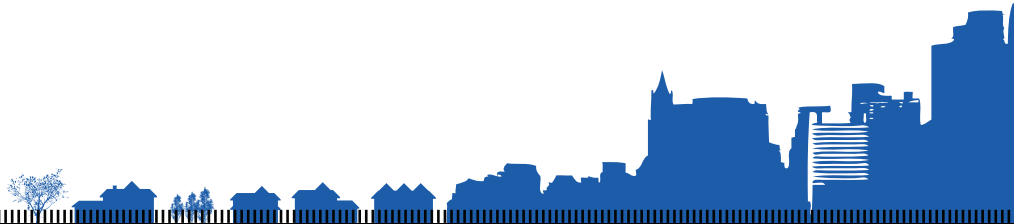


Perceptions of Drinking Water Quality

A Review of the Literature and
Surveys Covering the Topic



PD&R



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Perceptions of Drinking Water Quality—A Review of the Literature and Surveys Covering the Topic

Prepared for
U.S. Department of Housing and Urban Development
Office of Policy Development and Research

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April 2022

PREFACE

From time to time, the U.S. Department of Housing and Urban Development (HUD) receives requests to include questions on perceptions of home drinking water quality as a part of its American Housing Survey (AHS). The requests are not surprising because no other federal surveys ask householders those questions.

Research shows that perception of drinking water quality is closely linked to the use of bottled and other sources of water for drinking, as illustrated by the review of the literature that follows. Analysis of the AHS data has shown that the cost of avoiding presumably “bad” tap water by using bottled water costs more than \$5 billion annually. Researchers at the Earth Policy Institute estimate that “more than 17 million barrels of oil are required to produce enough plastic water bottles to meet America’s annual demand for bottled water,” and bottled water costs approximately 3,000 percent more per gallon than tap water (Harvard Graduate School of Education, 2013). The plastic used for the bottles is increasingly contaminating our waterways, including streams, rivers, and oceans.

Minority populations in the United States and those with lower household incomes are more likely to distrust the water coming out of their taps compared with those who do not identify as a minority group or those who earn higher incomes. This distrust is evident in a variety of studies, even though data from the Environmental Protection Agency (which collects actual water quality data) show that almost all public health systems in the United States are in compliance with set standards. Thus, trust in tap water is an equity issue, as those who are least able to afford to buy drinking water are often the ones more likely to perceive the need to do so. A better understanding of the drivers of water quality perceptions and trust in tap water would be useful not only in mitigating the negative environmental impact of increased bottled water use but in addressing an important equity issue that disproportionately affects minority and low-income households in the United States.

The AHS is uniquely positioned to contribute to this important topical area because no other federal survey is currently addressing the issue. The author recommends that the AHS include a short module of questions focused on better understanding the drivers of water quality perception so that public water officials, policymakers, regulators, and legislators can make more informed decisions regarding the consumption of tap water.

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EXECUTIVE SUMMARY

HUD is interested in exploring whether a module of questions on household perceptions of drinking water quality should be included in the American Housing Survey (AHS). This report reviews recent literature on water quality perceptions, discusses existing surveys that ask questions about water quality, and outlines information on actual water quality data that are available for the United States. Actual water quality is objectively measured water quality. By contrast, perceptions of water quality are attitudes toward water quality—perceptions of water quality can be based on both subjective and objective quality characteristics.

Literature Review

A review of the recent literature shows the following:

- Perceptions of water quality often rest upon sensory qualities, such as look, taste, color, and odor. The actual quality of water has little bearing on people’s perception of water quality.
- Negative perceptions of tap water quality often lead people to consume bottled water, spend money on filters, or consume sugary beverages rather than water. Research also shows that those using bottled water as their main source of drinking water are more likely to have unfavorable views of their tap water, indicating that negative perceptions of tap water and consumption of bottled water might mutually reinforce each other.
- Based on analysis of prior data collected through the AHS and confirmed by other surveys, minority households and those with lower incomes are more likely to perceive their tap water quality as bad and are subsequently more prone to seeking alternative sources of water. In addition, those living close to coastal areas or in rural areas with potential contamination from neighboring farms are more likely than their counterparts in other locations to perceive their water quality to be low.
- Households who received communication from water management authorities regarding the quality of their water were more likely to be satisfied with their water quality.
- Research in Western Europe suggests that consumers are more likely to trust the quality of water under public management compared with sources managed by mixed or private entities, although surveys conducted in Texas indicate that consumers prefer their water from privately managed water sources.

Surveys on Water Quality Perception

A review of household surveys on perceptions of water quality reveal the following:

- No federal surveys ask about perceptions of water quality.
- No regular state surveys ask about perceptions of water quality, although states and municipalities conduct surveys on this issue from time to time.
- A review of surveys shows that, based on available information, no surveys on the perceptions of water quality have been tested for validity using cognitive interviews. Most of them were pretested with a small group of respondents before fielding, however.

Actual Water Quality Data

Under the Safe Drinking Water Act (SDWA), the U.S. Environmental Protection Agency (EPA) sets standards for drinking water and monitors its quality across the nation.

- The SDWA requires states to report drinking water information from all water systems within their jurisdiction (excluding private wells serving fewer than 25 individuals).¹
- EPA, in conjunction with the U.S. Geological Survey and the National Water Quality Monitoring Council, has created a Water Quality Data portal,² where data on the quality of source water (streams, rivers, etc.) are collected in a standardized way from more than 900 federal, state, and tribal agencies; watershed organizations; and other groups.

Conclusion and Recommendations

Although federal authorities collect data to assess the quality of drinking water in the United States, no federal surveys ask households about their perception of the quality of their tap water. Most householders in the United States view their water quality favorably,³ but a significant number have negative perceptions of their tap water; those with negative views disproportionately tend to be ethnic or racial minorities and those with low incomes. In turn, those households are more likely to turn to expensive and environmentally damaging alternatives, such as bottled water. Because residents' decisions on water consumption are dependent on their perception of its quality, including information on water quality perception in public policy decisionmaking on this issue is important.

Because no other federal survey asks about the perception of water quality and resulting behaviors, HUD could include a module of questions that would provide data to determine and track the link between consumers' perception of and local-level communication regarding water quality, the effectiveness of the frequency of receiving such information, and other factors that link perception and consumption. The AHS is particularly well suited for those questions because the survey already collects information on the water and plumbing systems in the home alongside other housing characteristics, such as the age of the home, that might be important indicators of water quality. Thus, the author recommends that HUD include a module of questions in the AHS to help understand this phenomenon and how to address it.

Because the research shows that drivers of drinking water quality perceptions are related to sensory qualities—such as the look, taste, color, and odor of the water—and that other factors such as receiving information on water from the water utility organization or trust in the utility also influence perceptions of water quality, survey questions should focus on these issues:

- Primary source of drinking water (keeping the current AHS question focused on the source of most of the water in the unit).

¹ Those data, including data on violations and enforcement, are available at the Safe Drinking Water Information System (SDWIS) page: <https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting>.

² The Water Quality Data portal can be found here <https://www.epa.gov/waterdata/water-quality-data>.

³ The last time the question was asked was in the 2015 AHS. At that time, 91 percent of householders reported that they found their primary source of water to be safe.

- Alternative sources of drinking water.
- Frequency of use of various sources of drinking water, including tap and bottled water.
- Perception of tap water.
 - Overall perception of safety.
 - Perception of—
 - Look.
 - Taste.
 - Color.
 - Odor.
- Recall of receiving information on water quality from water utility organization.
- Trust in local water utility organization.

PERCEPTIONS OF DRINKING WATER QUALITY

HUD has been asked from time to time to include questions on water quality in the American Housing Survey (AHS). HUD questioned how the inclusion of items on water quality can contribute to a greater understanding of the topic, however. As a result, HUD is interested in examining what public data are already available and the key gaps in knowledge that HUD might fill through the inclusion of a set of items on water quality in the AHS.

To better understand whether to include questions on water quality perception and, in the event of inclusion, what questions to ask, this report presents a review of the literature from the past decade.

Literature Review

Perceptions of water quality rely on multiple factors. Literature review shows that perceptions of water quality often rest upon sensory qualities such as look, taste, color, and odor and that the actual quality of water has little bearing on people's perception of water quality.⁴ However, negative perceptions of tap water quality often lead people to consume bottled water, spend money on filters, or consume sugary beverages rather than water; those using bottled water for drinking are more likely to hold unfavorable views about their tap water. Minority households and those with lower incomes are more likely to perceive their tap water quality to be negative and hence be more prone to seeking alternative sources.

Research indicates that consumers who received communications from their water management authorities regarding the quality of their water were more likely to be satisfied with the quality of their water. Research from Western Europe suggests that consumers are more likely to trust the quality of water under public management compared with sources managed by mixed or private entities, although that relationship may possibly be reversed or not hold in the U.S. context.

Factors Related to Perceptions of Water Quality

A recent Canadian study of more than 1,000 citizens found that satisfaction with water quality is linked to the taste, odor, and color of tap water and that use of tap water was mediated by strategies applied at home, such as filtering or boiling then cooling. Those dissatisfied with the taste and odor of tap water were more likely to consume bottled water, as were those who had negative perceptions of the overall quality of tap water (Delpla et al., 2020). Another study from Australia, which examined historical water quality data and customer complaints, also noted that customers primarily perceive the safety of drinking water on aesthetic qualities such as taste and odor (Webber, Atherton, and Newcombe, 2015).

⁴ Actual water quality is objectively measured water quality.

Surveys of U.S. adults conducted in 2020 and 2021 confirmed the relationship between water quality perception and sensory perceptions (look, color, taste, and odor); those surveys also found that those who remembered receiving communication (other than a bill) from their water utility in the past year were likely to perceive their water to be safer, rate the quality to be higher, and be more satisfied with their water quality (AWWA, 2020, 2021). Several international studies measure perceptions of water quality. A 2019 study of 400 residents in Gonabad, Iran, found that perceptions of poor water quality were often due to unsuitable taste (60.7 percent), unacceptable appearance (27.8 percent), production of foam (11.1 percent), or other reasons (0.4 percent). The study also showed a link between demographics and the perceived safety of tap water. Women, those who were literate, those who had office jobs, and those with lower incomes were more likely to be satisfied with the quality of tap water in Iran (Sajjadi et al., 2016). This Iranian study indicates that the characteristics people use to make decisions regarding the quality of their drinking water may not vary much by race, ethnicity, or other cultural factors, thus allowing measurements to be developed that cut across cultural lines.

Conducted by Munene and Hall, a 2019 systematic review of the literature on perceptions of water quality among American and Canadian users of private sources of water, such as wells, included an intensive review of more than 200 peer-reviewed publications, which was then narrowed down to 52 studies from the past 31 years (Munene and Hall, 2019). The review found that households using private water sources such as wells relied on sensory properties of drinking water such as taste, look, or smell to judge the quality of their water; those who had concerns with those aspects of their water were more likely to find their water to be unsafe. Some well users also referred to the “hardness” of their water and the tendency of such water to discolor appliances or plumbing systems. Which of the sensory perceptions take precedence in determining the quality of water was unclear, however. In addition, the review found that well owners were reluctant to switch to the public water supply, often due to concerns about “chemicals” in the water and a personal preference for their well water. The review found that well water consumers were less likely to drink the water if they perceived risks other than aesthetic concerns, such as environmental risks due to proximity to livestock, septic systems, oil and gas activities, mining areas, or nuclear power plants or during flooding, drought, or severe runoff events. Often those environmental events result in changes to the aesthetic characteristics (taste, look, and odor) of the water.

A study conducted by de Franca Doria, Pidgeon, and Hunter used a convenience sample of 499 individuals in Portugal to examine tap water risk perception (2005). The study found that perceived quality of water is largely influenced by flavor. Perceptions of risk were due mainly to external information, often from friends but also from the media, past health problems, and the color of the water. The use of tap water for drinking could be moderately explained by the ability to find alternatives such as bottled water, the taste of the tap water, and the perceived risk. The authors of that study concluded that “it is clear that public perception of water quality is not entirely dependent on risk or on organoleptic [i.e., sensory] parameters, as other factors, such as external information and trust, also play a role” in trust in water companies influencing perceptions of quality and risk.

A 2019 survey of residents of Roanoke, Virginia, found that people who drink more tap water have higher trust in their water managers, evaluate water quality more favorably, have lower risk perceptions, and pay less attention to changes in their tap water (Grupper, Schreiber, and Sorice,

2021).⁵ The study included a survey that asked questions about the perception of drinking water quality and the choice of in-home drinking water. The survey also asked questions about the frequency of drinking water use from various sources at home, trust in and comfort with their local water utility, and their perceived risk of tap water using five indicators (assessing cognitive safety, affective safety, cognitive severity, affective severity, and comparative risk). The survey measured the attention residents pay to water quality by asking how often they had noticed unacceptable changes in their tap water in terms of taste, smell, and appearance.

Research from Europe links perception of water quality to the entities managing the water. Sources of water managed publicly were found to correlate with higher satisfaction with water quality compared with privately managed sources in Spain and Italy.⁶ The 2011 Spanish study, which surveyed more than 1,000 adults in 64 Spanish cities, found that satisfaction with tap water was related to levels of hardness, the presence of residual chlorine, whether they are located near the coast, the level of rainfall in the area, and demographic factors such as education and income. One of the most significant findings, however, is that privatization of water management led to a fall in satisfaction with water quality; that finding was not related to the ideological factors of the consumers (García-Rubio et al., 2015). The more recent Italian study, conducted with students at the University of Pisa, similarly found a link between perceived water quality and the entity that manages the water, with perceptions of water quality declining when mixed or private firms managed the water (Romano and Masserini, 2020). A Dutch study found that transparency and availability of more information about water treatment and quality increased consumer trust in water quality and that trust in water companies in the Netherlands was high. The researchers recommended that those entities communicate directly about water quality with their consumers and that they emphasize their treatment procedures (Brouwer, Hofman-Caris, and van Aalderen, 2020).

Research in Newfoundland, Canada, communities comparing residents' perception of water quality from public sources (collected using a telephone survey of 100 households) and actual quality of the water from those sources (using water quality reports from the same communities composed of 2,091 water samples) found no relation between perception of water quality and actual water quality. This study found that opinion of water quality differed within communities supplied by the same public water source—those from higher socioeconomic status as measured by income and education were more likely to be satisfied with the quality of their water compared with those from lower socioeconomic status (Ochoo, Valcour, and Sarkar, 2017). Another study among primarily tap and bottled water drinkers compared perceptions of water quality (using an online survey) and a blind taste test. The study found that, although tap and bottled water drinkers diverged in their perceptions of the quality, health risks, and taste of the

⁵ Tap water drinkers, for example, gave a trust rating of 7.60 compared with 5.26 for bottled water drinkers on a 9-point scale, on which higher values indicate greater trust—Cohen's *d* was 1.32. Note that Cohen's *d* is a quantitative measure of the magnitude of effect; values greater than 0.80 indicate large effects.

⁶ Various indicators of trust in government show that differences between the United States and Western Europe are difficult to untangle and vary across time. In some Western European countries, trust in government might be lower than in the United States, and in others, it might be higher. In addition, those numbers fluctuate over time. Data on trust in government are available from the OECD (n.d.) and the Pew Research Center (Wike et al., 2021), among other sources. Furthermore, the surveys that collect this type of information do not ask about trust in water management entities specifically.

two types of water, they were unable to tell the two types of water apart in the blind taste test (Debbeler et al., 2018).

Still, most U.S. households find their drinking and cooking water to be safe, as evidenced by previous questions on this topic in the AHS; more than 9 in 10 U.S. households reported their primary source of water for drinking and cooking to be safe in 2015, the last time this question was asked. In addition, a 2015 telephone survey of more than 1,200 U.S. adults asked about their perception of the quality of water in schools and parks. The survey asked if the water in schools and parks was safe to drink, if it tasted good or bad, and if they supported rules requiring schools and parks to provide access to drinking water throughout the day. More than 8 in 10 of those surveyed found the water in both schools and parks to be safe and tasty, and they supported requiring access to drinking water throughout the day (Long et al., 2016).

Who Trusts Their Water?

The 2013 AHS included questions on water quality perception. The questions focused on the household's source of drinking water, the householder's perception of the safety of their tap water for cooking and drinking, and the type of accessibility and monitoring of the unit's water heater. If the unit obtained water through a private well, the survey asked about the type of well and the number of units served by that well. Analyzing the data, Pierce and Gonzalez found that although the overwhelming majority of American householders (more than 90 percent) perceive their drinking and cooking water to be safe, perceptions of safety varied by key demographics (Pierce and Gonzalez, 2016): Immigrants (especially those from Latin American countries), native-born Hispanics, African-Americans, and other minority householders were more likely to distrust the quality of their drinking and cooking water compared with non-Hispanic Whites. In addition, lower respondent ratings of the quality of their housing units and neighborhoods corresponded to greater distrust of their water quality; residents of trailer parks were less likely to perceive their water to be safe. Households served by small, private water systems (fewer than 15 connections) were more likely to trust their tap water quality.

The 2015 AHS included the same questions, and Javidi and Pierce used those data to generate the first national estimates of drinking water alternatives used by households who perceived their tap water to be unsafe and the resultant cost of such perceptions (Javidi and Pierce, 2018). Their analysis found that—in addition to Hispanics and African-Americans—renters, those living in mobile homes, and public housing residents were more likely to perceive their tap water to be unsafe and confirmed that ratings of housing units and neighborhoods were positively correlated with perceptions of drinking water quality. An unsurprising finding was that those who perceived their tap water to be unsafe were more likely to use alternative sources, with bottled water being the most common go-to option. Javidi and Pierce estimated the cost of bottled water to avoid tap water amounts to be more than \$5 billion annually. Similar findings were evident in the 2010 HealthStyles Survey, a national mail survey of more than 4,000 U.S. adults, which showed that trusting the safety of drinking water differed significantly by age, race or ethnicity, and income (Onufrak et al., 2012). The 2015 Estilos survey of 1,000 U.S. Hispanic adults found that 34 percent of respondents did not think their home tap water was safe to drink, and 41 percent did not think their community tap water was safe to drink (Park et al., 2019). Approximately 65 percent thought that bottled water is safer than tap water, and 69 percent of respondents said that they would buy less bottled water if they knew their tap water was safe. The study concluded that negative perceptions of tap water are common among Hispanic households.

Although the analysis of the AHS data did not indicate perception of unsafe water to be related to source of the tap water, surveys conducted in Texas in 2008 and 2014 found that respondents using private sources of water, such as wells, were more likely to find their water to be safe compared with those obtaining their water from public sources; consumers of bottled water were significantly less likely to find their tap water to be safe (Gholson et al., 2018). Further evidence that well owners are more likely to perceive their water to be safe emerged in a survey comparing private well owners (N=167) to consumers supplied by the public water system (N=195) and members of a group water scheme (N=160). Private well owners not only found their water to be superior but also felt they had more control over their water quality; those feelings might suppress their perception of risk in relation to water quality. The study found that well owners who felt they had more control over their water quality were also more likely to maintain their wells more frequently (Schuitema, Hooks, and McDermott, 2020).

A statewide 2020 online survey of more than 3,800 low-income mothers in Michigan (sampled from those who had given birth at the University of Michigan between 2016 and 2020) found that 11 percent of those mothers perceived their tap water to be unsafe for drinking, and another 22 percent were unsure; mothers with friends and family in Flint were more likely to find their tap water unsafe. Those negative perceptions were correlated to greater use of bottled water for drinking and preparing baby formula, as well as higher consumption of sugar-sweetened beverages. On average, those mothers spent \$27 per month on bottled water (Bauer et al., 2021). Earlier studies, such as the one conducted by Hu, Morton, and Mahler (2011), demonstrated that U.S. consumers are more likely to report using bottled water for drinking when they perceive their drinking water is unsafe.

A recent study looked at the relationship between the presence of retail water stores in neighborhoods across 8,000 census tracts in California and merged that information with tract-level socioeconomic indicators available from the 2011–2015 American Community Survey 5-year estimates and local water quality data (Pierce and Lai, 2019). The study concluded that the location of retail water stores in urbanized neighborhoods does not appear to be strongly related to observed measures of water quality as reported to the U.S. Environmental Protection Agency (EPA) Safe Drinking Water Information System (SDWIS). Still, the study found strong evidence that “the presence and popularity of retail water stores are most influenced by neighborhood indicators of disadvantaged socioeconomic status, most notably foreign-born status and citizenship.” The study also noted that use of alternative water sources is not tied to actual water quality. In addition, a study looking at the relationship between bottled water sales and county-week observations of water quality violations (as measured by the presence of nitrates in the water) in 2,151 U.S. counties from 2006 to 2015 found that violations that present an immediate health risk are associated with a 14-percent increase in sales of bottled water (Allaire et al., 2019) and that greater tap water aversion actions are taken when the risks are greater and require immediate public notification. Rural and low-income communities are less likely to take such aversion actions, even though they might be exposed to higher nitrate levels.

Finally, a study in Appalachia, looking mainly at the quality of spring water in the region, surveyed households in the area about their source of water and their perceptions of water quality. All but 2 of the 35 households in the survey reported access to either public water or private wells; those 2 households reported filling cisterns from area springs for their water needs. Many households reported using the spring water for drinking because they preferred the taste, found it to be of higher quality, or perceived the spring water to have health benefits (Krometis et al., 2019).

Surveys on the Perception of Water Quality

Although public water management organizations routinely collect data on actual water quality (see next section for more details) that are reported to state and federal agencies charged with ensuring the safety of water, no regular household surveys at the state or federal level ask consumers about their perceptions of water quality. The AHS is the only federal survey that includes questions on the perception of water quality as a part of its Healthy Homes module. Questions on the perception of water quality have also been asked in years when questions from the Healthy Homes module were not asked, such as in 2013. The questions on water quality focused on the household's source of drinking water, the householder's perception of the safety of their tap water for cooking and drinking purposes, and the type of accessibility and monitoring of the unit's water heater. If the unit obtains water through a private well, the survey asked about the type of well and the number of units served by that well.

A search of the Inter-university Consortium for Political and Social Research (ICPSR) database found no survey questions on this topic in the past decade.⁷ Still, several studies conducted on water quality perception at the local level (primarily in cities or towns) have asked these questions, and some nonprofits and local water authorities also survey consumers from time to time about their perception of water quality. The following tables provide an overview of the questions asked in various surveys, along with available information on how or if those items had been tested.

2021 American Community Survey—U.S. Census Bureau	
<i>Testing Information:</i> The U.S. Census Bureau cognitively tests all survey items before fielding, so the following questions have been cognitively tested.	
Does this house, apartment, or mobile home have—	
Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
	a. Hot and cold running water?
<input type="checkbox"/>	<input type="checkbox"/>
	b. A bathtub or shower?
<input type="checkbox"/>	<input type="checkbox"/>
	c. A sink with a faucet?
<input type="checkbox"/>	<input type="checkbox"/>
	d. A stove or range?
<input type="checkbox"/>	<input type="checkbox"/>
	e. A refrigerator?

⁷ ICPSR maintains a data archive of more than 250,000 files of research in the social and behavioral sciences. It hosts 21 specialized collections of data in education, aging, criminal justice, substance abuse, terrorism, and other fields, and its archives include public and privately funded survey data. Information is available at <https://www.icpsr.umich.edu>.

2021 American Community Survey—U.S. Census Bureau

In the past 12 months, what was the cost of water and sewer for this house, apartment, or mobile home?

\$ _____. OR

Included in rent or condominium fee.

No charge.

Note: HUD is likely aware of these items, and these items do not address perception of water quality, but they were included here to indicate the coverage available in federal surveys on water services and water quality perceptions.

UNICEF/World Health Organization Joint Monitoring System—Water, Sanitation, and Hygiene (WASH) (Household)⁸

Testing Information: The WASH surveys are designed to be administered in person and have been tested and validated in a variety of contexts (such as schools in Indonesia; UNICEF and World Health Organization, 2016⁹), although likely not in the United States. These instruments are used by the United Nations, the U.S. Agency for International Development, and the World Bank (among others) to monitor Sustainable Development Goals regarding access to clean drinking water.

What is the **main** source of drinking water for members of your household?

Piped water.

Dug well (protected or unprotected).

Water from spring (protected or unprotected).

Rainwater collection.

Delivered water.

Water kiosk.

Packaged water (bottled or sachet).

Other (specify).

Note: The instrument includes subcategories for each of these categories, which are not necessarily relevant to the U.S. context. Some potentially relevant categories have been included in parentheses.

What is the **main** source of water used by members of your household for other purposes, such as cooking and handwashing?

Piped water.

Dug well (protected or unprotected).

Water from spring (protected or unprotected).

Rainwater collection.

Delivered water.

⁸ For more information, see <https://www.unwater.org/publications/who-unicef-joint-monitoring-program-for-water-supply-sanitation-and-hygiene-jmp-progress-on-household-drinking-water-sanitation-and-hygiene-2000-2020/>.

⁹ The report indicates that survey questions were tested in Indonesia, and additional validation work should continue; testing methodology and results from the Indonesia study do not seem to be publicly available.

UNICEF/World Health Organization Joint Monitoring System—Water, Sanitation, and Hygiene (WASH) (Household)⁸

Water kiosk.
Packaged water (bottled or sachet).
Other (specify).

Note: The instrument includes subcategories for each of these categories, which are not necessarily relevant to the U.S. context. Some potentially relevant categories have been included in parentheses.

Have you or any other household members done anything to this water to make it safer to drink?

Yes.
No.
Don't know.

What do you usually do to the water to make it safer to drink? Record all methods used.

Boil.
Add bleach/chlorine.
Strain it through cloth.
Use water filter.
Solar disinfection.
Let it stand and settle.
Other (specify).

Is the water supplied from your main source [insert source] usually acceptable? If unacceptable, select the main reason.

Yes, acceptable.
No, unacceptable taste.
No, unacceptable color.
No, unacceptable smell.
No, contains materials.
No, other (specify).
Don't know.

American Water Works Association (AWWA)

Conducted June 2021 by Morning Consult¹⁰

Note: Only a subset of the questions asked in the survey are presented below, as these questions are most relevant to perceptions of water quality. The survey also asks other questions regarding water, which have not been included here.

¹⁰ A similar survey sponsored by AWWA and fielded by Morning Consult asked several open-ended questions regarding why respondents rated their water quality the way they did; presumably, some of the 2021 questions were derived from that list. In open-ended items in the 2020 survey (<https://www.awwa.org/Portals/0/AWWA/Communications/23001PDFEdits-1.pdf>), respondents detailed finding their water quality to be “excellent” or “good” because it tasted good, it was clear and clean, there was no harsh taste, and/or it did not leave residue. They found the water quality to be “fair” or “poor” because it tasted bad, was sometimes cloudy, smelled bad, was discolored, had heavy mineral content, and/or tasted like chemicals.

American Water Works Association (AWWA)

Testing Information: The survey was conducted online. Information on item testing is not available.

In your view, how safe or unsafe is the water at your faucet?

- Very safe.
- Somewhat safe.
- Don't know/No opinion.
- Somewhat unsafe.
- Very unsafe.

Thinking about the past 5 years, has the safety of your water supply gotten better or worse or has the level of safety stayed about the same?

- Gotten better.
- Stayed about the same.
- Gotten worse.
- Don't know/No opinion.

Would you say you are generally satisfied or dissatisfied with the water at your faucet?

- Very satisfied.
- Somewhat satisfied.
- Don't know/No opinion.
- Somewhat dissatisfied.
- Very dissatisfied.

Which of the following best describes the water you drink from your faucet? Please select all that apply.

- Clear.
- Clean.
- Convenient.
- Safe.
- Cold.
- Refreshing.
- Satisfying.
- Enjoyable.
- Low Quality.
- High Quality.
- Tasteful.
- Pure.
- Cloudy.
- Unsafe.
- Smells.
- Warm.
- Disgusting.
- Dirty.
- Musty.

American Water Works Association (AWWA)

None of the above.

Do you agree or disagree with the following statements about the water at your faucet?

Strongly agree.

Somewhat agree.

Don't know/No opinion.

Somewhat disagree.

Strongly disagree.

- a. My tap water is convenient.
- b. My tap water does not have an odor.
- c. My water pressure is good.
- d. I know the name of my water utility.
- e. My water supply is reliable.
- f. My tap water is affordable.
- g. My tap water is safe to drink.
- h. I trust the source of my water.
- i. I trust my water utility.
- j. My tap water tastes good.
- k. I know where my water comes from.
- l. I trust my utility company to update my water infrastructure.
- m. I trust my state and local government to permit the updating of my water infrastructure.
- n. I trust the Environmental Protection Agency (EPA) to appropriately...¹¹
- o. My tap water is safer than it was 10 years ago.
- p. I trust the federal government to appropriately regulate my water supply.
- q. My tap water has natural minerals that are good for me.

Would you say you are generally satisfied or dissatisfied with your water provider?

Very satisfied.

Somewhat satisfied.

Don't know/No opinion.

Somewhat dissatisfied.

Very dissatisfied.

If you wanted to learn more about your water supply, which TWO sources would you use to find more information? Select up to two.

The water utility company's website.

Internet search engines.

Local government websites.

State government websites.

Local news sources.

Friends, family, and neighbors.

Social media.

¹¹ Full text of question is not available.

American Water Works Association (AWWA)

Federal agency websites.
 Nonprofit websites.
 Other.

Besides a utility bill, do you remember receiving any communication from your water utility provider?

Yes, in the past week.
 Yes, in the past month.
 Yes, in the past six months.
 Yes, in the past year.
 No, no recent communication.
 Don't know/No opinion.

Where do you get your water supply?

Public water supply.
 Private well.

How often do you drink water from each of the following?

Several times a day.
 About once a day.
 A few times a week.
 About once a week.
 About once a month.
 Every few months or less often.
 Never.

- a. Bottled water.
- b. A water filtering system (i.e., filtered pitcher, faucet-mounted filter, fridge dispenser).
- c. The water at your faucet.

Note: The order of questions in the survey is unknown, as the questions were obtained from the publicly available report.

2010 HealthStyles Survey

Testing Information: According to the fact sheet about the survey, the DDB Needham Lifestyles survey was an annual survey with approximately 300–400 questions examining constructs such as perceived personality traits, media and shopping habits, political beliefs, and other consumer characteristics. Items are developed in consultation with health-related organizations, including the Centers for Disease Control and Prevention, and may vary from year to year.

Respondents were asked to indicate if they Agreed, Disagreed, or were Neutral regarding the following statements:

- a. My local tap water is safe to drink.
- b. Bottled water is safer than tap water.

2010 HealthStyles Survey

Note: The complete survey instrument was not available—these items were extracted from the narrative in the journal article (Onufrak et al., 2012).

Survey of Perceptions and Attitudes about Water Issues in Oklahoma¹²

Testing Information: Information on instrument testing is unavailable.

Respondents were asked what were presumably binary Yes/No questions:

Do you feel your home tap water is safe to drink?

I am satisfied with my home drinking water (piped in house).

I test my home drinking water.

I use a water treatment or filter system.

Note: The complete survey instrument was not available—these items were extracted from the narrative in the journal article (Eck et al., 2019).

Public Perceptions of Water Quality in Iowa: A Statewide Survey

Instrument Testing: The survey methodology section in the report does not provide any information on instrument testing but notes that the instrument was developed on the basis of findings from focus groups.

I am going to read a list of issues that are viewed by some as problems IN IOWA. As I read each one, please tell me if you think it is not a problem at all, a small problem, a moderate problem, or a very big problem in YOUR AREA. Would you say poor quality of drinking water is not a problem, a small problem, a moderate problem, or a very big problem in your area?

Not a problem.

Small problem.

Moderate problem.

Very big problem.

In the city or area where you live, are you satisfied or dissatisfied with the quality of the water?

Satisfied.

Dissatisfied.

What aspects of the water would you say are unsatisfactory? Check all that apply.

Bad taste.

Worried about contamination/Chemicals/Bacteria.

Too hard/High mineral content.

Smell, chlorine.

Not clear/Bad color/Cloudy water.

Smell, odor/Sulphur/Rotten egg smell.

Particulate matter floating in it/Floaties/Specks.

¹² Eck et al., 2019.

Public Perceptions of Water Quality in Iowa: A Statewide Survey

- Algae.
- Too soft/Etches glasses/Film or milky color on glassware.
- High iron/Rust/Discolors clothing, appliances.
- Unsafe/Can't filter/Don't trust.
- Dead fish/No fish.
- Too expensive.
- Trash/Waste.
- Other.
- Don't know/Not sure.

Overall, would you say water quality in Iowa is poor, fair, good, or excellent?

- Poor.
- Fair.
- Good.
- Excellent.

Roanoke Study Survey

Instrument Testing: The survey was pretested with 60 respondents, and the questions were refined as needed before fielding. No findings from the pretest were published.

Roanoke Study Survey

The survey measured trust, risk perception, salience, and evaluation of tap water quality.

Trust:

Measured using two items—the extent to which “you trust your local water utility to provide drinking water to your home that is safe to drink” and the degree of comfort with “your local water utility controlling the quality of water delivered to your home” on a nine-point scale from 1 = *Do not trust at all/Not comfortable at all* to 9 = *Completely trust/Completely comfortable*.

Risk:

“Cognitive safety assessed the residents’ beliefs about the likelihood of tap water safety issues by asking the respondents to rate how safe they believed their water was from 1 = *Completely unsafe to drink* to 5 = *Completely safe to drink*. The affective safety item asked how concerned the residents were about their tap water safety (1 = *No concern* to 5 = *Extremely concerned*). To identify how severely the residents believed a public water disturbance could impact their lives, the respondents indicated how they would react cognitively (inconvenience and daily routine change) and affectively (worry and anger) and if they found themselves unable to access tap water in their homes. We measured these items on a 5-point Likert-type scale from 1 = *Not at all* to 5 = *A great deal*. Lastly, to measure comparative risk, we chose to focus on the risk of drinking bottled water compared to tap water. The respondents ranked tap water on a 5-point Likert-type scale from 1 = *More safe* to 5 = *Less safe*.”

Salience:

“Drawing from Stewart’s (2009) salience framework, we measured attention by asking how often respondents noticed unacceptable changes in their tap water in terms of taste, smell, and appearance (1 = *Never* to 5 = *Extremely often*) and unacceptable changes in their tap water in general (1 = *Never* to 4 = *Often*). We measured knowledge of water topics by asking the residents the amount of information they could provide to a friend or family about their neighborhood water quality (1 = *No information* to 5 = *A great deal of information*).”

Tap Water Quality Evaluations:

“Tap water quality evaluations were measured on a 5-point Likert-type scale of acceptability. Respondents rated how acceptable their water was overall and in specific terms of taste, smell, appearance, and safety (1 = *Not acceptable* to 5 = *Completely acceptable*).”

Note: The complete survey instrument was not available—the information in the paper describing the survey items is presented above (Grupper, Schreiber, and Sorice, 2021).

Survey on Water Quality Perception and Private Well Management

Instrument Testing: Piloted using the Qualtrics soft launch with 50 respondents before proceeding to the full survey. Reliability testing showed that the scales were reliable with Cronbach's alpha of over 0.70.

The following items were asked on a Likert scale:

Perceived water quality:

How would you rate the quality of your drinking water?

Perceived Risks: (*Cronbach's alpha = 0.70*)

My water is generally free from contaminants.

My water is a health risk.

My drinking water contains chemicals.

My drinking water contains contaminants.

Worry: (*Cronbach's alpha = 0.85*)

I worry about contamination of my drinking water.

I worry about harmful chemicals in my drinking water.

I worry about the quality of my drinking water.

Perceived Control: (*Cronbach's alpha = 0.79*)

I'm best placed to manage my water quality.

Contamination of my drinking water is not easy to detect and contain.

I feel in control over my water quality.

Current Maintenance Behavior: (*Cronbach's alpha = 0.84*)

How often do you carry out the following types of maintenance on your well?

Water test.

Clean filter.

Inspect well head.

Inspect pipes/valves/filters.

Replace pump.

Intention to Maintain Well: (*Cronbach's alpha = 0.79*)

If you suspect there is an issue with your drinking water, please rate the following actions on the likelihood of you undertaking them:

Get water tested.

Install a filter system.

Carry out maintenance/check system.

Note: The complete survey instrument was not available—the information in the paper is extracted from the published paper (Schuitema, Hooks, and McDermott, 2020).

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

Instrument Testing: The questions were tested using a variety of methods. Some questions in the survey were established questions from other surveys, and the research team tested new questions on a sample before launching and correlated the results with other questions. No cognitive testing was conducted, however.

- Q1. When it comes to drinking water at your house, which of the following do you use? (Check all that apply)
1. Water out of the tap without a filter.
 2. Water out of the tap with a filter (Brita, reverse osmosis system, refrigerator front, water ionizer).
 3. Bottle water.
 4. Well water.
 5. Other.
 6. Don't know.
 7. No answer.
- Q2. When it comes to cooking, making coffee or tea, which of the following do you use? (Check all that apply)
1. Water out of the tap without a filter.
 2. Water out of the tap with a filter (Brita, reverse osmosis system, refrigerator front, water ionizer).
 3. Bottle water.
 4. Well water.
 5. Other.
 6. Don't know.
 7. No answer.
- Q3. About how much do you pay for bottled water used at your home each month?
* Emphasize only water bottles consumed in household.
1. \$ _____ per month.
 2. Don't know.
 3. No answer.
- Q4. If you have one, why do you use a water treatment device in your home? [Do not read choices. Check all that apply]
1. To improve the taste.
 2. To remove contaminants.
 3. To make it look clearer.
 4. To make it smell better.
 5. Already installed.
 6. Water at my house is low quality.
 7. Other.
 8. Do not have a water treatment device. (SKP to Q6)
 9. Don't know. (SKP to Q7)

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

10. No answer. (SKP to Q7)
- Q5. How much do you spend each month on the water treatment device and supplies?
1. \$_____ per month. (SKP to Q7)
 2. Don't know. (SKP to Q7)
 3. No answer. (SKP to Q7)
- Q6. There are many reasons why people choose not to treat their water. Please tell me why you do not treat your water. [Do not read choices. Check all that apply]
1. Water treatment systems are too expensive.
 2. It's too difficult or time consuming to choose a treatment system or device.
 3. I'm not convinced that in-home water treatment devices work well enough to satisfy me.
 4. I'm already satisfied with my tap water quality.
 5. We don't drink our tap water at all—we use bottled water.
 6. Other (specify) _____.
 7. Don't know.
 8. No answer.
- Q7. How strongly do you agree or disagree with the following statements? Keep in mind this is for taps without water treatment systems.
- Your tap water is perfectly safe to drink.
1. Strongly agree.
 2. Somewhat agree.
 3. Neither agree nor disagree.
 4. Somewhat disagree.
 5. Strongly disagree.
 6. Don't know.
 7. No answer.
- Q8. Your tap water has a foul smell. Keep in mind this is for taps without water treatment systems.
1. Strongly agree.
 2. Somewhat agree.
 3. Neither agree nor disagree.
 4. Somewhat disagree.
 5. Strongly disagree.
 6. Don't know.
 7. No answer.
- Q9. Your tap water is contaminated. Keep in mind this is for taps without water treatment systems.
1. Strongly agree.
 2. Somewhat agree.

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

3. Neither agree nor disagree.
4. Somewhat disagree.
5. Strongly disagree.
6. Don't know.
7. No answer.

Q10. The government does not know how bad the tap water quality is. Keep in mind this is for taps without water treatment systems.

1. Strongly agree.
2. Somewhat agree.
3. Neither agree nor disagree.
4. Somewhat disagree.
5. Strongly disagree.
6. Don't know.
7. No answer.

Q11. There is nothing that you can do about the tap water quality. Keep in mind this is for taps without water treatment systems.

1. Strongly agree.
2. Somewhat agree.
3. Neither agree nor disagree.
4. Somewhat disagree.
5. Strongly disagree.
6. Don't know.
7. No answer.

Q12. Have you heard about any potential problems that your town or city supplier has, or had, with their water supply?

1. Yes.
2. No. [SKP to Q14]
3. Don't know. [SKP to Q14]
4. No answer. [SKP to Q14]

Q13. How did you learn about potential problems in the tap water? [Do not read choices. Check all that apply.]

1. I read about it the newspaper.
2. I saw a story on the television.
3. I read about it in a magazine.
4. I saw it on social media.
5. I read a letter from my water supply company about this.
6. I was told about it by a friend or relative.
7. I first learned about it by reading the information brochure.
8. Other source _____.

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

9. Don't know.
10. No answer.

Q14. Using a scale of 1 to 5, where ONE means you are not at all concerned and FIVE means you are very concerned, how concerned are you about you or another member of your family getting sick from drinking water contamination?

1. Not at all concerned.
- 2.
- 3.
- 4.
5. Very concerned.
6. Don't know.
7. No answer.

Q15. How concerned are you about you or another member of your family dying from drinking water contamination?

1. Not at all concerned.
- 2.
- 3.
- 4.
5. Very concerned.
6. Don't know.
7. No answer.

Q16. On your JEA [energy company] utility bill, how much do you pay for water per month?

- \$_____per month. OR
Water is included with the rent.
Don't know.
No answer.

Q17. How much of an increase in your monthly water bill would you be willing to pay to improve the quality of your water?

1. \$15. [SKP to Q19]
2. \$10. [SKP to Q19]
3. \$5. [SKP to Q19]
4. \$3. [SKP to Q19]
5. \$2. [SKP to Q19]
6. \$0.
7. Don't know. [SKP to Q19]
8. No answer. [SKP to Q19]

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

Q18. Which reason best explains why you would not be willing to pay an increase in your water bill? (Check all that apply)

1. I don't think that the tap water is unsafe.
2. I already have a home filter that removes water contaminations.
3. I already, or will, drink bottled water instead.
4. I don't have one yet, but I would rather just have a reverse osmosis or distillation treatment system put in our home.
5. I think someone else should pay for this treatment, not me.
6. I just don't have that much money I can pay each month.
7. Other reason: _____.
8. Don't know.
9. No answer.

Q19. Do you think the tap water quality can be improved?

- Yes.
No.
Don't know.
No answer.

Before Response [If Q1=1 Skip Q21]

Q20. If the quality of the tap water were improved, would you start drinking tap water?

1. Yes.
2. No.
3. Don't know.
4. No answer.

Q21. How much of the time do you think you can trust Florida's state government to do what is right?

- Just about always.
Most of the time.
Only some of the time.
Never.
Don't know.
No answer.

Q22. How much of the time do you think you can trust the City of Jacksonville to do what is right?

- Just about always.
Most of the time.
Only some of the time.
Never.
Don't know.
No answer.

2016 Duval County (City of Jacksonville), Florida Willingness to Pay for Safe Drinking Water: A Contingent Valuation Study

Q23. How much of the time do you think you can trust the Environmental Protection Agency to do what is right?

1. Just about always.
2. Most of the time.
3. Only some of the time.
4. Never.
5. Don't know.
6. No answer.

Q24. How much of the time do you think you can trust JEA to do what is right?

1. Just about always.
2. Most of the time.
3. Only some of the time.
4. Never.
5. Don't know.
6. No answer.

Q25. In general, how certain are you of the answers you just gave to the questions on this survey?

1. Very certain.
2. Somewhat certain.
3. Somewhat uncertain.
4. Very uncertain.
5. Don't know.
6. No answer.

Kent County, Washington Water Quality Survey¹³

Instrument Testing: No evidence indicates that these survey items have been cognitively tested.

This survey is an example of surveys used by local water utilities to collect customer satisfaction information.

Has the water quality in Kent improved during the past 12 months?

- Better.
- Worse.
- No Change.

How do you rate the quality of Kent's water in regard to the criteria questions below?

- Excellent.

¹³ For more information, see <https://www.kentwa.gov/Home/Components/Form/Form/abd1bc5031434a08ace847be5f07bdfd/>.

Kent County, Washington Water Quality Survey¹³

Acceptable.
 Poor.
 Taste.
 Odor.
 Color and Clarity.
 Water Pressure Fluctuations.

How often have you been unable to use your water because of a shutdown?

Never.
 Occasionally (1–2 times/year).
 Frequently (3–5 times/year).

Do you feel the information provided in the Water Quality Report was useful?

Not at all.
 Definitely.
 Somewhat.

Do you have any questions or concerns about Kent's water quality?

[OPEN-ENDED]

Actual Water Quality Data

Although several studies exist that measure the perception of drinking water and behaviors tied to those perceptions (such as the use of alternative sources of drinking water), this literature review revealed only one study, conducted by Pierce and Lai (2019), that compared people's use of alternative sources of drinking water with actual data about water safety. That study found that use of alternative water sources is not tied to actual water quality. Actual water quality data are available from all jurisdictions in the United States in a centralized, federal database.

The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974, and later amended in 1986 and 1996, to protect public health by regulating the nation's public drinking water supply. The SDWA requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. The Act does not regulate private wells that serve fewer than 25 individuals, however. The SDWA authorizes EPA to set national health-based standards for drinking water to protect against both naturally occurring and manmade contaminants that may be found in drinking water. EPA, states, and water systems work together to make sure that these standards are met.

The SDWA requires states to report drinking water information from all water systems within their jurisdiction (that is, all public water systems in the state) to EPA periodically. That information is maintained in the Safe Drinking Water Information System (SDWIS). For each public water system within their jurisdiction, states are required to report the following information:

- Basic information about each public water system, including—
 - System name.

- o ID number.
 - o City or county served.
 - o Number of people served.
 - o Type of system (residential, transient, nontransient).
 - o Whether the system operates year-round or seasonally.
 - o Characteristics of the system’s source of water.
- Violation information for each public water system, including whether the system has—
 - o Failed to follow established monitoring and reporting schedules.
 - o Failed to comply with mandated treatment techniques.
 - o Violated any maximum contaminant levels.
 - o Failed to communicate required information to their customers.
 - Enforcement information, including actions that states or EPA has taken to ensure that a public water system returns to compliance if it is in violation of a drinking water regulation.

These data are available at <https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting>. Exhibit 1 shows the SDWIS information for the public water systems in Washington, D.C.

Exhibit 1. Safe Drinking Water Information System, District of Columbia

PWS ID	PWS Name	PWS Type ↑	Primary Source	Counties Served	Cities Served	Population Served Count	Number of Facilities	Number of Violations	Number of Site Visits
DC0000002	D.C. WATER AND SEWER AUTHORITY	Community water system	Surface water purchased	District of Columbia	-	632,323	15	29	9
DC0000004	JOINT BASE ANACOSTIA - BOLLING	Community water system	Surface water purchased	District of Columbia	-	16,559	6	15	5
DC0000003	NAVAL STATION WASHINGTON - WNY	Community water system	Surface water purchased	District of Columbia	-	15,690	3	20	10
DC0000001	WASHINGTON AQUEDUCT DIVISION.	Community water system	Surface water	District of Columbia	-	0	29	6	10
DC0000005	NAVAL OBSERVATORY	Non-Transient non-community system	Surface water purchased	District of Columbia	-	250	3	11	6
						664,822			

Source: Safe Drinking Water Information System

SDWIS allows the user to obtain data for all jurisdictions and download them as a CSV (comma-delimited), HTML, or PDF file. It includes data from 144,140 public water systems in the country. Because the dataset includes the cities and counties served by each public water system, AHS data likely can be linked at the city or county level with data in SDWIS, although some jurisdictions might be served by more than one public water system (see exhibit 2).

Exhibit 2. Safe Drinking Water Information System Screenshot

PWS ID	PWS Name	PWS Type ↑	Primary Source	Counties Served	Cities Served	Population Served Count	Number of Facilities	Number of Violations	Number of Site Visits
AZ0407280	67 AVE PROPERTY OWNERS ASSOCIATION	Community water system	Ground water	Maricopa	PHOENIX	40	4	68	19
AZ0409032	A PETERSEN WATER COMPANY	Community water system	Ground water	Navajo	SNOWFLAKE	112	6	82	15
AZ0403087	A1 RANCH HOMEOWNERS ASSOCIATION INC.	Community water system	Ground water	Coconino	FLAGSTAFF	45	4	1	0
AZ0413001	ABRA WATER COMPANY	Community water system	Ground water	Yavapai	PAULDEN	1,658	10	131	18
AZ0413055	ACME WATER - BLUE HILLS	Community water system	Ground water	Yavapai	COTTONWOOD	138	8	84	10
AZ0413077	ACME WATER - YAVAPAI ESTATES	Community water system	Ground water	Yavapai	CHINO VALLEY	243	10	69	20
AZ0407001	ADAMAN MUTUAL WATER COMPANY	Community water system	Ground water	Maricopa	ADAMAN	700	10	160	24
AZ0407307	ADJC ADOBE MOUNTAIN SCHOOL	Community water system	Ground water	Maricopa	PHOENIX	500	7	156	12
AZ0405303	ADOC ASPC FORT GRANT	Community water system	Ground water	Graham	BONITA	800	13	835	27
AZ0411705	ADOC EYMAN UNIT	Community water system	Ground water	Pinal	FLORENCE	5,100	8	428	21
AZ0411066	ADOC FLORENCE ASP	Community water system	Ground water	Pinal	FLORENCE	4,000	11	328	21

Source: Safe Drinking Water Information System

Many municipalities, research groups, and organizations collect data on the quality of natural water sources, which often are the source of drinking water. Many of those researchers and organizations use nonstandard or inconsistent data descriptions and structures, however. EPA, along with the U.S. Geological Survey and the National Water Quality Monitoring Council, has created a data portal where water quality data can be collected in a standardized way. The Water Quality Portal is the largest standardized water quality dataset, with more than 290 million records from more than 2.7 million sites in groundwater, inland, and coastal waters. Data are submitted by more than 900 federal, state, and tribal agencies; watershed organizations; and other groups. The data can be accessed at <https://www.epa.gov/waterdata/water-quality-data>.

Conclusion and Recommendations

As the preceding review shows, no federal surveys ask households about their perception of the quality of their tap water. Public authorities collect and compile actual water quality data (both tap and source water) that are available in federal data portals. Overall, U.S. tap water is of good quality, with almost all public water systems in compliance with EPA standards for drinking water quality.

Most American consumers have favorable views of their water quality, but a significant minority have negative perceptions. Those consumers with negative views disproportionately tend to be ethnic or racial minorities and those with low incomes. Those households, in turn, are more likely to turn to expensive and environmentally damaging alternatives, such as bottled water. Because residents' decisions about water consumption are dependent on their perception of its quality, including information on water quality perception is important in public policy decisionmaking on this issue. Gaining a better understanding of the drivers of water quality perception and trust in tap water is in the interest of the public to mitigate unnecessary, environmentally damaging, and expensive behaviors.

Because no other federal survey asks about the perception of water quality and the resulting behaviors, HUD could include a module of questions that would provide data to determine and track the link between consumers' perception of local-level communication regarding water quality, the effectiveness of the frequency of receiving such information, and other factors that

link perception and consumption. The AHS is particularly well suited for those questions because the survey already collects information on the water and plumbing systems in the home alongside other housing characteristics, such as the age of the home, that might be important indicators of water quality. Thus, the author recommends that HUD include a module of questions in the AHS to help understand this phenomenon.

Because the research shows that drivers of drinking water quality perceptions are related to sensory qualities such as the look, taste, color, and odor of the water and that other factors such as receiving information on water from the water utility organization or trust in the utility also influence perceptions of water quality, the author recommends survey questions focused on the following topics:

- Primary source of drinking water (keep the current AHS question on the source of most of the water in the unit).
- Alternative sources of drinking water.
- Frequency of use of various sources of drinking water, including tap and bottled water.
- Perception of tap water.
 - Overall perception of safety.
 - Perception of—
 - Look.
 - Taste.
 - Color.
 - Odor.
- Recall of receiving information on water quality from water utility organization.
- Trust in water utility organization.

SUGGESTED QUESTIONS FOR A POTENTIAL “PERCEPTION OF DRINKING WATER SAFETY” MODULE

On the basis of a review of surveys that have asked questions related to perceptions of drinking water safety and the suggested topics on which a module of questions on this topic should be focused, the following are some questions suggested for inclusion.

Source of Drinking Water and Frequency of Use of Various Sources:

1. Does most of the water for this housing unit come from a water system, either public or private; from an individual well; or from some other source?
 - Public or private water system.
Consider splitting this category into one for public and another for private water systems.
 - Individual well.
 - Spring.
 - Cistern.
 - Stream or lake.

- Commercial bottled water.
 - Other (specify): _____.
2. Where do you get your water for drinking?
Note: Change universe to ask of all respondents being asked questions in the module.
- Unfiltered tap water.
 - Filtered tap water.
 - Commercial bottled water.
 - Other (specify): _____.
3. When you are at home, do you regularly use any other sources of water for drinking?
- Unfiltered tap water.
 - Filtered tap water.
 - Commercial bottled water.
 - Other (specify): _____.
4. How often do you drink water from each of the following?
- Several times a day.
About once a day.
A few times a week.
About once a week.
About once a month.
Every few months or less often.
Never.
- a. Bottled water.
 - b. A water filtering system (e.g., filtered pitcher, faucet-mounted filter, fridge dispenser).
 - c. The water at your faucet.

Perception of Tap Water

1. In your view, how safe or unsafe is your tap water?
- Very safe.
 - Somewhat safe.
 - Don't know/No opinion (VOLUNTEERED).
 - Somewhat unsafe.
 - Very unsafe.
2. Thinking about the past 5 years, has the safety of your tap water gotten better or worse, or has the level of safety stayed about the same?
- Gotten better.
 - Stayed about the same.
 - Gotten worse.
 - Don't know/No opinion.

3. Would you say you are generally satisfied or dissatisfied with your tap water?
- Very satisfied.
 - Somewhat satisfied.
 - Don't know/No opinion (VOLUNTEERED).
 - Somewhat dissatisfied.
 - Very dissatisfied.
4. Please tell me if you agree or disagree with the following statements. How strongly do you agree or disagree?
- Strongly agree.
Somewhat agree.
Don't know/No opinion (VOLUNTEERED).
Somewhat disagree.
Strongly disagree.
- RANDOMIZE*
- a. My tap water does not have an odor.
 - b. My tap water is clear.
 - c. I do not like the color of my tap water.
 - d. My tap water tastes good.
 - e. My tap water has natural minerals that are good for me.
 - f. Bottled water is safer than my tap water.

Water Supply Organization: Receipt of Information and Trust in Organization

1. Besides a utility bill, do you remember receiving any communication about the safety of your drinking water from your water utility provider? When?
- Yes, in the past week.
 - Yes, in the past month.
 - Yes, in the past 6 months.
 - Yes, in the past year.
 - No, no recent communication.
 - Don't know/Don't remember.
2. Would you say you are generally satisfied or dissatisfied with your water provider?
- Very satisfied.
 - Somewhat satisfied.
 - Don't know/No opinion.
 - Somewhat dissatisfied.
 - Very dissatisfied.
3. If you wanted to learn more about your water supply, which TWO sources would you use to find more information? *Select up to two.*
- The water utility company's website.
 - Internet search engines.

- Local government websites.
 - State government websites.
 - Local news sources.
 - Friends, family, and neighbors.
 - Social media.
 - Federal agency websites.
 - Nonprofit websites.
 - Other (specify): _____.
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U.S. Department of Housing and Urban Development
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Washington, DC 20410-6000



August 2022