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Regulatory Barriers to Approval of New Technologies for Small Drinking Water Systems

Deanna T. Ringenberg
University of Nebraska-Lincoln, dtmlnarik@gmail.com

REGULATORY BARRIERS TO APPROVAL OF NEW TECHNOLOGIES FOR SMALL DRINKING WATER SYSTEMS

by

Deanna T. Ringenberg

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Deanna T. Ringenberg, M.S.

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Advisor: Bruce I. Dvorak

Small drinking water systems face different challenges than large water systems. Small systems are more likely to use ground water whereas larger systems are more likely to use surface water. Small systems cannot simply be designed as scaled-down versions of larger systems. Innovative technologies can provide cost and reliability benefits to small systems, but new technologies are not frequently considered for small systems. One important barrier to the implementation of new technologies is obtaining state drinking water agency approval.

To identify specific state regulatory barriers, a survey including sixteen questions was sent to the 49 state agencies. The survey included questions regarding their acceptance programs, experiences with new technologies, barriers, data needs for technology approval, and interest in a shared approach for acceptance of new technologies. The survey was sent in 2015 and received an 82% response rate.

The survey confirmed that new technologies are rarely considered for implementation in small systems. Key barriers encountered by states include an overall lack of state agency time, lack of training for their staff, lack of data from vendors

(including appropriate pilot data), and lack of independent verification/certification. Regulatory and statute issues were found to be less important barriers. To overcome barriers, states are primarily interested in performance data and information from pilot studies. States are less concerned about obtaining information regarding the cost to operate new technologies.

It was found that some “emerging” technologies are more commonly implemented than previously realized, which means there may be an opportunity for agencies to share information across states. Most states are interested in sharing data and are willing to collaborate by collecting performance data for new technologies. Since there is an interest in information sharing, the next step is to identify how to share information nationwide, according to this survey past EPA programs like the Arsenic Demonstration Program were effective, so perhaps the arsenic program could be used as a template for the new information sharing program. This information could be easily shared through a website which is password protected.

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Thanks to my husband, Jon, for being supportive and understanding during the all the long evenings I have spent researching and writing this thesis. Thanks to my parents for your unfailing support and unflappable pride. Thanks especially to my mom who knew I wanted to go back to school before I did.

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CHAPTER 1 INTRODUCTION

Innovative technologies can provide cost and reliability benefits for drinking water systems, but due to many barriers, new and innovative technologies are not believed to be frequently applied to small drinking water systems. There are many types of barriers to technology adaptation, of which state agency approval is an important one for small systems. The main objective of this state agency survey was to identify the barriers to approving new technologies and ways to overcome those barriers.

1.1 BACKGROUND

Understanding the barriers to implementing innovative technology for small drinking water systems is valuable. A large percentage of systems in the United States are considered small treatment systems, therefore it is important to understand why innovative technology is not usually considered by small systems. Small systems face different challenges than larger systems including differences in source water quality, so they cannot necessarily apply the same solutions.

The origin of this study was from the United States Environmental Protection Agency's (US EPA) efforts to stimulate innovation in small systems. As part of this effort, the US EPA funded two National Centers for Innovation in Small Drinking Water Systems to assess and assist in getting new technologies into the hands of those small systems that need them most. The Water Innovation Network for Sustainable Small Systems

(WINSSS) Center, a multi-university center for innovative small drinking water systems, led by the University of Massachusetts at Amherst, conducted a survey of state technology acceptance staff to better understand the current state of technology approval nationwide. The goals of project included increasing communication between states about technologies already developed, facilitating and improving relationships between stakeholders who are developing/approving/using new technologies, and facilitating the advancement of a more cooperative approach to technology approval that provides the states more opportunities to share information and work together to streamline efforts where common goals can be identified.

This study also benefited from collaboration with the DeRISK (Design of Risk-reducing, Innovative-Implementable Small-system Knowledge) center, which is associated with the University of Colorado Boulder, focuses on applying principles of risk reduction, sustainability and new implementation approaches to innovative technologies that will reduce the risk associated with key contaminant groups and will increase the chance of adoption and sustainable use in small systems (DeRISK, 2017). ASDWA (The Association of State Drinking Water Administrators) also provided its guidance and assistance to this project. ASDWA is a professional association serving state drinking agencies which strives to support states in their efforts to provide safe drinking water, collect information, encourage the exchange of experiences and information among state drinking water agencies and to provide advice, counsel and expertise to entities like Congress, US EPA, and other organizations (ASDWA, 2016).

1.2 Objectives of Research

The key objective of this study was to survey state agencies to determine: the frequency that state agencies consider innovative technology for small systems, the frequency that state agencies have sufficient time to consider new technologies, the barriers to implementing innovative technology for small drinking water systems, the necessities to overcome the aforementioned barriers, the requirements at the state agency-level to approve new technology, and the interest in sharing information across state agencies.

1.3 Thesis Overview

This thesis is organized into five chapters. A literature review can be found in Chapter 2, which gives an overview of the regulation of drinking water systems in the United States, a comparison of small and large drinking water systems, barriers to innovation, and a summary of innovative drinking water technologies. Chapter 3 explains the methods of creating the survey, administering the survey, and analyzing the results. Chapter 4 details the outcome of the survey, reports responses from the survey and discusses the responses from questions that were particularly interesting. Chapter 4 is largely based on a manuscript which has been accepted for publication in the August 2017 issue of in the Journal of the American Water Works Association. Chapter 5 provides conclusions from this study and recommendations for future study. An appendix is included with a breakdown of the frequency of three common drinking water maximum contaminant level violations for the ten EPA regions.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter is a review of available literature regarding barriers to technology in small drinking water systems. The review begins with an explanation of drinking water regulation in the US, which is followed by a profile of the characteristics of small drinking water systems in comparison to larger systems. The next section is a review of barriers to innovation in other industries, water systems, and small water systems. The final section of the literature review is a description of innovative technologies which can be applied to small systems.

2.2 Drinking Water Regulation in the United States

In the United States, most states (all but Wyoming) are responsible for approving new technologies in the public water systems they regulate. Therefore, each state makes independent decisions to determine which technologies are acceptable for use in drinking water systems. This can make it difficult for manufacturers to implement new technology since they must obtain approval on a state-by-state basis and state-specific regulations may block some technologies (Ajami et al., 2014).

The primary federal regulations for drinking water stem from The Safe Drinking Water Act (SDWA) which was enacted in 1974. The SDWA gives the Environmental Protection Agency (EPA) the authority to create national standards for naturally occurring and anthropogenic containments which present health risks. The SDWA applies to every public water system in the United States (US EPA, 2004).

2.3 Small systems profile

The definition of a small drinking water systems can vary across the US EPA, for the purposes of this paper, small systems are classified as systems which provide drinking water to 10,000 or fewer people (US EPA, 2016a). Using the 2013 data retrieved from the EPA's Safe Drinking Water Information System (SDWIS) (US EPA, 2016b), figures were created to visualize the differences between systems of different size with the percent of systems in each size range (Figure2.1a) and the population served by each range (Figure 2.1b). The percentages of community water systems which fall into four different size classifications: less than 3300 people served, 3,301 to 10,000 people served, 10,001 to 100,000 people served, and systems which serve more than 100,000. This figure indicates that although a majority of systems in the United States serve relatively small communities (e.g., <10,000) a majority of people are served by large and very large systems (e.g. >10,000).

2.3.1 Comparison of Small and Large Systems: Source Water

In terms of source water, small systems tend to use ground water as a source, and larger systems tend to use surface water (because surface water is more readily available at the quantity needed to serve the system). Groundwater generally needs less treatment than surface water, but groundwater can contain inorganic contaminants which are not found commonly in surface water (e.g., nitrate-N, arsenic, uranium).

Therefore, different water sources can be associated with different natural water qualities.

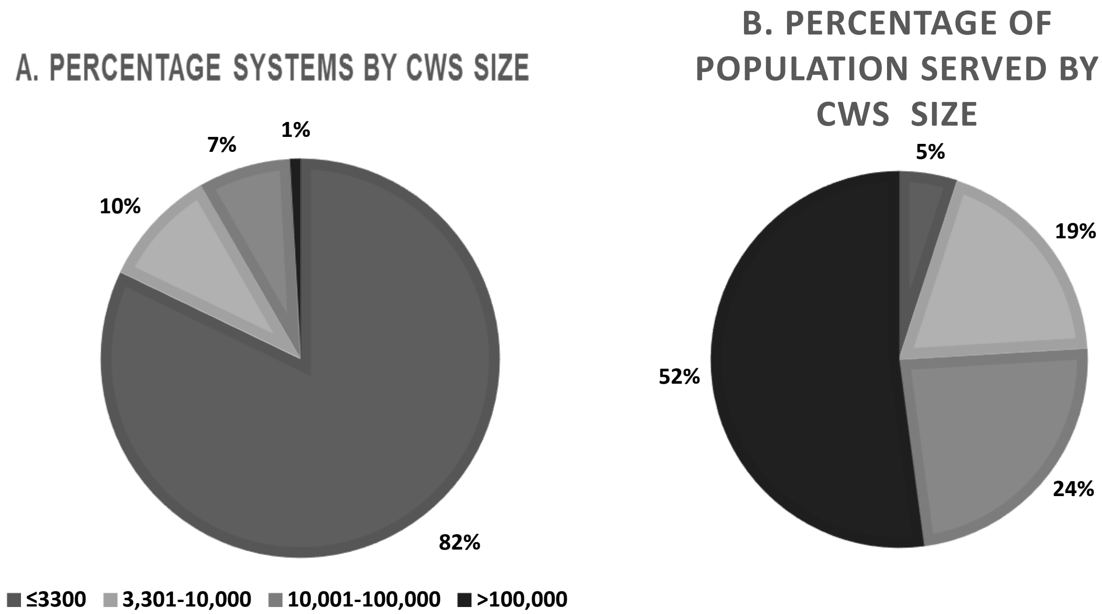


Figure 2.1. Breakdown of Community Water Systems by Community Size and Population Served.

Table 2.1 is a breakdown of the number of community water systems in the ten EPA regions. For reference, Figure 2.2 is a map of EPA regions. Columns 3-6 show the number of systems in four size categories based on the population served. The second row in each region shows the percent of systems that use ground water (dark gray) and surface water (light gray). The number (#) above each circle indicates the number of systems which are included in the that region and size category and the total number of systems used for each circle.

Table 2.1. Number of systems in each EPA region in four different size categories and the percent of systems that use groundwater (dark gray) and surface water (light gray) as their source in 2013

EPA Region		Population Served				
		≤3,300	3,301-10,000	10,000-100,000	>100,000	Total
1	#	2,357	191	243	13	2,804
2	#	2,916	291	340	39	3,586
3	#	3,718	385	248	42	4,393
4	#	6,711	1,064	871	95	8,741
5	#	5,667	861	734	41	7,303
6	#	6,660	1,050	478	46	8,234
7	#	3,619	308	145	16	4,088
8	#	2,907	216	164	18	3,305
9	#	3,722	367	441	101	4,631
10	#	4,045	203	187	15	4,450
Total	#	42,322	4,936	3,851	426	51,535

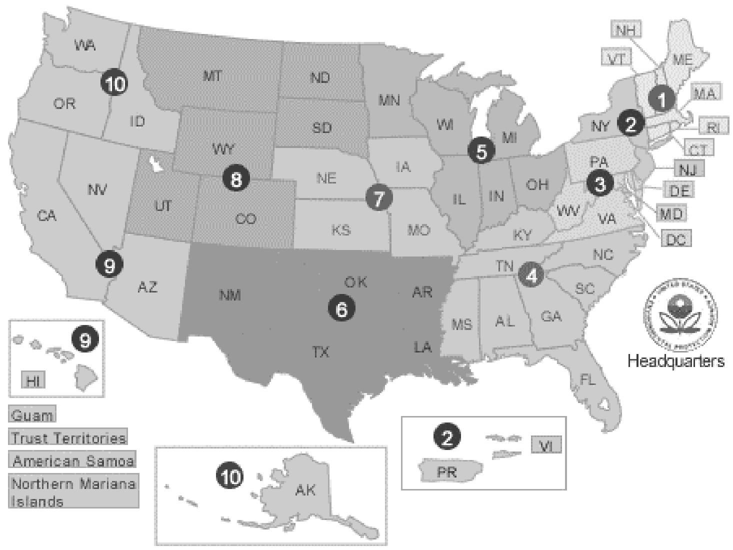


Figure 2.2. Map of EPA regions (Source: https://www.epa.gov/aboutepa/visiting-regional-office)

Interestingly, the frequency of water types can vary by region in the U.S. In every region in the USA, a majority of very small systems (less than 3,300 served) use ground water as a source, which can be seen in the circles in Table 2.1 which have a larger percentage of dark gray (ground water). A national average of 83% of very small systems (≤3,300) use groundwater. For small systems, ones that serve 3,301 to 10,000 people, regional differences in source are more varied. For small systems, there are more surface water systems for regions two, three, and eight, and more systems that use groundwater in regions one, four, five, six, seven, nine, and ten. For large systems, ones that serve 10,000 to 100,000 people, surface water is the most common source for every region but seven.. For every region, as the systems serve more population, they are more likely to use surface water with an average of 84% of very large systems (more than 100,000 served) using surface water as a source.

2.3.2 Comparison of Small and Large Systems: Violations

Since small and large systems use different sources, it is important to include an overview of drinking water violations for differing system size because groundwater and surface water are associated with different contaminants. Other work has determined that some types of violations are more common in small systems than larger systems, these violations include, total coliform rule, arsenic, and lead and copper rule, and small systems are more likely to violate monitoring, reporting and notification requirements (Oxenford & Barrett, 2016; Rubin, 2013).

Drinking water system violations are reported to the EPA by state agencies, and this information can be accessed in a database (EPA, 2016b). Information from this database was accessed to compare system size and frequency of violations. There are different types of EPA violations like monitoring/reporting, and treatment technique. This section focuses on health based (e.g., MCL or Maximum Contaminant Level violations). All MCL violations were investigated, but violation frequency from three contaminants are included in this manuscript; total coliform rule (TCR), nitrate-N, and disinfection byproducts (DBPs) These three are often associated with a specific water source (either ground water or surface water). Three different system size categories are shown for each violation, less than 3,300 people served, 3,301-10,000 people served, and more than 10,000 people served. Figure 2.3 (a and b) shows the percent of systems that had MCL (maximum contaminant level) violations in 2013, using data from EPA's SDWIS database for 2013.

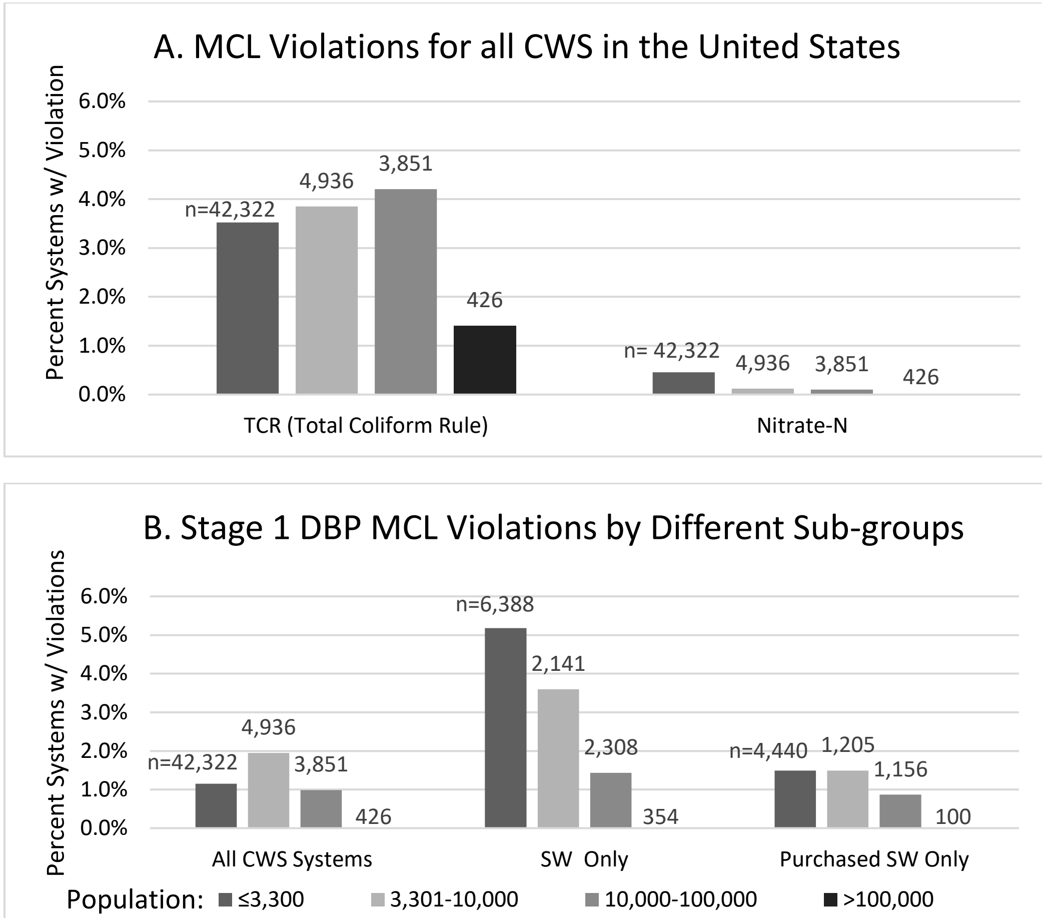


Figure 2.3. Percent of systems in violation of different EPA rules. **A**. Percent of all systems in violation of MCL TCR and Nitrate-N rule. **B.** Stage 1 DBP MCL violations for all systems, for only SW (surface water) systems and for purchased SW systems. The total number of systems in each sub-group is listed above the bars as n. (EPA 2016b)

In Figure 2.3a the percent of all community water systems with TCR and Nitrate-N MCL violations is shown. Total coliform rule (MCL) is a relatively common violation in community drinking water systems. TCR violations show no trend with system size. Nitrate-N violations are more common in small systems, in large part because most nitrate-N violations are for groundwater in agricultural regions. Violation frequency was also investigated on a regional basis; it was found that nitrate-N violations are slightly more common in EPA Regions 6-10 (Appendix A).

Figure 2.3b illustrates data of violations of the Stage 1 DBP MCL violations. In the first group on the left all community systems are considered, the second group is only surface water systems, and the third is only systems which purchase surface water. In all systems, the medium-sized systems are more likely to have DBP violations. Small surface water systems are more likely than larger systems to have Stage 1 DBP MCL violations. Some communities purchase treated drinking water from other communities and are considered a consecutive system. In these systems, the two communities' public water systems are connected and the purchasing community does not treat the purchased water. Water in these types of systems frequently have a long residence time before being consumed. Since surface water is treated with disinfection chemicals and long residence times for the water can create larger concentrations of trihalomethanes, DBP MCL rule violations for purchased surface water was investigated. Interestingly, purchased surface water is less likely to have DBP violations than traditional surface water systems. It should be noted that the first and second sets of surface water systems in Figure 2.3b also include purchased surface water systems.

There are some rules which small systems are more likely to be in violation than larger ones. These violations include inorganics like nitrate-N and arsenic that are commonly found in groundwater, DBP stage I for surface water systems, and monitoring and reporting violations (US EPA, 2016b). Therefore, there is a need for innovative technologies and methods to ensure small systems remain in compliance.

2.4 Barriers to Innovation

In general, innovation is impeded by many factors. Five barriers to innovation were identified in a report from IBM Global Business Services (IBM Global Business Services, 2006). According to the report, innovation can be hindered by inadequate funding, risk avoidance, siloing (the tendency for a department to work on one type of project), time commitments, and difficulties in quantifying innovation in comparison to profits (IBM Global Business Services, 2006).

2.4.1 Barriers to Innovation in Drinking Water Systems

Barriers to innovation in drinking water systems are comparable to barriers in other fields. The following sections discuss the innovation barriers which include financial concerns, the risk avoidant nature of the water sector, and a focus on regulatory compliance.

2.4.1.1 Financial

In the drinking water field, barriers to innovation have been identified by American Water Works Association Innovation Committee, the European Innovation Partnership on Water, and others. The European Innovation Partnerships (EIP) is an initiative within the EU 2020 Innovation Union which works to create innovative solutions for European and global water systems (European Commission, 2016). A common barrier identified in the reports is the lack of awareness of the value of water and the low economic value of water (AWWA, 2015; EIP Water 2014, Ajami et al., 2014). This barrier illustrates a precieved low return on investment when implementing innovative drinking water technology. Another finacial barrier to innovation is lack of funding or lack of access to capital and funding (EIP Water, 2014; Ajami et al., 2014). Long life expectancy and the size and complexity of many water systems can make it difficult to implement innovation because the adapter must be certain that the innovation will perform optimally for the lifetime of the system. (Duffy, 2014; Ajami et al., 2014).

2.4.1.2 Risk Avoidant Nature

Additionally, the water sector is generally risk avoidant which slows the acceptance of new technology and the desire to seek it out (AWWA, 2015; EIP Water, 2014). In conjuntion with the risk avoidant nature of the water industry, another barrier is the conservative nature of the industry (Duffy, 2014). This is due to a high priority on protecting public health and concerns about risks associated with adapting new technology (Duffy, 2014; Ajami et al., 2014). These barriers slow change, innovation, and progress in the sector.

2.4.1.3 Regulatory Compliance

Water systems need to maintain regulatory compliance to ensure the safety of drinking water and to maintain the confidence of the public. Multiple regulatory-related barriers have been identified which include: regulatory policy fragmentation, complex regulatory requirements, unnecessary regulatory restrictions, absence of regulatory incentives, geographical fragmentation of the regulations, and maintaing regulatory compliance (AWWA, 2015; EIP Water, 2014; Duffy, 2014; Ajami et al., 2014). These barriers can make it difficult for agencies to approve new technologies.

The way in which specifications are written can limit the appropriateness of new technologies. Specifications are written to ensure that an appropriate technology is chosen to address issues, and occasionally, specifications favor long-established technologies. These types of narrowly written specifications have been identified as a barrier to public works innovation in the United Kingdom (Uyarra et al. 2014).

2.4.2 Small Systems Barriers

The EPA Innovation blueprint states that the EPA is committed to improving the performance of small drinking water systems, creating a regulatory space for innovation, and supporting research and development (US EPA, 2014). Since small systems face difference challenges than larger ones, the barriers are similar but not identical. To help small systems approve new technology, it is important to identify and understand the barriers which slow or stop approval.

Small water systems face many difficulties which include: lack of expertise to choose, operate and maintain systems, lack of financial resources, aging infrastructure, limited options for residual disposal, and limited managerial support to comply with regulatory requirements as discussed below. Approval of new technologies for small systems can be problematic since the return on investment may not be as significant as for larger systems (Shih et al., 2004). Small systems cannot be simply considered as a scaled-down version of a large system because small water systems face a negative economy of scale; they tend to pay more for production than larger systems (Shih et al., 2004). Operators at small systems are more likely to be less skilled than at larger systems, and as a result, retention of knowledgeable employees can cause a problem for small systems (Dziegielewski & Bik, 2004) It is perceived that small drinking water systems less frequently utilize new technologies than larger systems. To ensure that these systems provide clean safe drinking water, there is a need to find new or innovative modifications of existing treatment technologies that can perform significantly better than current technologies for small systems.

2.4.3 Regulatory Barriers in other Sectors

The barriers to innovation in the water sector are similar to those which have been identified in other regulatory agencies. In a report from the United States Department of Agriculture on barriers to ecosystem management innovation is slowed by centralized bureaucracies with strict rules and regulations. The risk avoidant nature in upper levels of management was also mentioned as a barrier (Cortner et al. 1995).

2.5 Treatment Technologies

For this study, new and innovative technologies were considered those that were not believed to be frequently applied in a majority of the states. To better understand the breadth of technology acceptance, a list of 14 technologies was compiled by the WINSSS, DeRISK, and ASDWA workgroup to examine the frequency of technology acceptance. Technologies at various stages of adoption in both the larger water marketplace and for small drinking water systems were examined, some of which may or may not be considered new and innovative in some states. The selected technologies ranging from those that are well accepted and are not new to many states (e.g., UV, membranes, MIOX, magnetic ion exchange), technologies for which vendors are starting to emerge (UV using LEDs and ferrate oxidation), some that have a different set of approval barriers than other technologies, and some that are considered new methods of treatment (POE, and POU).

Fourteen technologies at various stages of adoption in the marketplace were examined and an explanation of each technology is provided below. Similar technologies are grouped together in the following sections; membranes, magnetic ion exchange, ferrate oxidation, ultraviolet light (UV), alternative chlorine sources, in-distribution removal of disinfection by-products (DBP), point of use (POU) and point of entry (POE).

2.5.1 Membranes

Membranes have the potential for being beneficial for small systems because they reduce the amount of chemicals needed in water treatment, but traditionally, membrane technology is too expensive for small systems. (Anderson & Sakaji, 2007; Speight & Via, 2011). Recently, technological advances have made membranes more attractive for small systems (Anderson & Sakaji, 2007). Larger pore size membranes such as microfiltration (MF) can remove larger colloids and bacteria, ultrafiltration (UF) can remove smaller colloids, viruses, and dissolved organics. Smaller pore size membranes such as nanofiltration (NF) may remove particles like dissolved organics, inorganic pollutants (nitrate-N, arsenic, and heavy metals) and DBPs, and reverse osmosis (RO) can remove the smallest particles like salts (Duranceau & Taylor, 2011).

The contaminants that do not pass through the membrane are collected in a concentrate or waste stream.   Systems may face limitations when properly disposing of the waste stream; especially since disposal issues associated with concentrate are more difficult than conventional water treatment plants. Additionally, many membranes are cleaned using chemicals which must also be disposed. Techniques for disposing of concentrate and residuals from a membrane are surface water, surface disposal, sewer discharge, deep-well injection, and evaporation pond (Duranceau & Taylor, 2011).

2.5.2 Magnetic Ion Exchange

A new technology to address the creation of DBPs and reduce the amount of coagulants, oxidants, and disinfectants used in drinking water treatment is magnetic ion exchange an example of this technology is the MIEX® system. The magnetic properties in the magnetic ion exchange resin attract contaminants like dissolved organic carbon (DOC) so that they may be removed from water. DOC can react with disinfectants to form potentially harmful DBPs (Singer et al., 2009; Gan et al., 2013). This technology could be beneficial to small systems because it reduces the amount of chemicals which are added and stored by water systems. This could reduce hazards for operators and reduce the risk of under-dosing and overdosing chemical additives, while providing low DBP drinking water.

2.5.3 Ferrate Oxidation

Another new technology, ferrate (Fe(IV)) is a powerful alternative oxidant, that can replace strong oxidants like chlorine dioxide, ozone, and permanganate. Ferrate is added as a pretreatment, before clarification, and it produces an iron precipitate that can be removed with coagulation and filtration. Ferrate could remove inorganic and organic contaminants more effectively than coagulation alone (Goodwill et al., 2016). Additionally, if ferrate is added as K_2FeO_4 instead of a chlorine containing salt, it could reduce the formation of DBPs in drinking water. Ferrate could be added as a solution or as a powder, which could make application easier (Goodwill et al., 2016). Ferrate is not currently commercial available therefore, it is not widely used.

2.5.4 Ultraviolet Light

Ultraviolet light (UV) has gained acceptance for disinfection in municipal wastewater in the US, but it is still gaining regular acceptance for drinking water applications (Dotson et al., 2012). UV is an effective method but will not leave a disinfectant residual. Thus, it often will be one of two or more disinfectants used. UV minimizes the formation of DBPs, but has a significant power requirement and validation of the process can be difficult (Dotson et al., 2012; Reckhow et al., 2010). Low pressure (LP) mercury UV lamps are widely used to inactivate microorganisms like bacteria, protozoan parasites and viruses (Sholtes et al., 2016; Tracey, 2012). Medium pressure (MP) UV lamps emit a broader spectrum of light than LP lamps and can deactivate more contaminants by damaging nucleic acids and causing reactions in proteins and enzymes (Beck et al., 2014; Linden & Rosenfeldt, 2011). UV light emitting diode (LED) is a very new technology and it is comparable to low pressure mercury arc lamps in its ability at inactivating bacteria, viruses and bacterial spores, but offers the potential for longer bulb life and lower power usage (Sholtes et al., 2016).

2.5.5 Alternative Chlorine Sources

Chlorine is commonly used as a disinfection agent in drinking water. An alternative to traditional sources of chlorine can be solid calcium hypochlorite in the form of tablets or granules which can be added directly to water and can be easier to handle than liquid solutions (Singer & Reckhow, 2011). Another alternative source for chlorine disinfection is a mixed oxidant (MIOX) system. MIOX technology creates sodium hypochlorite on-site by utilizing a salt water brine in combination with an electrolytic reaction to inactivate viruses, bacteria, giardia and cryptosporidium (Singer & Reckhow, 2011; USAPHC, 2011).

2.5.6 In-distribution removal of DPBs

Some emerging technologies are designed to remove DBPs after they are formed in the treated water (Cecchetti et al., 2014). Spray aeration can be used to remove TTHM from water at high removal rates depending on the amount of air that is applied and in a simple application, water is sprayed from the top of storage tanks in the distribution system (Brook & Collins, 2011; McDonnell, 2012). Pressurized diffused aeration can also be added as an in-line process within distribution system (Brooke et al., 2013). Activated carbon has been found to adsorb DBPs like THM and HAA and can be used in the form granular activated carbon (GAC) in the distribution system (Potwora, 2006).

2.6 Innovative Treatment Methods

The following sections discusses two treatment methods which use innovative and established technologies to treat water in a decentralized manner. These methods treat drinking water closer to the final consumer and outside of a centralized drinking water plant.

2.6.1 Point of Use

For very small and non-community water systems, treatment at the point of use (POU) may be a cost effective option. POU systems are applied immediately before the water is consumed by the user and require maintenance to ensure water is safe to drink (Barstow et al., 2014; Goodrich et al., 1992; Lykins et al., 1995; Gurian & Small, 2002). Small systems may find that these systems are less costly and may allow the consumer to drink potable water while having non-potable water for purposes other than ingestion (Goodrich et al., 1992; Cotruvo, 2003).

2.6.2 Point of Entry

Point of entry (POE) systems treat water as soon as it enters a home or building, and are frequently applied for secondary contaminants like hardness, iron, magnesium, and sediments. POU and POE systems use technologies which have been long-utilized at centralized water treatment facilities like RO, ion exchange, and specialized adsorptive media. POE systems can supply potable water to more taps in a home/business, like showers.

Since POU/POE systems are in each home/business, it can be difficult to ensure that systems are maintained properly and providing properly treated drinking water. Approval pathways of POU/POE systems can differ from other technologies in some states. To ensure that a device is appropriate for water treatment in a system, POU/POE approval is often based on independent certifications (e.g., NSF International, Water Quality Association, Underwriters Laboratories), but states apply Safe Drinking Water Act rules to make approval determinations based on additional factors such as ownership and control of units and maintenance/monitoring (H.R. 16760 – 93rd Congress: Safe Drinking Water Act).

2.7 EPA Programs Providing Performance Data

The EPA has developed programs to assist drinking state drinking water agencies in the acceptance of new technologies by providing performance data. Two programs, the Arsenic Demonstration Program and the ETV (Environmental Technology Verification) program, have been viewed as successful. But neither is active, due to funding limitations. Legacy information about each program is currently available on the EPA website. These two programs are discussed in the following sections.

2.7.1 Arsenic Demonstration Program

In 2001, the EPA lowered the acceptable level of arsenic in drinking water from 50 micrograms per liter to 10 micrograms per liter. The Arsenic Demonstration Program was created and funded by the EPA to help states meet the new lower standards. The program funded arsenic treatment demonstrations in 50 small drinking water systems in 27 states across the United States. The program ended in 2011 (Sorg et al., 2015; US EPA 2016c).

At each demonstration location, the EPA funded the technology purchase, system purchase, permitting support, installation, one year of operation, and performance study costs. The utility funded facility costs, waste disposal, and operators. The EPA provided training to state and utility operators through workshops, software, design manuals, and webcasts. The program determined capital, operational, and maintenance costs, evaluated the performance of the process, characterized the residuals produced, evaluated residual disposal process, and determined the effect of arsenic treatment on distribution systems. The program included demonstrations of adsorptive media, coagulation/filtration, ion exchange, and iron removal (US EPA 2016c). The information from all the demonstrations are available on the EPA’s website.

2.7.2 ETV Program

The ETV program verified the performance of over 500 technologies for environmental technologies in air, water, soil, and surface applications. The program began in 1995 and was concluded in 2014. The program was financed by the EPA until 2007 when funding switched to vendor/collaborator support and EPA in-kind funding. The goal of the ETV program was to “Verify once, accept everywhere”. (US EPA, 2016d)

Three criteria were applied when selecting technologies to be evaluated and potentially verified: existence of an environmental problem, availability of techniques for performance testing, feasibility and practicality considerations. When technologies were selected for the program, ETV stakeholders identified the performance data which was needed to verify the technology. Performance considerations included: required technical ability of the operator, time for setup and breakdown, durability, energy consumption, downtime considerations, failure rate, residuals produced, flow rates (US EPA, 2016d). A Drinking Water Systems Center (DWS) was created within the ETV program to produce credible performance data (US EPA, 2008).

The ETV verified technologies for drinking water analysis included arsenic test kits, Escherichia coli tests, estrogen ELISA kits, and lead monitors. The ETV verified technologies for drinking water treatment included alternative filtration/media technologies, membrane filtration systems, point of use devices, technologies for the reduction of inorganic chemicals, technologies for the reduction of disinfection by-products, UV disinfection, ozone treatment, and other alternative inactivation disinfection and oxidation technologies. Information regarding all the ETV verified technologies is currently on the EPA website, though the site is no longer being updated (US EPA, 2016d)

CHAPTER 3 METHODOLOGY

3.1 INTRODUCTION

A survey was used to gather information from the state drinking water agencies regarding barriers to innovation in small systems. The survey was developed with the help of DeRISK (Design of Risk-reducing, Innovative-Implementable Small-system Knowledge), ASDWA (Association of State Drinking Water Administrators), and WINSSS (Water Innovation Network for Sustainable Small Systems), and distributed digitally to state agencies. The method in which the survey was developed and distributed is explained in this chapter.

3.2 SURVEY DEVELOPMENT

The following sections outline the creation, testing, administration and the return rate of the survey. The survey was created in cooperation with professional organizations, it was tested by volunteers at state agencies and it was administered online in the spring of 2015. The survey went through the IRB (Institutional Review Board) approval process at the University of Illinois and the University of Nebraska and was determined to be exempt. The survey also went through the US EPA's human subjects research program.

3.2.1. Work group with DeRISK, ASDWA, WINSSS

The survey was created with the participation of professionals from university affiliates with the two EPA-funded research centers. ASDWA was contacted to seek their support and collaboration. ASDWA supported the project by reviewing survey questions, identifying key contacts within states, and following up with the state contacts. ASDWA's efforts were critical to the survey's success by encouraging respondents' participation in the survey.

To create the survey, a work group consisting of industry professionals was assembled from ASDWA, and two EPA-funded centers for small systems innovation: the WINSSS and DeRISK centers. The work group reviewed and commented on the initial questions which developed as part of this project. At ASDWA's request, the survey was administered online to provide states with a simple approach which is similar to past ASDWA efforts and to allow agencies to complete the survey when time permitted. The website "Survey Monkey" was used to distribute the survey to the State Agencies. The survey covered current state program logistics and status, recent experiences with new technologies, barriers and data needs related to technology approval, and interest moving forward in cooperating with their peers to develop a shared approach to accepting new drinking water technologies. The survey was approved by the University of Illinois IRB (Institutional Review Board) and the US EPA, as noted in the QAPP (Quality Assurance Program Plan) for this project.

3.2.2 Survey Testing

To test the survey, it was determined that a preliminary 'beta test' should be performed. A draft of the survey was given to eight states which had previously agreed to test the survey and feedback was collected. The answers from the beta-testing were included in the final results for survey questions that did not change.

3.2.3 Survey Administration

After the results of the primary testing were returned, the survey was ready to administer. In mid-June of 2015, ASDWA sent a link to the Survey Monkey survey which included 16 questions. The survey covered current state program logistics and status, recent experiences with new technologies, barriers and data needs related to technology approval, and interest moving forward in cooperating with their peers to develop a shared approach to accepting new drinking water technologies.

3.3 Data Analysis

The results from the survey were collected and entered into an electronic spreadsheet. The data from the survey was compared to other data sets to explore possible correlations. The survey responses were compared to state population, frequency of EPA drinking water violations using SDWIS (Safe Drinking Water Information System), and geography. No strong correlations were found between these datasets and the results of the survey.

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction

The following chapter lists the responses to the survey which was distributed to state agencies. For many questions, a table is included to visualize the state agencies' responses. The responses are grouped together in sections: consideration of new technologies, barriers, technology approval information needs, approval status of selected technologies, perception of past EPA programs that provided data for new technologies, and interest from states in future collaboration. Most of the survey questions were multiple choice and included an opportunity for the states to provide an open-ended explanation or to comment on their answer. The survey questions are included in Appendix B, and the responses can be found in Appendix C (the answers for questions 14 and 15 are not included in Appendix C because they contain contact information for the individual who took the survey).

4.2 Survey Response Rate

The survey was sent to 49 state agencies, since Wyoming does not have primacy over drinking water. The number of state agencies which responded was 40 responding which is an 82% response rate.

4.3 Consideration of New Technology

New technologies are not frequently considered for implementation in small drinking water systems. When the state regulators were asked “How often do you consider new technologies for small systems”, only 2 of 40 said that they do it frequently (Table 4.1). A number of concerns were listed by regulators, including that new technologies are too costly and too risky for small systems. The state regulators also mentioned that they worry about the ability of operators to run systems using innovative technologies. Some states expect the vendors to pay for the pilot testing of a new technology while others rely on the individual communities to pay for generating pilot study data.

Table 4.1. How often do you consider new technologies?

Frequency	Number of Respondents
Frequently	02 (05%)
Infrequently	22 (55%)
Rarely	15 (38%)
Never	01 (03%)

The respondents were asked “Does your state have a standard approach to acceptance of new technologies?” Over half (23 of 40) reported that they had a standard approach/ review procedure. Five state specifically mentioned pilot testing as part of their process. Some survey respondents stated that industry documentation was used as part of their approach; examples provided by the respondents included the "10 State Standards", AWWA Standards, EPA Guidance Manuals and ANSI Standards. Some noted that they approve new technologies on a case by case basis, while others (18 of 40) said that they have some form of written documentation.

When asked "How often does your agency have sufficient technical background to evaluate a new proposed technology?", only a few (6 of 40) said always. 11 more said often, while the majority (23 of 40) answering sometimes, rarely, or never (Table 4.2). Some states mentioned that they develop the expertise as needed and that it is a time consuming effort and strain on their staff resources. Human resource limitations were again a concern for some of the respondents who said that research is time consuming especially when the staff is limited or when the in-house staff lacks expertise.

Table 4.2. How often does your agency's staff have sufficient technical background to evaluate a new proposed technology?

Frequency	Number of Respondents
Always	06 (15%)
Often	11 (28%)
Sometimes	13 (33%)
Rarely	08 (20%)
Never	02 (05%)

States were also asked which technologies were the most challenging for them. Many responses were generic, stating “non-best available technologies, “anything new”, “emerging issues”, etc. Ultraviolet light (UV) disinfection was mentioned by 15 states, because even though it is a widely accepted disinfection technique, EPA regulations do not provide specific recommendations, only guidance. Membrane technology was only mentioned by three state agencies in response to this question

When respondents were asked how many full time equivalent (FTE) employees were dedicated to technology approval in their agency, half (20 of 40) indicated that there were none dedicated to working in this capacity. Six others listed less than 1 FTE. These responses highlight the human resources challenge many state regulatory agencies face.

4.4 Barriers

Identifying the barriers to acceptance of new technologies from the state agency perspective was an important goal of this survey. Respondents were given the 12 barriers listed in Table 4.3. As expected, resources (staff time, number of staff, good data, training, funding for testing, and cost to systems) were the most commonly identified barriers; limited staff time for review/approval (29 or 73%) and limited staff to run the program (23 or 58%) being the most mentioned. Regulations, statutes, and procedures were less commonly considered barriers to the acceptance of new technology. Previous studies have mentioned risk avoidance as a major barrier to innovation for drinking water innovation. This question did not specifically ask if risk avoidance was a barrier, but a few of the options, like lack of information from vendors, lack of training, and risk from deceptive vendors may be considered barriers because of the risk avoidant nature of the drinking water agency.

Table 4.3. What are the barriers to acceptance of new technologies?

Barriers	Number of Respondents
Staff time for review/approval	29 (76%)
Limited Staff to run program	23 (61%)
Lack of information from vendors (data)	23 (61%)
Lack of training of staff for adequate evaluation	22 (58%)
Lack of funding for testing/evaluation	21 (55%)
Concern over cost to systems	19 (50%)
Risk from deceptive vendors	13 (34%)
Regulation	09 (24%)
Lack of product/technology support	09 (24%)
Cost to vendors to meet program requirements	08 (21%)
Procedural	08 (21%)
Statute	04 (11%)

As a part of this survey, the respondents were asked if there were any other barriers that weren’t mentioned. Responses included concern about higher operator certification and pay, systems be avoiding risk and not wanting to be first, lending agencies being avoidant to funding new technologies, applicability of new technologies, need for independent testing and approval, long-term performance data, and need for products to be certified.

The respondents were asked "What specific types of questions need to be answered related to the approval of new technologies?" The survey provided 11 initial responses that could be selected which are listed in Table 4.4. Generally speaking, quality pilot and performance data are key to technology acceptance for the states. The most common responses were to pilot data from one or more locations and with one or more water qualities (36 or 90%) and to obtain performance data to support a technology (30 responses or 75%). Other common responses concerned residuals produced and the need for 3rd party certifications.

4.5 Technology Approval Information Needs

The survey respondents were asked if there were other questions that needed to be answered related to technology approval. The responses included identification of failure (how quickly, what can cause it to happen, etc.), vendor funding of pilot studies, providing key design features and parameters (proprietary information), verifying the pilot study at the facility, O & M manuals and instructions, and waste stream disposal information.

Table 4.4. What specific types of questions need to be answered?

Questions needing to be addressed	Number of Respondents
Pilot data from one or more locations/water qualities	36 (97%)
Performance data to support the technology	30 (81%)
Residuals produced	25 (68%)
3rd party certification and identification of where technology is appropriate	24 (65%)
Operator skill needed to operate	21 (57%)
Ease of operation	18 (49%)
Projected capital costs	14 (38%)
Projected operations costs	14 (38%)
Vendor description of appropriateness	12 (32%)
Vendor contract for replacement	11 (30%)

Pilot and performance data are clearly essential to confirm that a technology is appropriate for each specific water quality. The state regulators were asked: "What are some of the treatment technology performance deficiencies that have been a problem in your state with piloting new technology?" Responses included a range of water qualities tested (10 or 25%), the pilot study should be long enough (to test seasonal changes, through several maintenance cycles, etc.) (10 or 25%), appropriate scale of the pilot testing (7 or 18%), and operating costs (3 or 8%). Some respondents mentioned that they were not sure which questions to ask until the pilot test had been run. Others noted deficiencies included raw water data, training, and the need for third party oversight.

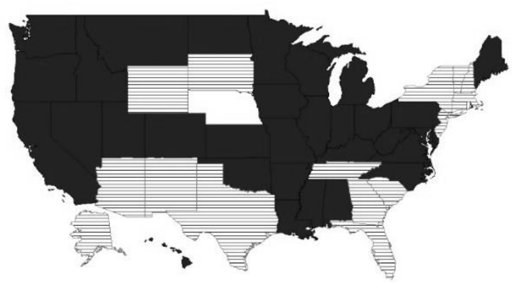
4.6 Approval Status of Selected Technologies and Methods

Table 4.5. Which of the following emerging technologies and methods have been evaluated or approved for use in your state? (Some responders left the approval status of some technologies blank.)

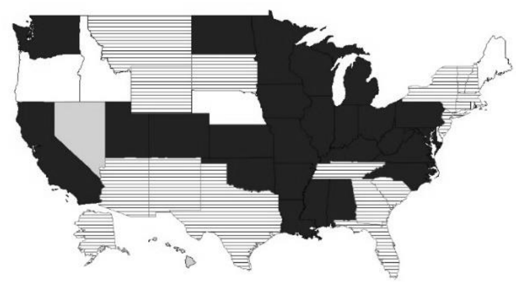
	Number of States that approved the technology	
Emerging Technology/Method	At least once	More than 5 Locations
Low Pressure MF/UF Membranes	33 (94%)	16 (46%)
High Pressure NF/RO Membranes	26 (76%)	13 (38%)
UV- Low Pressure	24 (67%)	2 (06%)
MIOX	23 (62%)	3 (08%)
TTHM Aeration	22 (61%)	4 (11%)
POU	19 (53%)	10 (28%)
Calcium Hypochlorite Briquettes	18 (50%)	7 (19%)
UV- Medium Pressure	18 (49%)	2 (05%)
Aeration for DBP removal	16 (46%)	3 (09%)
POE	16 (46%)	8 (23%)
Magnetic Ion Exchange	10 (27%)	0 (00%)
Ferrate Oxidation	0 (00%)	0 (00%)
GAC for DBP removal	5 (14%)	2 (06%)
UV-LED	1 (03%)	0 (00%)

A list of fourteen emerging technologies and methods was compiled by the WINSSS, DeRISK, and ASDWA workgroup that developed the questions. The respondents were asked to identify “Which of the emerging technologies listed below has been evaluated or approved in their state?” by answering for each of the previously described 14 technologies. Table 4.5 provides the list of treatment technologies and methods and their acceptance and use in the states that participated in the survey. Column 2 lists the total number of states that have approved that technology at least once. Column 3 lists the number of states that have approved a technology or method in more than 5 locations within the state, which is a subgroup of those in column 2. The percentage in the table is based on the number of state agencies which answered the question about each technology. The number of states which responded to each technology varies from 34 to 37. Some of these have been considered in many states and technologies and might not be considered new and innovative in those states. These technologies include low and high pressure membranes, low pressure UV disinfection, MIOX, and aeration to remove disinfection by-products (DBPs), which have been accepted at least once in more than half of the surveyed state agencies.

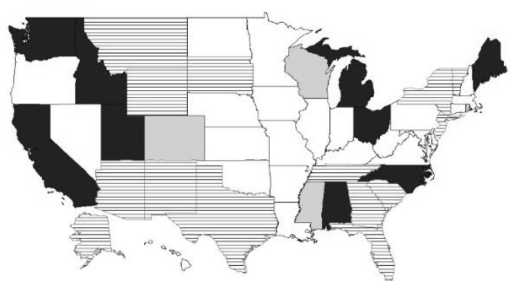
The approval of new technologies varies from state to state. If a state approves one emerging technology it does not necessarily mean that it has approved others. Maps of the approval of the 14 technologies are shown in Figures 4.1., 4.2., and 4.3. Solid colors were used to represent different responses from states (white, gray, or black). Hatching represents states that did not respond to the survey or question concerning that technology, or preferred to be anonymous and Wyoming, who has not accepted primacy from the US EPA over Safe Drinking Water Act, was included in this group. Figure 4.1 shows the approval rate of high and low pressure membranes, magnetic ion exchange and ferrate oxidation. Figure 4.2 shows the approval rate of low pressure, high pressure and LED UV, calcium chloride briquettes, MIOX, and TTHM aeration. Figure 4.3 shows the approval rating of in-distribution aeration for DBP removal, in-distribution GAC for DBP removal, and the use of POU and POE methods for treatment. Since some states preferred to be anonymous, the frequency of approval in Table 4.5 may not be the same as Figures 4.1 through 4.3



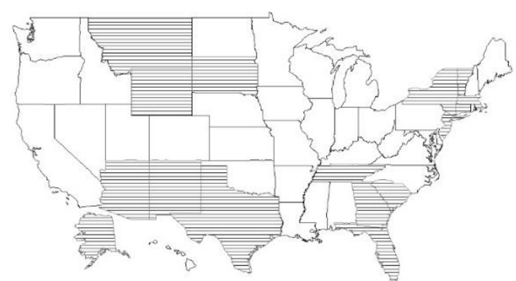
A) Low Pressure MF/UF Membranes



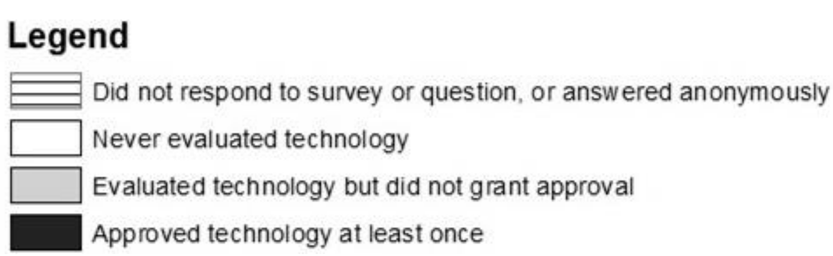
B) High Pressure NF/RO Membranes



C) Magnetic Ion Exchange

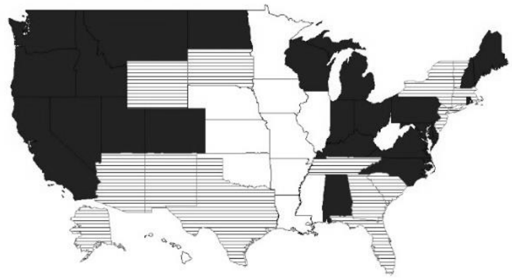


D) Ferrate Oxidation

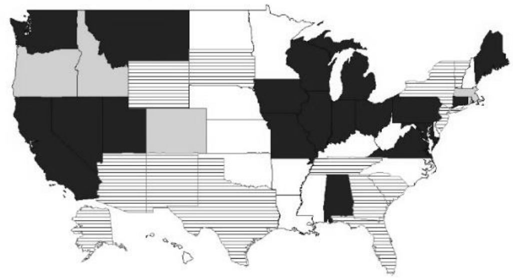


*Wyoming does not have primacy

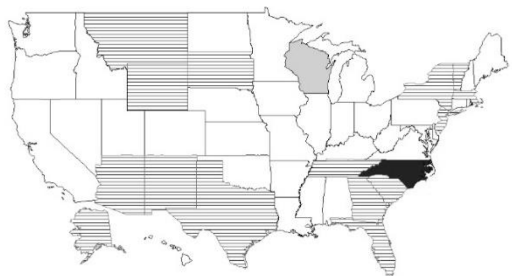
Figure 4.1. Technology Approval by State **A**) Low Pressure MF/UF Membranes, **B**) High Pressure NF/RO Membranes **C**) Magnetic Ion Exchange **D**) Ferrate Oxidation



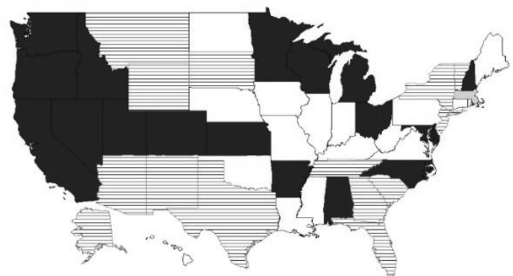
A) UV Low Pressure



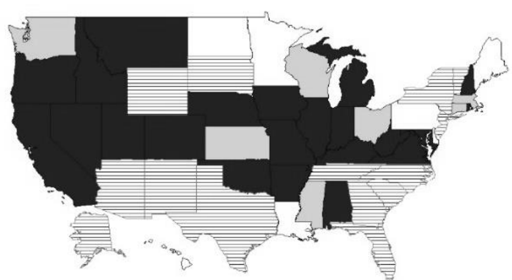
B) UV Medium Pressure



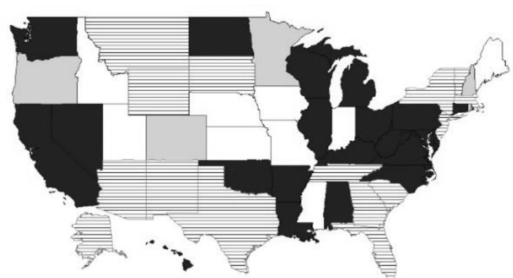
C) UV LED



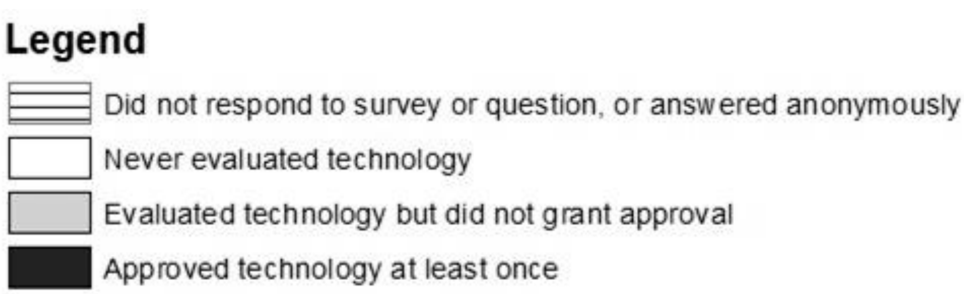
D) Calcium Hypochlorite Briquettes



E) MIOX

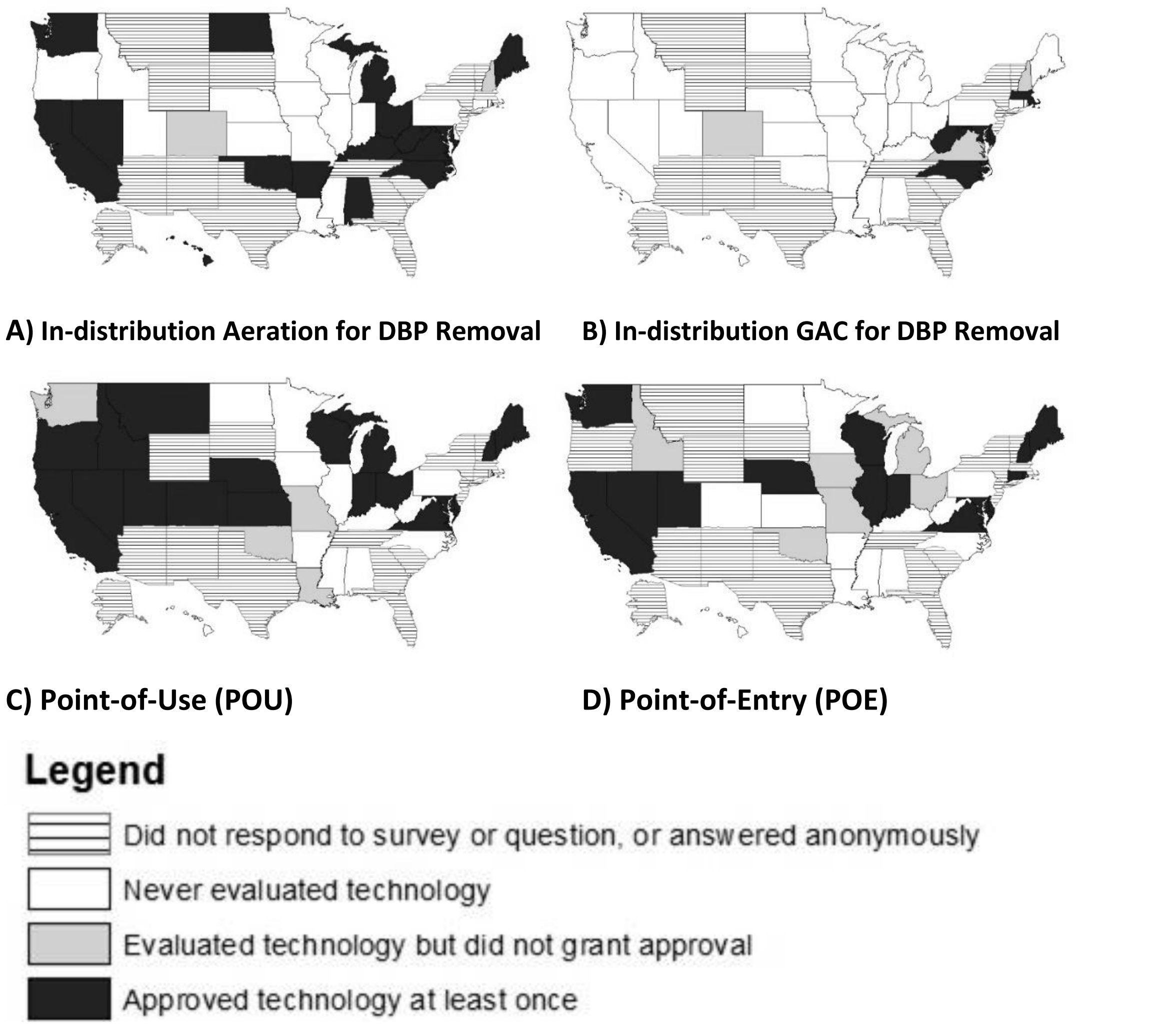


F) TTHM Aeration



*Wyoming does not have primacy

Figure 4.2. Technology Approval by State **A**) UV Low Pressure, **B**) UV Medium Pressure **C**) UV LED, **D**) Calcium Hypochlorite Briquettes Technology Approval by State, **E**) MIOX, **F**) TTHM Aeration



*Wyoming does not have primacy

Figure 4.3. Technology Approval by State **A**) In-distribution GAC for DBP Removal, **B**) In-distribution GAC for DBP Removal **C**) Point-of-Use (POU), **D**) Point-of-Entry (POE)

Although there is generally some similarity in geography trends for similar technologies (e.g., low pressure and high pressure membranes), difference in factors ranging from common water quality, contaminants, vendors, and state agency resources result in variations in which states are among the first adopters each technology. There are also approval frequency differences in states which are members of the 10 State Standards (Great Lakes-Upper Mississippi River Board or GLUMRB) group-Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio, Pennsylvania, and New York

(Great Lakes-Upper Mississippi River Board, 2017). For example, in Figure 4.3 a, MIOX approval varies across the 10 states, this is because within the 10 State Standards approval of new technology is on a state-by-state basis.

4.7 Perception of Past EPA Programs that Provided Data for New Technologies

The EPA Environmental Technology Verification (ETV) programs was developed by the USEPA to support water system compliance, manage specific contaminant issues and provide performance data. The ETV program ran from 1995 until 2014, providing performance information on innovative technologies (US EPA, 2016d). Respondents were asked if they recalled the program and if so, what the benefits of the program were. When the states were asked if they rely on ETV certification or use ETV testing protocols as part of their technology approval process (Table 4.6), almost half did. When asked about how ETV is used, there were mixed answers, some states saying they used it for 3rd party performance data, but some states saying that for some

Table 4.6. USEPA's ETV verification program

Does your state rely on ETV certification or use ETV testing protocols as part as your technology approval process?	
Yes	19 (48%)
No	13 (33%)
Not aware of the program	08 (20%)

technologies the data were not as useful. ETV membrane information was specifically mentioned as beneficial to several states.

The arsenic demonstration program ran from 2003 to 2011 and included 50 full-scale pilot study demonstration projects for removing arsenic in 26 states. (US EPA, 2016c, Sorg et al., 2015). The arsenic demonstration program provided full scale pilot study data, information on cost, labor requirements, contaminant removal performance, and waste stream data (US EPA, 2016c). The program was practical, reliable, and had no vendor influence. Respondents were asked a question regarding the arsenic demonstration program, though 14 states were not aware of the program, 5 of those commented that arsenic is not a concern in their state. Answers from this question are listed in Table 4.7. Of those that said that the arsenic demonstration program influenced their approval process, the program was praised for the detailed data it provided regarding various arsenic removal technologies. Among the benefits mentioned were: reliable pilot data, detailed monitoring and reporting on treatment performance, experts available to help with reviewing treatment options, guarantee of performance, operator training, cost data, and findings were communicated. Based on the data needs identified in the survey, the approach and data collected for the arsenic demonstration program could be used as a model for future piloting programs.

Table 4.7. Arsenic Demonstration Program

Did the USEPA arsenic demonstration program influence your procedures and/or acceptance of the tested technologies?	
Yes	15 (38%)
No	14 (35%)
Not aware of the program	11 (28%)

Regarding the arsenic demonstration program, though 14 states answered “No”, 5 of those commented that arsenic is not a concern in their state. Of those that said that the arsenic demonstration program did influence their approval process, the program was praised for the detailed data it provided regarding various arsenic removal technologies. Among the benefits mentioned were: reliable pilot data, detailed monitoring and reporting on treatment performance, experts available to help with reviewing treatment options, guarantee of performance, operator training, cost data, and findings were communicated. Based on the data needs identified in the survey, the approach and data collected for the arsenic demonstration program could be used as a model for future piloting programs.

4.8 Interest from States in Future Collaborations

To address the need to make the process of approving new technology less complex for individual states, respondents were asked if they would have an interest in working together. They were asked to respond to three levels of cooperation, 1) an information sharing network to provide data from pilot studies with other states (sharing data), 2) form a workgroup of nearby states to develop common standards and piloting protocols (developing common standards but acceptance decided individually), and 3) partner with nearby states to coordinate technology acceptance (acceptance by one means acceptance by all). This question was answered by 34 states and their responses are listed in Table 4.8. One state expressed no interest in sharing data, but the overall response is very encouraging, 33 of 34 states having at least some interest in sharing data and 23 of 34 states having at least some interest in partnering in technology acceptance.

Table 4.8. Number of state agencies which are interested in information sharing

Interstate Communication Opportunity	Number of Respondents				
	No interest	(2)	(3) Some Interest	(4)	(5) Strong Interest
Information Sharing Network	1	0	14	3	16
Develop Standards/Common Data	6	0	12	7	9
Partner for Approval	8	3	10	4	9

The last survey question proposed a workgroup of states be initiated as a follow up to this survey to evaluate the results and work toward developing an initial set of criteria for new technology acceptance. 24 respondents answered that they would be interested in participating in such a workgroup.

4.9 Summary

Innovative technologies can provide cost and reliability benefits for drinking water systems, but due to many barriers, new and innovative technologies are not applied to small drinking water systems. There are many types of barriers to technology adaptation, and state agency approval is an important one for small systems. Thus, the main objective of this study was to identify the barriers at the state agency-level to approving new technologies and ways to overcome those barriers.

Many barriers to innovation were identified; the most common barriers were lack of sufficient state agency time, staff, expertise, and sufficient pilot data to evaluate new technologies and ensure that technologies provide safe drinking water which meets EPA regulations. These barriers are like ones which have been identified by previous studies and overcoming them will require support for all parts of the drinking water industry.

The state agencies are also interested in sharing their knowledge and expertise among their peers to benefit both technology acceptance and drinking water compliance for the water systems they regulate. Some new technologies have been implemented in several states, since the data exist for these technologies, the next step is to identify ways that this information can be shared with those that need it.

CHAPTER 5 CONCLUSIONS AND FUTURE WORK

5.1 CONCLUSIONS

Small systems cannot simply be considered scaled-down versions of larger systems; they face different challenges due to differences in water source. Small systems make up a large percentage of systems in the United States, so it is important to ensure that appropriate technologies are being considered for the unique water qualities they treat. In general, new technologies are not considered for small systems because they are less likely to have the resources, expertise, and ability to successfully implement them. In addition, as an industry, water systems avoids risks and often use technologies that are widely used.

It was found that some technologies which were considered emerging by industry experts, may be more common than realized, and are being implemented in a number of states. If the data already exist for these technologies, the next step is to identify how to share that information nationwide with those states that need it. Most states are interested in sharing information, and many are willing to explore the idea of working together to develop a common approach to collect and evaluate performance data for new technologies.

The barriers identified through this survey are basically the same barriers that have been discussed in the water industry for the last 20-30 years. Vendors develop new technologies to make a profit, so technology development cannot be so cost prohibitive that there is no possibility of being financially successful. The states, however, have a clear directive to protect public health. They need assurance that a new technology will work properly to ensure they are protecting the public. The states' needs must be met, so the key to improving the process for technology acceptance is to provide adequate data to states in a manner that is cost effective to the technology developers. The two most significant barriers identified are, 1) the states having the time, staff and expertise to evaluate new technologies, and 2) having adequate performance data to ensure a technology is going to perform as expected. Overcoming barriers will require support for all parts of the drinking water industry. There is interest among the states in reducing the complexity and duplicative state efforts for new technology acceptance, and to facilitate development of nation-wide criteria to be used in evaluating new technologies for small systems.

5.2 Future Work

The state agencies are interested in sharing their knowledge and expertise among their peers to benefit both technology acceptance and drinking water compliance for the water systems they regulate. This is an opportunity for more research to be completed to determine the most effective way of information sharing. Future work should focus on this opportunity to determine the best means of information sharing and the type of information to be shared.

Information could be shared by a website or data portal that is accessible to all pertinent state agency employees. Since drinking water can be a national security risk, the website should provide some level of security to ensure that the documents are uploaded by verified state agency employees and it should be maintained by a professional to ensure content is acceptable. Information shared could include, approval status of technology by states (similar to the maps included in this manuscript), current contact information of those responsible for state agency, and benefits/issues associated with a technology. There are a few issues which need to be resolved: determining the group responsible for creating the website, determining the easiest way to share information, deciding if a level of security is needed like password protection or ensuring that information can only be accessed from state agency servers, and delegating the maintenance of the website to a group guarantee that all information is up-do-date and correct.

Some information may be shared more effectively in through conference calls or web conferences. Since it is a large group, 49 state agencies, perhaps regional groups should be created to make sure that each state has a chance to voice its opinion and hear information that is pertinent to the state. Perhaps the EPA regions could be used to group states together. Conference calls could highlight successes stories and specific issues in states. Notes from the regional conference calls could be shared on the websites with the other states.

To gather information in an organized way, a survey could be sent out to state agencies. The survey could ask more in-depth questions regarding innovative technologies, like the fourteen technologies mentioned in this manuscript. The survey could ask about specific questions about each technology, like the benefits, challenges, and the type of data that has been collected by the state agencies. The survey could also ask more specific questions about the pathway to approval of new technology in states. Like the survey in this manuscript, the new survey should be sent in association with a professional organization to encourage participation. When developing the information sharing program, previous programs which have proven effective, like the Arsenic Demonstration Program, could be used a model.

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APPENDIX A: Percent of Systems in Violation of 3 MCL Rules by Size and EPA Region

	TCR				Stage 1 DBP			
EPA Region	Total	<3,300	3,301-10,000	>10,000	Total	<3,300	3,301-10,000	>10,000
1	274	9.5%	13.1%	9.4%	19	0.6%	1.6%	0.4%
2	157	4.0%	5.5%	6.6%	31	1.0%	0.7%	0.0%
3	107	2.4%	2.3%	2.4%	27	0.6%	1.0%	0.0%
4	207	2.0%	3.1%	4.3%	127	1.4%	2.3%	1.2%
5	167	2.5%	2.1%	1.0%	28	0.3%	0.8%	0.5%
6	296	3.3%	4.7%	5.3%	268	3.2%	3.8%	2.9%
7	214	5.3%	4.5%	5.0%	31	0.6%	2.3%	1.2%
8	131	4.1%	2.8%	3.8%	14	0.4%	0.5%	0.5%
9	169	3.8%	3.8%	2.8%	50	1.1%	1.9%	0.6%
10	126	2.9%	3.0%	2.0%	26	0.6%	0.5%	0.0%
Total	1,848	3.5%	3.8%	3.9%	621	1.2%	1.9%	0.9%

	Nitrate-N			
EPA Region	Total	<3,300	3,301-10,000	>10,000
1	1	0.0%	0.0%	0.0%
2	1	0.0%	0.0%	0.0%
3	11	0.3%	0.0%	0.0%
4	3	0.0%	0.0%	0.0%
5	10	0.2%	0.0%	0.0%
6	74	1.1%	0.2%	0.4%
7	43	1.1%	0.6%	0.0%
8	8	0.3%	0.0%	0.0%
9	33	0.8%	0.3%	0.4%
10	20	0.5%	0.5%	0.0%
	204	0.5%	0.1%	0.1%

APPENDIX B: SURVEY QUESTIONS

Project to Improve Understanding of Drinking Water Treatment Technology Approval

ASDWA and the two recently EPA funded National Centers for Innovation in Small Drinking Water Systems, the WINSSS Center at the University of Massachusetts at Amherst and the DeRISK Center at the University of Colorado Boulder, are asking for assistance from state primacy agencies to better understand the landscape surrounding regulatory acceptance and approval of new treatment technologies used by small community water systems. The Centers, with assistance from ASDWA, are developing a program to identify and address potential barriers and commonalities in how each state approves and implements the acceptance of new treatment technologies.

The Centers, working with ASDWA, are providing this online survey to collect information from each state program and then follow up, as necessary, with direct contact to identified staff to collect additional information regarding specific parts of each state's technology acceptance program.

A workgroup of interested stakeholders will be convened to evaluate the survey information, determine common barriers to acceptance, develop a set of desired documentation that will satisfy state data needs for new technologies, and identify potential areas where states can coordinate acceptance. Please consider being a part of this important workgroup.

The data collected from this survey and the findings of the workgroup will be presented at conferences, such as the EPA Small Systems Workshop in Cincinnati on Aug 25-27 and the ASDWA Annual Conference in Fort Worth Oct 20-23. Information will be shared as coming from your state, not an individual, and no individual contact information requested as a part of this survey will be included in any publicly available report.

This survey consists of 16 questions, most are yes/no, fill in the blank, or multiple choice, and it should take less than 15 minutes to complete. If you are not able to answer all of the questions and need to share the survey with colleagues, please feel free to share the link. If you have any questions about the survey, please contact Steve Wilson, University of Illinois at 217-333-0956, sdwilson@illinois.edu. If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the University of Illinois Institutional Review Board at 217-333-2670 or via email at irb@illinois.edu.

<u>**Current Program**</u>

1. **Does your state have a standard approach** to acceptance of new technologies for drinking water treatment? (e.g., written rules, guidelines)

    a. Yes [go to 1i]

    i. Is written documentation publicly available to explain your approach to technology acceptance?

    1. Yes [go to 2]

    2. No (please provide a brief description of your approval process): _______ [go to 2]

    b. No [go to 2]

    Additional comments on this question? _________________________

2. **How many FTE's are dedicated** to technology approval? (e.g., 1.5 FTE) __________

3. **Does your state rely on ETV certification or use ETV testing protocols as part of your technology approval process**?

    a. Yes [go to 3ai]

    i. Please provide a brief description of how ETV is incorporated into your approval process and if it is used only for specific technologies: ______________________ [go to 4]

    b. No [go to 4]

    c. No, not aware of what the ETV protocols are. [go to 4]

    Additional comments on this question? _________________________

4. **Did the USEPA arsenic demonstration program influence your procedures** and/or acceptance of the tested technologies?

    a. Yes. [go to 4ai]

    i. How did the USEPA arsenic demonstration program influence your procedures and/or acceptance of the tested technologies? ___________________________

    ii. Which technologies did it influence? ______________________

    b. No [go to 6]

    c. No, not aware of the Arsenic demonstration program. [go to 6]

    Additional comments on this question? __________________________

5. Presuming that a program on the scale of the arsenic demonstration program (well over $10 million dollars) will not be instituted again, **what aspects of the arsenic demo program were most useful in supporting your technology approval process** and might be used in another way to support technology approval? (check all that apply)

a. _____ Experts available to help with reviewing treatment options
b. _____ Availability of reliable pilot data
c. _____ Specialized training for operators, with follow up
d. _____ Experts available to help with troubleshooting performance options
e. _____ Detailed monitoring and reporting on treatment performance
f. _____ Guarantee of performance, or replacement of treatment process
g. Other beneficial aspects____

Recent Experiences

6. **How often do you consider new technologies** as a solution for small systems (for purposes of this survey, please consider small systems as those serving <3,300 people)?

a. Frequently
b. Infrequently
c. Rarely
d. Never
e. Additional comments on this question? _________________________________

7. **How often does your agency's staff have sufficient technical background** to evaluate a new proposed technology?

a. Always
b. Often
c. Sometimes
d. Rarely
e. Never
f. Additional comments on this question? __________________________________

8. **What types of technologies are most challenging** to the technical capacity of your staff?
____

Barriers and Data Needs

9. **In your state, what are the barriers to acceptance of new technologies**? Please check all that apply, add others we might have missed, and provide additional information to explain your state's specific barriers that you think we should be aware of:

a. ____Statute

b. ____Regulation

c. ____Procedural

d. ____Lack of funding for testing/evaluation

e. ____Lack of training of staff for adequate evaluation

f. ____Limited staff for running program

g. ____Staff time involved in review/approval

h. ____Cost to vendors to meet program requirements

i. ____Concern over cost to systems

j. ____Lack of information from vendors (operational data, performance data)

k. ____Risk from deceptive vendors

l. ____Lack of ongoing product/technology support

m. Please provide specific barriers and an explanation:

____

10. **What specific types of questions need to be answered** related to the approval of new technologies? Below is a list of initial questions/data needs that have been identified. Are there others you would require in order to approve technologies for use in your state? Please check those that are typically lacking, but necessary for approval of any new technologies.

a. _____Ease of operations

b. _____Residuals produced

c. _____Projected capital costs

d. _____Projected operational costs

e. _____Pilot data from one site

f. _____Pilot data from multiple locations / water qualities

g. _____Willingness of vendor to provide a contract that specifies replacement of new technology with more conventional technology if new technology doesn't perform as planned (to allow for tentative approval until full scale is verified)

h. _____Vendor provided description of where technology is appropriate, and where it is not

i. _____3rd party certification, and identification of where technology is appropriate and where it is not (operating ranges of chemistry, temp, skill needed, etc)

j. _____Operator skill level needed to operate

k. _____Performance data to support the technology (what level is needed)

l. Others you would require____

11. What are some of the treatment technology performance deficiencies that have been a **problem in your state with piloting new technologies**? (some examples include: Insufficient testing scale (laboratory or bench-scale vs. pilot), Insufficient time period for piloting, Too narrow of a range of water quality parameters considered in piloting, Insufficient analysis of operating requirements, Lack of data on operating costs)

____

12. **Which of the emerging technologies** listed below has been evaluated or approved for use in your state? Please answer using 1 through 5 below.

1 = Never requested and/or unfamiliar with the technology
2 = Evaluated, but never granted
3 = Approved for one plant/situation
4 = Several plants/applications (5 or less)
5 = Commonly applied (>5)

Technology

_____In-distribution system aeration for DBP removal
_____In-distribution system GAC for DBP removal
_____UV - Medium Pressure
_____UV - Low Pressure
_____UV - LED (very new)
_____MIEX
_____MIOX
_____Calcium hypochlorite briquettes
_____TTHM Aeration
_____Point of use
_____Point of Entry
_____Ferrate oxidation
_____Low pressure MF/UF membranes
_____High pressure NF/RO membranes

Please list other emerging technologies you have approved or considered.
____

Moving Forward

13. To what degree would your state have an interest in doing each of the following in hopes of reducing the complexity and individual state effort for new technology acceptance?

Strong interest
No interest
Some

a. **Form an information sharing network** related to new technology installation, with mutually accepted protocols for expected data that can be used by all technology approving agencies. (continuing current practices, but sharing information on piloting, issues, etc, no real collaboration between states for acceptance but allowing other states to see what data you have collected and used for approval)

b. **Form a workgroup of neighboring states to develop common standards** and piloting protocols for mutually beneficial technology acceptance. (forming a workgroup to collect similar data and agreeing to data needs between member states, but each state still assesses the data and grants approval independently)

c. **Partner with nearby state regulatory agencies to coordinate new technology approval** where there are commonalities that be exploited. (not only develop common standards for data needs, but also agree on acceptance, such that states share piloting and workload to provide mutual acceptance of a technology – acceptance by one means acceptance by all)

d. **What other suggestions** do you have for improving new technology acceptance?
____

14. **For follow up questions** and to ask for clarifications regarding your answers, who should we contact? We are looking for the person(s) most versed in the acceptance of new technologies for your state.

Name:
Title:
Phone Number:
Email Address:
State and Agency:

15. Is there more than one person involved in technology acceptance?
    a. Yes [go to 15ai]
        i. Second set of contact boxes with same question at end
            1. Yes [go to 15aii]
            2. No [go to 16]

        ii. Third set of contact boxes with same question at end
            1. Yes [go to 15aiii]
            2. No [go to 16]

        iii. Fourth set of contact boxes [go to 16]

    b. No [go to 16]

16. **Would you or others in your agency be interested in being part of a national workgroup** looking at the survey data and collaborating to better understand the issues related to technology acceptance? The goal would be to develop an initial set of criteria that all members can agree on related to acceptance of new technologies. It is proposed that the workgroup meet 3-4 times if necessary, by conference call, between September 2015 and Sept 2016, with those who are able, meeting in person at the USEPA Small Systems Workshop in Cincinnati, should that event take place (usually August or September each year). The centers and ASDWA will facilitate exchange of information via email as needed between calls.
    a. Yes [End of Survey]
    b. No [End of Survey]

End of Survey – Thank you for participating. As a follow up to the survey, someone from the WINSSS center team at the University of Illinois will likely be contacting you in the next few months to get clarification on answers, and to follow up on some of your program details. The results of this survey will be presented at the Small Systems Workshop in Cincinnati this fall, and possibly the ASDWA Annual Conference in October. This information will provide the starting point for a national workgroup to evaluate and develop a minimum set of criteria and data needs to recommend to stakeholders that would be necessary for technology acceptance.

If you have any questions, please contact Steve Wilson at the University of Illinois (217) 333-0956, sdwilson@illinois.edu

APPENDIX C: SURVEY RESULTS

QUESTION 1.1

State	Q 1: Does your state have a standard approach to acceptance of new drinking water treatment?		Q 1a: Is written documentation publicly available to explain your approach to technology acceptance?	
		If no, please explain		**If no, please explain**
AL	No			
AR	No			
CA	Yes		Yes	
CO	Yes		Yes	
CT	No			
DE	Yes	Plan submittal and Delaware Construction Guidelines	Yes	
HI	Yes	Alternative Technology for surface water and groundwater under the direct influence of surface water sources only.	No	Review of 60-day pilot study report to demonstrate consistent 3-log Giardia removal and 4-log virus removal and 2-log Cryptosporidium removal.
IA	Yes		No	We review guidance documents and manufacturer information, and so far takes a lot of resources and time
ID	Yes		Yes	
IL	Yes		Yes	
IN	No			
KS	Yes	Yes - guidance is in our minimum design standards for public water supply systems in KS: "Policies, General Considerations, and Design Requirements for Public Water Supply Systems in Kansas," most current edition. Most current edition at this time is 2008.	No	See 1. above. http://www.kdheks.gov/pws/peu.html#standards General guidance allows the KS to be flexible and accommodating, while also ensuring due diligence.
KY	No			
LA	Yes	Typically a pilot study is conducted.	No	We rely on pilot study data conducted onsite.
MA	Yes		Yes	
MD	Yes	Appropriate pilot testing or submission of pilot test or actual plant operation data for treatment of similar raw water quality and quantity for review and approval.	No	We use 10 State Standards, 2012 revision; AWWA Standards; and EPA guidance manuals. Water system design guidelines are available on MDE website.
ME	No			
MI	Yes		No	new technologies must undergo a successful pilot study or other verification process to be approved prior to installation
MN	Yes		No	We are working on putting this acceptance list together.
MO	Yes		Yes	

QUESTION 1.2

State	Question 1: Does your state have a standard approach to acceptance of new drinking water treatment?		Q 1a: Is written documentation publicly available to explain your approach to technology acceptance?	
		If no, please explain		**If no, please explain**
MS	Yes		Yes	
MT			Yes	
NC	Yes		Yes	
ND	No	We do not preapprove technologies. We do however approve it on a project by project basis.		
NE	No			
NH	No	NH - we follow the same review process so the fact that we don't have specific rules doesn't mean we don't approve new technologies.		
NV	No	Generally, we start by looking for compliance with various NSF/ANSI standards; or that the components of the technology all meet standards if they are cobbled together in a new way.		
OH	Yes		Yes	
OK	Yes		Yes	
OR	Yes	regulations, generally not very specific	Yes	
PA	No	PA routinely utilizes a standard approach/rationale in the review of new technologies. There is no current specific public document on this. Some of the common aspects could be further formalized. Though, it is not feasible to attempt to capture the variety of technology-specific details within a document issued by our particular agency.		
RI	No			
UT	Yes		Yes	
VA	Yes	Approach is outdated and we have shifted from it recently with scope and acceptance of other work, need to revise our policy.	Yes	
WA	No	The only standardized approach is for alternative filtration technologies as defined under the SWTR (40CFR 141.73(d)). For other relatively new technologies.		
WI			Yes	
WV	No			
AN-1	Yes		Yes	
AN-2	Yes	Approve on case-by-case basis based on pilot testing in accordance with Minimum Standards.	Yes	
AN-3	No			

QUESTION 2

State	**Q 2: How many FTE's are dedicated to technology approval?**
AL	0
AR	Varies
CA	1
CO	1.25
CT	0
DE	<1.0
HI	0
IA	0.25
ID	1
IL	0
IN	1
KS	None dedicated, but can have 1-3 FTE's involved.
KY	0
LA	0
MA	0.5
MD	None. It is part of the job responsibilities of two MDE Programs: Water Supply Program and Engineering and Capital Projects Program.
ME	0
MI	1
MN	0
MO	Engineers are capable to review the new technology
MS	1-2
MT	none are specifically dedicated
NC	Approximately 5 FTEs dedicated to overall plan approval process
ND	3 as needed
NE	0
NH	We have 5 engineering staff doing design review, inspections, and technical assistance … Zero "dedicated"?
NV	1.5
OH	0.5
OK	2
OR	0.2
PA	1
RI	none, we have 2 engineers for all plan approval for the state drinking water program
UT	0
VA	No FTEs specifically dedicated and we generally use a team approach to effort.
WA	0.2
WI	3
WV	0
AN-1	0
AN-2	No dedicated FTEs
AN-3	0

QUESTION 3.1

State	Q 3: Does you rely on ETV certification as part of your technology approval process?		
		Comments	**How is ETV is incorporated?**
AL	No	Sometimes we do and sometimes we don't. It depends.	
AR	Yes		Verify that the technology has been through the ETV process before our review
CA	No	I'm not aware of what different ETV testing protocols are available.	
CO	Yes		For Membranes - we use it as 3rd party removal performance. For Bag/Cartridge - we do the same. Those are the only ETV we have used to date.
CT	Yes		ETV is used when available
DE	Yes	Must meet ANSI/NSF 60 and/or 61 or equivalent	Used to ensure technology meets ANSI/NSF standards
HI	No		
IA	No		
ID	Yes		ETV Certification is used for membrane filtration approval
IL	No		
IN	No		
KS	Yes		In part rely on ETV certifications as providing proof of performance. Use is general - if there's a certification we'll want to review it.
KY	Not aware		
LA	No		
MA	Yes		Without ETV, a proponent would need to conduct full scale piloting, whereas with ETV only site specific piloting is required.
MD	No		
ME	Not aware		
MI	Yes		If a ETC report is available, we review it to see how the technology performed. We usually require additional pilot studies for specific systems and raw water quality.
MN	No	It appears that the ETV program is no longer active	
MO	Not aware		

QUESTION 3.2

State	Q 3: Does you rely on ETV certification as part of your technology approval process?		
		Additional Comments	**Describe how ETV is used**
MS	Unaware		
MT	Yes		DEQ-1, Standard 4.3.9.1
NC	Yes	ETV cert. can be used by Professional Engineer as basis for required PE cert.	Required PE cert. may be based in part on ETV cert.
ND	Yes		We use it as a starting point to determine if the tech. is acceptable per project basis.
NE	Unaware		
NH	Yes	4th option, ETV reports serve as one of many useful references for tech. review.	Useful as literature reference, when available.
NV	No		
OH	No		
OK	No		
OR	Yes	we treat ETV verifications like any other challenge study or verification.	we look at their protocol and results and treat them like any other verification.
PA	Yes	our agency's central office has required submission of and has reviewed applicable reports (from ETV, other third-party etc.) as one important aspect of a product/technology review. Evaluation per an appropriate and nationally recognized test protocol is one of the other important considerations.	
RI	Yes		When a water system wishes to use a new tech. we ask for ETV doc. If it cannot be provided, then we look for extensive piloting.
UT	Yes		Will accept ETV approval for proposed tech.
VA	Yes	We have begun to so more recently than in the past where we often required work to be redone or slightly altered to meet our needs.	Data and available info. has been reviewed and not repeated, generally a newer concept approach for us.
WA	Yes	Sometimes the ETV reports are very useful, and occasionally provide the all info. needed. In other cases, the reports aren't helpful. States need to be involved more at the front end to help shape reports that will be useful towards accept. by utilities and reg. agencies.	The only recent example that I can think of is a low pressure membrane approval. The rest of the ETV reports have not been useful.
WI	Unaware		
WV	Unaware		
AN-1	Yes		We use the ETV process to base our engineering plan review approvals on.
AN-2	No	aware of the ETV cert. and will see if a report exists.	
AN-3	Unaware		

QUESTION 4.1

State	Q 4: Did the Arsenic Demonstration Program influence your procedures?	
		Comments
AL	Unaware	
AR	No	Arsenic is not an issue in our State
CA	No	
CO	Unaware	
CT	Yes	was helpful in recognizing areas that would work and the conditions of use that need to be imposed
DE	Yes	
HI	No	Arsenic is not an issue in Hawaii.
IA	No	
ID	No	
IL	No	
IN	Yes	
KS	Yes	
KY	Unaware	
LA	No	
MA	Unaware	
MD	Yes	
ME	Unaware	
MI	Yes	
MN	No	We would still require pilot testing for the specific sites proposed unless we can see pilot results from very similar quality water.
MO	Unaware	
MS	Unaware	Arsenic is not a concern in our state.
MT	No	
NC	No	Less than 5 system with Arsenic MCL.
ND	Yes	
NE	Unaware	
NH	Yes	NH - extremely useful. Will there be a text box to answer how?
NV	Yes	
OH	Yes	
OK	Unaware	
OR	Yes	
PA	Yes	This third-party demonstration program was worthwhile, generating a good deal of worthwhile performance data. The reports were very thorough. They even had some capital and operational cost figures contained in the reports, which is something that ETV reports do not have. This would have had more of an impact if more final reports would have been released prior to the arsenic rule implementation date.
RI	No	Arsenic was not an issue in this state.
UT	Yes	
VA	No	
WA	Yes	
WI	Yes	
WV	Unaware	
AN-1	No	
AN-2	Unaware	
AN-3	No	

QUESTION 4.2

State	Q 4: Did the Arsenic Demonstration Program influence your procedures?	
	How did it influence your procedures?	**Which technologies?**
AL		
AR		
CA		
CO		
CT		ARSENEX (Preferred this technology due to its no discharge of liquid waste)
DE	DE had one of the demonstration projects. Allowed us to see first-hand how process works.	Arsenic removal using ferrate oxidation
HI		
IA		
ID		
IL		
IN	Provided useable and reliable data for the various treatment technologies to remove arsenic from drinking water. Provided information on which oxidizers work on arsenic and what other contaminants hinder effective removal of arsenic.	adsorptive media, RO, oxidation filtration
KS	USEPA demonstration program is another source of proof of technology performances. If there's a demonstration, we'll want to review it. No vendor influence in demonstration program. Include waste stream handling and disposal options, and the costs associated with both.	No specific vendor technologies, just process technologies in general.
KY		
LA		
MA		
MD	Reviewed results and efficiencies of arsenic removal treatment methods.	Adsorption and filtration, primarily.
ME		
MI	Data from the demonstration projects was used as supplemental information for arsenic removal systems.	adsorption medias
MN		
MO		

QUESTION 4.3

State	Q 4: Did the Arsenic Demonstration Program influence your procedures?	
	How did it influence your procedures?	**Which technologies?**
MS		
MT		
NC		
ND	Helped confirm what types of treatment worked and what did not.	NO specific type.
NE		
NH		Adsorptive media, Iron-Arsenic co-ppt, Arsenic III speciation and oxidation, Anion Exchange corrosion impacts
NV	Provided technical info to help make treatment decisions	ion exchange, coag-filtration, adsorption
OH	The information coming out from the studies helped State personnel make more informed decisions on acceptability of treatment technologies and ability to provide better technical assistance to public water systems. The USEPA demonstration testing did not replace the States requirement to conduct site specific demonstration studies for the use of new technology, however, it did provide valuable information on parameters to consider for each treatment technology, water quality considerations, pre-treatment considerations, performance goals/expectations, treatment limitations, waste residual handling and better prepared state in providing technical assistance to Public water systems looking at different arsenic treatment technologies.	Mainly, adsorptive media. However, USEPA demo study did bring to our attention important considerations for anion exchange (although no system choose to go this route). It also illustrated challenges with POU implementation which influenced the POU/POE rule requirements.
OK		
OR	provided info on what works and what doesn't	adsorptive media
PA		
RI		
UT	Allowed the State to review test site results, demonstrated what worked and what didn't. Able to review results.	Absorptive media
VA		
WA	The reports were useful, not so much for approval, but more for figuring out how to improve the performance of poorly performing treatment equipment.	Adsorbents, Oxidation/Filtration, Ion Exchange
WI	we learned what would and wouldn't work	oxidation filtration
WV		
AN-1		
AN-2		
AN-3		

QUESTION 5.1

State	Q 5: Which aspects of the Arsenic Demonstration Program were most useful?						
	Experts to review treatment	Avail. of reliable pilot data	Training for operator	Experts for trouble-shooting	Perform. Monitoring and Reporting	Guarantee of perform.	Other
AL							
AR							
CA							
CO							
CT		x			x		
DE		x	x		x		Funding
HI							
IA							
ID							
IL							
IN	x	x		x	x		
KS	x	x	x	x	x	x	EPA's demonstration program a golden opportunity for states, systems and consultants to get an up close experience with the +/-s of As removal technologies. Can base other demonstration program on this template. . Would include waste stream generation and disposal, and their related costs as part of the demonstration programs. Waste regulations and costs are just as important if not more so than technology performance. . Being well informed makes the making of good decisions much easier.
KY							
LA		x	x			x	
MA							
MD		x			x	x	
ME							
MI		x			x		
MN							
MO							

QUESTION 5.2

State	Q 5: Which aspects of the Arsenic Demonstration Program were most useful?						
	Experts to review treatment	Avail. of reliable pilot data	Training for operator	Experts for trouble-shooting	Perform. Monitoring and Reporting	Guarantee of perform.	Other
MS							
MT							
NC							
ND	x	x					
NE							
NH	x	x	x	x	x	x	Poster presentations and project factsheets to summarize and communicate findings.
NV	x	x		x	x		performance data and costs
OH	x	x			x		
OK							
OR		x			x		the project in our state didn't work :(
PA	x	x			x	x	
RI							
UT	x	x	x	x	x	x	
VA							
WA		x			x		Cost data. Performance data and troubleshooting existing installations.
WI	x	x		x	x		
WV							
AN-1							
AN-2							
AN-3							

QUESTION 6

State	Q 6: How often does your state consider new technologies?	
		Comments
AL	Rarely	
AR	Rarely	
CA	Infreq.	Small water system generally can't afford to take the risk with its funds and use a not-yet-proven technology.
CO	Freq.	
CT	Rarely	Small systems do not usually consider new technologies due to high cost
DE	Rarely	
HI	Never	
IA	Rarely	
ID	Infreq.	
IL	Rarely	
IN	Infreq.	
KS	Rarely	Most systems of this size in KS have been able to match technologies to needs.
KY	Infreq.	
LA	Infreq.	
MA	Infreq.	As needed should be an option
MD	Rarely	
ME	Rarely	
MI	Rarely	
MN	Rarely	Small systems typically do not have the money to spend on new technologies
MO	Infreq.	
MS	Infreq.	
MT	Infreq.	
NC	Infreq.	
ND	Rarely	
NE	Infreq.	
NH	Rarely	What are we considering "new technologies"?
NV	Infreq.	we are open to new technologies
OH	Infreq.	
OK	Infreq.	
OR	Freq.	once or twice a month
PA	Infreq.	
RI	Infreq.	New technologies are somewhat discouraged because third party verification is generally not available and extensive piloting is expensive and time consuming.
UT	Infreq.	
VA	Infreq.	… generally depends on the systems ability to pay for treatment and the quality or abilities of the consulting engineers they employ. However, we are actively looking for alternatives that are lower tech and lower cost.
WA	Infreq.	…What is a new tech.? What is frequently? Also, we/I don't "consider technologies as a solution". We mainly review treatment approaches, some of which are novel.
WI	Infreq.	
WV	Rarely	
AN-1	Infreq.	
AN-2	Rarely	
AN-3	Infreq.	

QUESTION 7.1 AND 8.1

State	Q 7: How often does your staff have sufficient technical background?		Q 8: Most challenging technologies?
		Comments	
AL	Never		Membranes
AR	Often		
CA	Often		Non-BAT / non-standard treatment technologies and emerging technologies that are still under development
CO	Often		Ion exchange - will it work. UV disinfection for small systems - lack of raw water data.
CT	Rarely	we do not have in house expertise to review & assess new technologies	they are all challenging given the lack of resources to address them
DE	Often		
HI	Rarely		In Hawaii, we only have UF and MF membranes, GAC, and chemical (e.g. chlorine, chloramine, lime, fluoride, orthophosphate, etc.) injection. We see the potential of UV. Membranes would be the most challenging of these technologies.
IA	Some.		UV, generators for biofouling control in water mains
ID	Often		Small system surface water filtration
IL	Always		
IN	Some.		UV
KS	Always	Where we don't initially have the familiarity required, we develop it.	Most challenging will be UV given its inherent ambiguities and competing interests of industry entities. Biggest technical challenge we've had to date is finding an ANSI/NSF certified POU system for removing uranium from groundwater.
KY	Some.		Getting the appropriate and accurate information on the technology is the challenge.
LA	Some.		
MA	Always		NONE
MD	Often		New treatment technologies with limited or no operational or pilot test data.
ME	Rarely		UV, Ozone, those involving chemical interactions
MI	Rarely		UV (specifically reviewing and approving validation reports), and Radium/Uranium removal
MN	Some.	We usually gain the experience as needed	UV light verification
MO	Always		UV light disinfection validation

QUESTION 7.2 AND 8.2

State	Q 7: How often does your staff have sufficient technical Background?		Q 8: Most challenging technologies?
		Comments	
MS	Some.		Currently, puroxone; ceramic membranes,
MT	Some.		UV
NC	Often		
ND	Rarely		New/not validated technologies that have no or limited data to back-up manufacture claims as there is not sufficient time to do research on a product.
NE	Often		Unknown
NH	Some.		none
NV	Some.	on-line research is time consuming for our limited staff resources	emerging and new technologies
OH	Often		UV for surface water
OK	Always		
OR	Often	we have had to develop the expertise	UV calculated dose, anything unproven
PA	Some.		The less established that a particular technology is, the more challenges it typically would present in terms of a DEP central office review/assessment. Technologies that have a very limited national track record or essentially no operational installations at treatment plants, coupled with a limited internal staff knowledge base, do present challenges.
RI	Rarely		At the moment, UV.
UT	Rarely		UV and filtration technologies
VA	Always		Rarely has this been a problem, when faced with this we self-educate and work with consultants and vendors in an open process to get up to speed on new products and technology.
WA	Often	Usually the difficulty is time and sometimes consulting engineers and equipment manufacturers seeking approval without giving much thought to long term operations and maintenance issues.	UV disinfection. There is no standard validation and operational approach, merely guidance. The evaluation of the technology is so complex, as it currently stands, that as one consulting engineer said to me "I don't think anyone but Harold really understands what is going on".
WI	Never		enhanced disinfection; emerging issues such as algal toxins
WV	Some.		
AN-1	Some.		Membrane and UV technologies
AN-2	Rarely		UV
AN-3	Some.		

QUESTION 9.1

State	**Q 9: What are the barriers to acceptance of new technologies?**										
	Regulatory	Procedural	Lack of fund.	Lack of train.	Limited staff	Limited time	Cost to vendor	Cost to system	Lack of info. from vendors	Risk from deceptive vendors	Lack of ongoing support
AL	x	x	x	x	x	x			x	x	x
AR		x		x							
CA						x		x			x
CO	x	x	x				x		x		
CT			x	x	x	x		x	x		
DE						x			x		
HI		x	x	x	x	x		x			x
IA						x		x	x	x	x
ID			x		x	x		x			
IL											
IN	x					x			x		x
KS	x		x		x	x	x	x	x	x	x
KY	x	x	x	x	x	x			x	x	
LA			x	x	x	x		x	x		
MA	x										
MD			x	x	x	x			x		
ME					x	x					
MI	x		x					x	x	x	
MN			x		x	x				x	
MO						x					
MS			x				x	x	x		
MT			x	x	x	x					
NC											
ND				x	x	x		x	x	x	
NE			x			x			x		
NH					x	x			x		
NV		x			x	x	x	x	x	x	
OH							x		x		
OK								x	x	x	x
OR			x	x	x	x		x	x	x	
PA				x		x		x	x	x	x
RI			x	x	x	x	x	x	x	x	
UT	x		x	x	x	x		x		x	
VA	x	x	x				x	x			
WA			x	x	x	x			x		
WI			x		x			x			
WV				x	x	x	x				
AN-1				x	x	x		x			
AN-2				x	x	x			x		
AN-3		x	x	x	x	x					x

QUESTION 9.2

State	**Q 9: What are the barriers to acceptance of new technologies?**
	Other Barriers
AL	
AR	
CA	The primary concern is whether a new technology will survive over time. Availability of long-term support is also a concern.
CO	
CT	
DE	
HI	Besides upgraded membranes, we have very few, if any, new technologies being proposed in Hawaii.
IA	
ID	Many small systems lack sufficient funding and technical expertise to operate systems
IL	
IN	
KS	Cost of performance testing/piloting is a major hurdle. . Performance data can be lacking so sources of independently verified information such as EPA performance programs, ETV testing, etc. are all the more invaluable. . Deceptive practices and "...everything about our product is just wonderful and it never, never fails..." sales presentations are problematic. . States and systems need access to information that is reliable and credible.
KY	
LA	
MA	Technology must meet performance criteria as well as having third party approval on chemical and/or material components of system.
MD	
ME	
MI	
MN	Additionally: worry about higher operator certification and pay levels; Systems wanting guarantees for treatment/removal; Finding money to pay for new tech; Getting systems interested in being the first to use the new tech; Lending agencies may be averse to giving loans on newer technology.
MO	

QUESTION 9.3

State	**Q 9: What are the barriers to acceptance of new technologies?**
MS	
MT	
NC	
ND	
NE	
NH	Poor technical submittals by vendors and consultants. Need independent, technically competent firms to perform necessary pilot testing for state approval. Vendors are biased and consultants do not have piloting expertise.
NV	lack of NSF 60/61 certification
OH	
OK	
OR	
PA	As applicable for the subject technology, up-to-date test protocols need to be in place nationally. And they must also be utilized by the manufacturer.
RI	The most problematic situation is when a vendor convinces a small system that they have a low cost treatment solution, but has not made the investment in performance testing. The small system has no understanding of why that is a problem and the vendor will play on that ignorance to try to use politics to get approval rather than actual performance data.
UT	
VA	We are working hard to overcome these where and when possible. Several recent success stories with TNC and NTNC systems. Mainly we are becoming more open to new approaches and taking reasonable risks while ensuring we protect public health.
WA	Lack of standards for novel treatment approaches.
WI	public acceptance of risks
WV	
AN-1	
AN-2	
AN-3	

Question 10.1

State	Q 10: What specific types of questions need to be answered?										
	Ease of operations	Residuals produced	Projected capital costs	Operational costs	Pilot data from one site	Pilot data from mult. locations	Willingness of vendor to replace technology	Vendor description of appropriateness	3rd party cert.	Operator skill level	Performance data
AL	x	x	x	x	x	x		x	x	x	x
AR		x	x	x	x	x	x		x	x	x
CA	x	x	x	x	x	x		x		x	x
CO		x							x	x	x
CT	x	x	x			x			x	x	
DE		x			x				x		
HI	x				x				x	x	x
IA		x				x					x
ID	x	x	x	x	x	x				x	x
IL											
IN		x	x	x		x		x	x	x	x
KS	x	x	x	x	x	x	x	x	x	x	x
KY		x			x		x				x
LA	x				x				x	x	x
MA					x				x		x
MD	x	x			x	x		x	x	x	x
ME		x			x		x		x		x
MI		x			x	x					x
MN		x			x	x	x	x	x		
MO					x		x	x		x	x
MS	x	x			x		x	x	x	x	x
MT	x	x			x	x					x
NC											
ND	x				x				x	x	
NE	x	x	x	x		x	x	x	x	x	x
NH	x	x	x	x	x				x	x	x
NV	x	x	x	x	x	x			x	x	x
OH	x	x				x					x
OK						x	x			x	x
OR						x			x		x
PA			x	x		x	x	x	x		x
RI					x	x		x	x		x
UT		x				x			x		x
VA	x	x	x	x	x	x	x		x	x	x
WA						x		x	x		
WI			x	x	x	x				x	
WV						x					x
AN-1	x	x		x		x				x	x
AN-2											
AN-3	x	x	x	x	x	x					

QUESTION 10.2

State	**Q 10: What specific types of questions need to be answered**?
AL	
AR	
CA	Identification of treatment failure - how quickly can it occur and how quickly will WQ return to normal after the problem is fixed.
CO	NSF 61, conditions of testing (for acceptance parameters), O&M manuals, P&IDs
CT	
DE	
HI	
IA	Pilot at specific location where installation is proposed.
ID	
IL	
IN	
KS	Would clarify b. to be "Waste Streams Produced" instead of "Residuals produced," and add another category for "Waste Stream Disposal." Waste stream refers to existing waste streams whether or not they are modified as well as newly generated waste streams. Waste streams may/may not be in the form of a residual so better to keep the terminology general. . In KS we address waste streams and their disposal up front to ensure that projects are compatible with the current waste disposal regulatory framework and that associated costs are included in project costs. Carrying that effort forward throughout the project ensures a quiet transition from design to operation. Not uncommon for past projects to be designed otherwise only to experience re-design, delays, and additional costs.
KY	
LA	
MA	
MD	
ME	
MI	
MN	ANSI/NSF 60 or 61 approvals
MO	

QUESTION 10.3

State	**Q 10: What specific types of questions need to be answered?**
MS	
MT	
NC	
ND	
NE	
NH	Site specific piloting by independent technical firm and development of appropriate operational data and pilot reports.
NV	If vendors would pay for pilot studies, it would help ease the process with small and very small PWSs. To avoid the cost of pilot study, vendors often try to prove theoretical efficacy with similar water quality. That has been problematic when it doesn't pan out and the system fails & finger pointing starts.
OH	Site specific performance data is generally required in Ohio.
OK	
OR	
PA	Providing regulators with specifics on key design parameters, as well as important operational/maintenance considerations.
RI	
UT	
VA	Tough question and not typically all inclusive to any one vendor or technology but overall it runs the course.
WA	
WI	question was confusing
WV	
AN-1	
AN-2	
AN-3	

QUESTION 11.1

State	**Q 11: What are some treatment technology performance deficiencies that have been a problem in your state with piloting new technologies?**
AL	Too narrow of a range of water quality parameters considered in piloting, Insufficient testing scale (laboratory or bench-scale vs. pilot)
AR	Time period length to address varying source water quality
CA	Insufficient testing scale, insufficient time period, too narrow a range of source water quality.
CO	insufficient testing scale. lack of WQ data. lack of product data for the trichlor product (alternative to calcium hypo).
CT	No known challenges (when piloting of new technologies are considered by large water systems, we have worked closely with the water system owners & consultants to ensure that all needed performance measures are accounted for)
DE	
HI	We prefer pilot tests on the specific water to be treated, however, if the membrane has been tested on similar or worse raw water qualities, we may accept previous data. It is also costly to pilot in Hawaii with shipping constraints and lack of qualified personnel from the vendor and the water systems.
IA	Cost of RO pilots, time constraints. we would not allow without a site specific pilot and a pilot protocol that we approve, so this hasn't been an issue. It's an issue for us to think of everything they should be testing during the pilot if we aren't familiar with the technology
ID	Insufficient time and range of water quality parameters
IL	
IN	insufficient time period for piloting, insufficient raw water quality data to show when it works well and when it does not, insufficient training on operating issues
KS	Independent, certified 3rd party oversight for performance testing is at times painfully lacking.
KY	
LA	Insufficient testing scale, time period for pilot testing, water quality issues unique to each area of the state
MA	Lack of approval in other New England States. Sometimes two seasons of piloting is required.
MD	Insufficient time period, too narrow a range of water quality parameters, insufficient analysis of data and results.
ME	Insufficient experience and information on how different technologies perform (i.e., antimony treatment)
MI	All those mention above.
MN	Reluctance to operate pilot studies for long periods of time usually due to cost.
MO	Lack of data on operating costs

QUESTION 11.2

State	**Q 11: What are some treatment technology performance deficiencies that have been a problem in your state with piloting new technologies?**
MS	Scale testing;
MT	insufficient testing scale, too narrow a range of water quality parameters
NC	
ND	Willingness of manufacture to pilot.
NE	Lack of data
NH	Need for 3rd party site-specific pilot testing
NV	all of the above
OH	Insufficient time period, unreliable test data at previous locations, insufficient data collection
OK	
OR	insufficient time period, narrow range of WQ, pre-treatment needs
PA	Insufficient testing scale (laboratory or bench-scale vs. pilot), Insufficient time period for piloting, Too narrow of a range of water quality parameters considered in piloting, Insufficient analysis of operating requirements, Lack of data on operating costs). Is the range of W.Q. parameters being evaluated actually too narrow? Insufficient information quantifying the key design parameters. Insufficient practical information on aspects of the new product€™s operation. Lack of pertinent costing data.
RI	We have very little experience with this.
UT	No resources to perform testing by State staff. Small time frame to pilot worst case scenario (i.e. spring runoff).
VA	time
WA	Nearly all treatment technologies, with the exception of simple disinfection technologies, need some degree of site specific pilot testing to demonstrate their efficacy and operational viability.
WI	In some cases, system owners not wanting to spend money on piloting
WV	
AN-1	
AN-2	
AN-3	

QUESTION 12.1

State	Q 12: 1-Never evaluated, 2-Evaluated, but never granted, 3- Approved at one plant, 4- Several Plants, 5-Commonly Applied (>5)													
	In-distrib. Aeration for	In-distrib. GAC for DBP	UV Med. Press.	UV Low Press.	UV LED	MIEX	MIOX	Ca(ClO)2 Tabs	TTHM Aeration	POU	POE	Ferrate Oxidation	Low Press. Mem.	High Press. Mem.
AL	3	1	3	3	1	4	4	3	3	1	1	1	5	3
AR	4	1	1	1	1	1	4	4	3	1	1	1	3	4
CA	4	1	4	4	1	4	4	4	4	4	4	1	4	4
CO	2	2	2	4	1	2	4	5	2	4	1	1	5	5
CT	1	1	4		1	1	2	1	4		5			
DE	1	4	1	3	1	1	1	5	4	5	5	3	3	1
HI	3	1	1	1	1	1	1	1	3	1	1	1	4	2
IA	1	1	4	1	1	1	4	1	1	1	2	1	4	5
ID	1	1	2	4	1	4	4	4	1	5	2	5	5	1
IL	1	1	4	1	1	1	5	1	4	1	4	1	5	5
IN	1	1	4	4	1	1	4	1	1	5	5	1	4	3
KS	1	1	1	1	1	1	2	4	1	4	1	1	5	5
KY	4	1	1	4	1	1	5	1	4	1	1	3	5	3
LA	1	1	1	1	1	1	1	1	4	2	1	3	4	3
MA		4	2			1	2	2						
MD	5	4	5	4	1	1	4	5	5	5	5	1	4	4
ME	4	1	5	3	1	3	1	1	1	5	5	1	3	1
MI	3	1	4	3	1	3	3	4	4	5	2	1	5	5
MN	1	1	1	1	1	1	1	3	2	1	1	1	5	5
MO	1	1	4	1	1	1	3	1	1	2	2	1	4	4
MS	1	1	1	1	1	2	2	1	1	1	1	1	4	4
MT			3	4			3			4			4	
NC	5	5	1	4	4	4		3	5	1	1	1	4	5
ND	3	1	1	3	1	1	1	1	4	1	1	1	5	5
NE	1	1	1	1	1	1	4	1	1	5	5	1	1	1
NH	2	2	1	5	1	1	3	5	2	5	3	1		
NV	5	1	4	4	1	1	4	4	5	5	5	5	4	2
OH	4	1	4	4	1	4	2	4	4	4	2	1	5	5
OK	4	1	1	1	1	1	4	1	4	2	2	1	5	5
OR	1	1	2	5	1	1	5	5	2	4		1	5	1
PA	1	1	4	4	1	1	1	1	4	1	1	1	5	3
RI	1	1	2	3	1	2	3	1	2	2	4	1	1	1
UT	1	1	4	4	1	4	4	5	1	4	4	1	4	4
VA	4	2	3	3	1	1	4	1	4	3	3	1	5	5
WA	4	1	4	4	1	3	2	5	4	2	4	1	5	5
WI	1	1	4	4	2	2	2	4	4	4	4	1	4	4
WV	4	5	1	1	1	1	3	1	3	1	1	4	4	4
AN-1														
AN-2														
AN-3				4		4	4		5	5	5	4	5	5

QUESTION 12.2

State	**Q 12: Other technologies which have been approved in your state.**
AL	Tank mixers
AR	
CA	Biological Treatment for Nitrate, Perchlorate; Alternative Filtration Technologies (cartridge/membranes); Mixed Oxidants and CT Credit for Mixed Oxidants.
CO	distillation of RO concentrate, trichlor disinfection, UV/H2O2, Ozone/H2O2, Natural filtration
CT	
DE	
HI	GAC for removal of EDB/DBCP/TCP, Aeration Towers for removal of TCE,
IA	ion generators for biofouling control
ID	
IL	
IN	Storage Tank Mixing Bubblers
KS	KS doesn't issue vendor/technology specific approvals. It does recognize tech. categories such as GAC, membranes, ion exchange, etc. KS doesn't maintain an approved vendor/tech./product listing. This practice keeps the door open to all vendors and gives systems the widest selection from which to choose from.
KY	
LA	
MA	Arch Chemicals Plus, Purolite,Solmetrex, Solarbee Proxaire
MD	
ME	
MI	
MN	2- Biological Nitrate removal; 3 - Biological ammonia removal; 2 - Biological iron and manganese removal; 4 - biological taste & odor removal
MO	
MS	Purifics PhotoCat;
MT	
NC	
ND	
NE	None
NH	Artificial Recharge; Riverbank Filtration
NV	we continue to work through issues with copper-silver ionization
OH	Superpulsators, Multi-Tech, Advanced Oxidation
OK	
OR	sketchy / borderline "cartridge" filters
PA	
RI	none
UT	None
VA	Recent approvals for an "ATS" cartridge filtration/UV system for GUDI wells and rainwater harvesting. Technology is less emerging than the packaging of the product and use. Required constant turbidity and pressure monitoring, chlorination also added with monitoring. Installations at NTNCs only so far.
WA	Permeable reactive barriers, biological treatment,
WI	
WV	
AN-1	
AN-2	
AN-3	

QUESTION 13.1

State	Q 13: What level of interest does you state have in the following?		
	Information Sharing Network	Workgroup of neighboring states to develop common standards	Partner with neighboring states to coordinate approval
AL	Some	No interest	No interest
AR	Some	Some	Some
CA	Strong interest	Strong interest	
CO	Strong interest	Strong interest	Strong interest
CT	Strong interest	Some	Some
DE	Some	Some	Some
HI	Some	Some	
IA	Strong interest		
ID	Some	Some	Some
IL	Strong interest	No interest	No interest
IN			Some
KS	Strong interest		No interest
KY	Some	Some	Some
LA	Strong interest	Strong interest	Strong interest
MA			
MD	Strong interest	Strong interest	Strong interest
ME	Some	No interest	No interest
MI	Some	Some	Some
MN	Some		Some
MO	Strong interest	No interest	
MS	Strong interest		
MT	Some	Some	
NC		Some	
ND	Some	Some	Some
NE			
NH	Some	No interest	No interest
NV	Some	Some	No interest
OH	Strong interest		Strong interest
OK	Strong interest	Strong interest	Strong interest
OR	Strong interest		
PA			No interest
RI	Some	Strong interest	Strong interest
UT	Strong interest	Strong interest	Strong interest
VA	Strong interest	Strong interest	Strong interest
WA	Strong interest	Strong interest	Strong interest
WI	No interest	No interest	No interest
WV	Some	Some	Some
AN-1			
AN-2			
AN-3			

QUESTION 13.2

State	**Q 13:Other suggestions for reducing complexity of technology acceptance?**
AL	Make EPA have the resources have the expertise to back-up the states when state programs are lacking the technical expertise.
AR	
CA	Share on-going treatment performance information (1 to 3 years) for new technologies to better reflect reliability of system.
CO	EPA should take the lead - we need national consensus of technology
CT	The preference is for EPA to take the lead in accepting new technology and develop procedures to use recognizing regional limitations and challenges
DE	
HI	
IA	
ID	
IL	
IN	Indiana has done this already with UV technology. We are in a workgroup with Kentucky and Ohio.
KS	KS would retain the right to vary its in-state approach to meet state-specific needs. Certified third party certifiers with independent testing so outcomes will be reliable and credible.
KY	
LA	
MA	
MD	
ME	Due to staff limitations we have no time to be involved with new technology evaluation and acceptance. We rely on consultants showing us that the technology meets EPA requirements (e.g., the UV Guidance Manual). We have a well-documented policy and procedure for treatment review and approval, but we rarely ever are involved with new technology acceptance.
MI	
MN	Provide funds for small systems to run pilot studies. Provide scholarships for state regulators to attend AWWA workshops/seminars on new technologies
MO	

QUESTION 13.3

State	**Q 13:Other suggestions for reducing complexity of technology acceptance?**
MS	
MT	
NC	
ND	
NE	None at this time
NH	ASDWA Treatment Forum Blog; Cincinnati Small Systems Workshop
NV	
OH	
OK	
OR	centralized, easy to use information sharing on actual applications, EPA providing a list of technologies approved according to their protocol, or ask NSF or ETV to use approved protocols only.
PA	
RI	none
UT	Greater collaboration
VA	Improved regulatory openness to new technology is a starting point, as well as, openness to accept existing data.
WA	A national standard website that is maintained and supported by AWWA, ASDWA, equipment manufacturers (WWEMA), and possibly others (AMTA, etc..) that would provide bite-snack-meal levels of information on new technologies ranging from simple listings of existing installations for X to more detailed summaries. It would be advantageous to equipment manufacturers (speed acceptance of their products), utilities (review other installations), and for the overall approval process. A neutral party, such as an academic institution, supported by multiple entities, would probably engender the most trust across the profession, though a long term commitment (> 5 years) would be needed for folks to develop confidence with repeated exposure/use.
WI	we are involved in Ten States; additionally, we already consult other states; greater national oversight on certain technologies
WV	
AN-1	
AN-2	
AN-3	

QUESTION 16

State	**Q 16: Would your state be interested in being part of a national workgroup?**
AL	Yes
AR	Yes
CA	Yes
CO	Yes
CT	No (Lack of resources & staff to participate at this stage)
DE	No
HI	Yes
IA	No
ID	Yes
IL	No
IN	Yes
KS	Yes
KY	Yes
LA	Yes
MA	Yes
MD	Yes
ME	No
MI	No
MN	Yes
MO	Yes
MS	Yes
MT	Yes
NC	Yes
ND	Yes
NE	No
NH	No
NV	Yes
OH	Yes
OK	Yes
OR	No
PA	
RI	No
UT	Yes
VA	Yes
WA	Yes
WI	No
WV	
AN-1	
AN-2	
AN-3	