
Department of Housing and Urban Development (HUD)	National
Yukon River Inter-Tribal Watershed Council (YRIT WC)	Regional/Tribal
Yukon-Kuskokwim Health Corporation (YKHC)	Regional/Tribal

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Table 2: A summarized version of the qualitative coding dictionary used to identify key themes which emerged across the document corpus.

Code	Definition
Document Properties	
Geopolitical Scope	*The level of regulatory government that published the document.*
Audience	*The group of people that the document is intended to inform.*
Technical Considerations	
Stage in the Water Process	*The stage of water treatment that the document targets.*
Administrative Considerations	*Items that concern administrative needs, including paperwork, planning, and other "back of house" tasks.*
Water Quality	*Considerations of water contaminants and cleanliness.*
Operating System	*Considerations of the water system equipment.*
Threats and Security	*Anything that threatens the daily operations of the water system, both physically and operationally.*
Background	*Information which helps inform, train or educate the user on why a process is designed like it is, what the technical/engineering-based/physics reason is.*
Social Considerations	
Certification	*Pertaining to the process of earning certification to become a certified water operator.*
Consequences of Poor Management	*Detrimental impacts of mismanaged water utilities on population and the environment.*
Collaboration	*The importance of cross-systems collaboration and disciplines.*
Water Governance	*How different levels of government interact and deal with policy and regulation related issues.*
Community Outreach	*Considerations of how water systems can interface with and interact with the communities they are serving.*
Water System Stakeholders	*Discussion of who will be impacted by the water system.*

Code	Definition
Relevance	*How is the content covered in the document made relevant to the context it is addressing or the individual using the materials.*
COVID-19	*Any aspects relevant to the COVID-19 Pandemic*

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Table 3: Statements made contextually relevant towards a given stakeholder in the community. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result. In this table we see that the local documentation "situates" or makes the content relevant to both operators and end-users, followed by regional documentation. We see the gap in situating the documentation at the state and federal documentation level.

	To Operator	**To End-User**
Federal	20% n = 5/24	8% n = 2/24
State	17% n = 3/18	11% n = 2/18
Regional	0% n = 0/5	20% n = 1/5
Local	50% n = 1/2	50% n = 1/2

Table 4: Content coded related to certification. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result. The discussion on the certification process, ranging from statistics provided on people clearing through each test through to study tactics, are only presented in federal and state documentation. We see an emphasis on federal discussion of the design of the certification process and the content covered in the exam which we see a state emphasis on some of the more logistical aspects of the exam including previous educational experiences required and the cost implications of the exam.

	Certification Exam Design	**Content Covered**	**Experience Requirements**	**Cost Considerations**	**Previous Education Considerations**	**Benefits of Certification**	**Study Tactics**
Federal	25% n = 6/24	30% n = 7/24	8% n = 2/24	0% n = 0/24	8% n = 2/24	16% n = 4/24	13% n = 3/24
State	11% n = 2/18	17% n = 3/18	22% n = 4/18	17% n = 3/18	22% n = 4/18	17% n = 3/18	0% n = 0/18
Regional	0% n = 0/5	0% n = 0/5	0% n = 0/5	0% n = 0/5	0% n = 0/5	0% n = 0/5	0% n = 0/5
Local	0% n = 0/2	0% n = 0/2	0% n = 0/2	0% n = 0/2	0% n = 0/2	0% n = 0/2	0% n = 0/2

Table 5: Content coded related to technical considerations. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result. Here we see that regional documentation had the highest prevalence of identifying a specific stage in the water process and highlight specific considerations about the operating systems. This suggests local and regional authorities are potentially filling gaps in federal and state documentation.

	Stage Specific in Water Process	**Administrative Considerations**	**Operating System**	**Water Quality**
Federal	29% n = 7/24	32% n = 8/24	28% n = 7/24	25% n = 6/24
State	33% n = 6/18	28% n = 5/18	17% n = 3/18	17% n = 4/18
Regional	80% n = 4/5	40% n = 2/5	60% n = 3/5	20% n = 1/5
Local	50% n = 1/2	50% n = 1/2	50% n = 1/2	0% n = 0/2

Table 6: Content coded related to administrative issues. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result. Considerations of standardization, such as compliance and worker safety, are more evenly discussed across the four stakeholder levels. However, local and regional documents place much more emphasis on understanding and navigating threats presented to water systems and possible avenues of funding.

	Funding	**Strategic Planning**	**Administrative Processes**	**Worker Safety**	**Compliance**	**Threats and Security**
Federal	4% n = 1/24	4% n = 1/24	20% n = 5/24	20% n = 5/24	32% n = 8/24	8% n = 2/24
State	0% n = 0/18	6% n = 1/18	0% n = 0/18	0% n = 0/18	28% n = 5/18	11% n = 2/18
Regional	40% n = 2/5	0% n = 0/5	0% n = 0/5	40% n = 2/5	40% n = 2/5	80% n = 5/5
Local	50% n = 1/2	0% n = 0/2	0% n = 0/2	50% n = 1/2	50% n = 1/2	50% n = 1/2

Table 7: Threats to a water system, showing a high prevalence placed on the discussion of environmental concern at the regional and local level. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result.

	Hazardous Materials	Cybersecurity	Climate and Environment	System Breakdown
Federal	4% n = 1/24	4% n = 1/24	0% n = 0/24	0% n = 0/24
State	6% n = 1/18	0% n = 0/18	6% n = 1/18	6% n = 1/18
Regional	20% n = 1/5	0% n = 0/5	60% n = 3/5	20% n = 1/5
Local	0% n = 0/2	0% n = 0/2	50% n = 1/2	0% n = 0/2

Table 8: Code presence across the management of the physical system. All tables show the percent of documents that have presence of any given code for that level of federal government. N values indicate the total sample size for each result. Here we see that aspects of system monitoring, equipment maintenance and operations are highlighted in the regional and local documentation whereas system components and design considerations are only discussed in federal and state documentation.

	System Components	Design Considerations	System Monitoring	Equipment Installation	Equipment Maintenance	Equipment Operations
Federal	8% n = 2/24	4% n = 1/24	20% n = 5/24	0% n = 6/24	24% n = 6/24	28% n = 7/24
State	6% n = 1/18	6% n = 1/18	6% n = 1/18	6% n = 1/18	6% n = 1/18	6% n = 1/18
Regional	0% n = 0/5	0% n = 0/5	40% n = 2/5	0% n = 0/5	60% n = 3/5	40% n = 2/5
Local	0% n = 0/2	0% n = 0/2	50% n = 1/2	0% n = 0/2	50% n = 1/2	50% n = 1/2

Table 9: Summary of key findings as they track to propositions.

Proposition	Key Findings
Proposition 1: As the regulatory level becomes more macro (i.e., moves towards state and federal documents), standardization of the process is prioritized over tailoring to the context.	Local agencies are better than state and federal agencies at making their documentation tailored specifically towards operators and end-users. Federal documents mention with higher prevalence exam design while state documents tend to focus on prerequisite experiences, educational requirements, and previous pass rates. There is a notable lack in publicly available documentation which discusses the certification process at the local level. Local and regional documentation provides more system-specific guidance compared to state and federal documentation.
Proposition 2: This tension between standardization and contextualization will become more acute following the degree to which local systems operate outside of typical ranges and tolerances.	Alaska has some of the lowest rates of certified operators per capita in the U.S. (Alaska Native Tribal Health Consortium 2022b) Alaska currently ranks as number 47 in terms of percentage of population served by a community water system with a serious drinking water violation in the past year (United Health Foundation 2023) Regional and local documents suggests that the extreme context might not always be compatible with Federal regulations and that federal documentation might miss the relevant situated context

Table 10: Summary of sectors where the standardized approach may hard the situated needs.

Program	Alignment with Proposition 1: As the regulatory level gets spatially larger, standardization of the process is prioritized over tailoring to the context	Alignment with Proposition 2: The tension between standardization and situatedness will become more acute following the degree to which local systems operate outside of typical ranges and tolerances
Requiring an Environmental Impact Statement (EIS) to apply for Federal Grants	To create a national framework to assess eligibility for grants, an EIS is required for all projects that are expected to have a detrimental impact on the health and well-being of community members in proximity to the project (EPA 2023).	Unlike the challenges of many other contiguous U.S. states, due to the changing, remote Arctic climate, the data required to create accurate EIS is not available or is not fully inaccurate, detrimentally impacting the eligibility of Alaska communities for Federal grants (Estus 2023).
Nurse Licensure Compact	To create a national network where workforce gaps in nursing staff can be filled (National Counsel of State Boards of Nursing 2023).	A lack of understanding about the unique health challenges of Alaskans could result in worse care (The Alaska Nurses Association 2023). Out of state nurses wouldn't be required to pay the same licensing fees as in-state nurses, meaning that Alaska nurses – who already pay among the highest fees in the nation – would have to shoulder additional financial burden (The Alaska Nurses Association 2023).
Airline Regulations for Safety	To protect aviator safety, federal laws and regulations are applied to the standard context that most airplanes operate in – controlled airspace (Alaska Department of Transport and Public Facilities n.d.).	Alaska is not within controlled airspace and as a result, Part 135 operators (those used in Alaska) are held to less stringent regulations and safety standards than Part 121 air carriers (other commercial carriers), resulting in higher accident rates (Larsen 2020). The FAA's NextGen initiative, which requires aircraft to be equipped with ADS-B to improve safety is not required outside of controlled airspace (Larsen 2020).

FIGURE CAPTION LIST:

Fig. I. PRISMA Diagram depicting the process of collecting and refining the final set of documents included in the analysis. The acronym dictionary for each of these terms is included in Table 1.

Fig. 2. A graphic representation of the propositions uncovered and how the scale of standardization to situatedness may occur (City of Bethel 2023; Durrani 2023; FEMA n.d.).

Fig. 3: Correlation table for all 50 states comparing states that use the Federal ABC Guidelines for Certification versus those that develop their own.