

The Efficacy of Water Quality Communication:
A Case Study of the Choctaw Lake Community

Paige Hagley

Advisor: Jeremy Brooks

School of Environment and Natural Resources

ABSTRACT

Harmful algal blooms in the United States have been increasing in number and economic cost in recent decades. Lake communities in Ohio are struggling to combat the causes of the growth in cyanobacteria populations. There is broad recognition of the importance of effective and strategic scientific communication to help address or prevent environmental problems. There are a variety of ways to inform the public about environmental problems, and such communication has the potential to improve the environmental literacy of the public and to increase support for regulations to address environmental problems. However, different sources of information can have different impacts based, in part, on the degree to which individuals trust these sources. The small community of approximately 700 households at Choctaw Lake near London, Ohio, is experiencing an increase in harmful algal blooms and presence of toxins in the lake. A Lake Water Quality Committee was formed in 2012 to address these problems and work with the public to create rules and regulations to protect water quality. Given the variety of means of communication available it is important to understand where residents are getting their information about water quality, how much they trust various sources, and what this means for their attitudes towards water quality and attempts to improve it. The study explored sources of water quality information and the levels of trust in these sources in this community. This research seeks to add to the literature on water quality communication in regard to harmful algal blooms and to provide a framework for future communication efforts by the Lake Water Quality Committee.

INTRODUCTION

Environmental communication is important for increasing public knowledge of science and scientific policy. This knowledge can contribute to solving and preventing environmental problems (Gregory & Miller, 1998; Miller, 1986; Tobey, 1971). Providing accurate scientific information, can also improve environmental decision-making by changing attitudes to promote changes in behavior. When faced with environmental risks and hazards, effective environmental communication can also increase support for policies. For instance, in relation to Superfund sites in particular, “inadequate communication with the public and a lack of stakeholder involvement...are thought to result in public opposition, prolonged clean-up time schedules and increased costs.” (Belsten, 1996).

Just as there are many ways that effective environmental communication can improve environmental outcomes, there are also many methods for communicating scientific information for policy and natural resource management decision-making. One method is the communication of information directly from scientists themselves. However, while the participation of scientists is encouraged (Wolfendale Committee, 1995), scientists may not be trusted, may only minimally engage in communicating important information, or may communicate with community leaders rather than with the general public (Poliakoff & Webb, 2007). When there is a lack of linear information transfer from experts to those with a knowledge deficit, media like newspapers, radio, television, and the internet can provide access to scientific information, as can local leaders and community organizations (Hansen, 2011; Nerlich, Koteyo, & Brown, 2010). However, the public’s trust in these different outlets of information can vary greatly. Exploring the sources from which the public obtains scientific information and the degree to which these

sources are trusted has implications for whether information will be internalized and lead to behavioral change and policy support (Pratap, Redman, Fagan, & Dorevitch, 2013).

Trust, defined in communication as “reliance upon the communication behavior of another person in order to achieve a desired but uncertain objective”, is particularly important in risky situations (Giffin, 1967). The character, including trustworthiness, of a source of information is tied to the impact of the message from that source. Hence, content or tone and the method of communication are unique but intertwined concepts (Murphy & Wears, 2009). Importantly, however, trust in the *source* of information can influence responses to risk communication more than the *content* of a message (Conchie & Burns, 2009). Therefore it is important to study the medium of communication, not just the message (McLuhan, 1964).

Given the risks and consequences associated with environmental problems, and because the academic field of environmental communication is relatively young, there is a great need for more research into how to improve communication, including insights into where the public obtains information and the degree to which various sources of information are trusted. Local water quality declines and harmful algal blooms (HABs) are both examples of environmental problems that provide an important system for research that explores how to more effectively communicate with impacted communities.

Currently, the crisis of HABs is being faced worldwide. These blooms not only affect the health of aquatic ecosystems but also pose a threat to human health. In the United States, the cost of HABs is around 82 million dollars every year (National Oceanic and Atmospheric Administration, n.d.). Most of the literature on environmental communication is focused on climate change rather than water quality. However, links may be drawn between these two fields

of study because they are similar. They can both be viewed as public health issues (Pratap et al., 2013; Maibach, Roser-Renouf, & Leiserowitz, 2008) and there is a need for solutions at local levels in both cases. However, water quality issues, especially in smaller lakes and rivers, are often much more localized and can be more personal, particularly when they have a direct effect on communities. For instance, the effects of poor water quality can range from a decline in waterfront property values to impacts on human health. Water quality issues also tend to operate on a much shorter time scale than climate change. As a result, the risks and consequences of inaction are much closer in time and space. Therefore, although advances in communication in one field can benefit another, further research is needed with regards to communicating the science associated with water quality problems.

This study explores how information about water quality is communicated in Choctaw Lake. The goal of the current study was to provide feedback to the Choctaw Lake Water Quality Committee to help them improve communication of their water quality issues and ultimately help them inform the public in ways, and through sources, that would help increase support for regulations aimed at preventing HABs. To better assist the Lake Water Quality Committee (LWQC) and their mission of educating the community and preventing behaviors harmful to water quality, I examined how information is obtained and trusted in the community. The study aimed to answer 3 questions: (1) where do Choctaw Lake residents access information regarding water quality and does the source of information that residents rely on vary among community members? (2) how much do residents trust each of these sources and why might that vary? and (3) how can the LWQC better frame communication to match the stated uses and reasons for concern among residents in order to garner more support for proposed policies and regulations?

STUDY SITE

Choctaw Lake is a community in Madison County near London, Ohio, about 30 miles west of Columbus (Figure 1).

According to the most recent US Census data, nearly 700 households and over 1,500 year-round residents surround the lake, with a median household income of \$106,975. The median age of the Choctaw Lake population is 44.7 compared to the Ohio and United States median age of 38.8 and 36.9, respectively. The Choctaw Lake population

is 97.9% white and 98.3% of residents have a high school degree or higher. Not all homes are inhabited year-round, leading to a rise in population over the summer months. The lake was built in 1946 for a housing development and has a maximum depth of 14 feet and an average depth of 7.6 feet. This shallow depth leaves the lake sediment more vulnerable to perturbation, which can increase the likelihood for HABs to occur. Residents and guests use the lake for boating, skiing, family recreation, fishing, and enjoyment of the aesthetics and scenery.

Algal blooms have been occurring in this small central Ohio lake for the past several summers, beginning in 2011. These blooms can emerge due to a variety of factors including warmer summers, irregular precipitation, fertilizer and animal waste runoff, and sediment layers being disturbed at the bottom of the lake (National Oceanic and Atmospheric Administration, n.d.). In Choctaw Lake, HABs are likely caused by boating activity stirring up lake sediment,



Figure 1. Map of Choctaw Lake

fertilizer runoff from both residential lawns and surrounding farmland, and organic material such as animal waste and lawn clippings polluting the lake. Although algae naturally exists in the lake, cyanobacteria, or blue-green algae, is outcompeting the native algae. Planktothrix is a particular kind of cyanobacteria present in Choctaw Lake that is of most concern. Planktothrix produces microcystin, a liver toxin, and can be harmful to humans and animals at certain thresholds. In summer 2014, levels of microcystin warranted a Recreational Health Advisory, which warned those with compromised immune systems, infants, and the elderly from coming into contact with lake water.

A Lake Water Quality Committee (LWQC) was formed in 2012 and tasked with (1) communicating with the public and the Lake Manager, (2) establishing regulations to prevent blooms from occurring, and (3) advising and assisting the Board of Trustees with lake water quality issues. The Committee is currently made up of 7 volunteers including the committee chair, and it organizes events like property owners' workshops and lake clean-ups. The LWQC is also responsible for research on preventing harmful algal blooms through methods that may include algaecides, dredging lake sediment, education and outreach with the watershed's landowners, installation of wetland areas, and reduction of fertilizers and organic material washing into the lake. As part of this research, the LWQC examines how other lakes have dealt with HABs. The work of the LWQC is funded at the discretion of the Board of Trustees, the main decision-making body at the lake.

Some of the LWQC's proposed solutions to HABs include regulations on lake activities like boating and water skiing, installation of shoreline barriers to reduce nutrient runoff, dredging or removal of the lake sediment, chemical treatment to kill the algae, restricting fertilizer use, and outreach to both the Choctaw Lake community and the rest of the lake's watershed,

including farmers. Some of these solutions are thought to be particularly important. For example, boating and other intense lake activity can stir up sediment and nutrients that were long ago buried in the shallow lake. However, boating regulations are controversial because residents view them as an intrusion to their personal freedoms and use of the lake, which they have paid for the use of. These regulations are also viewed as being poorly enforced by residents, which has led to further negative attitudes towards these rules. Another controversial approach is the installation of shoreline protection measures. The high cost of these installations to individual homeowners has led to resistance from some community members.

The controversial nature of boating regulations and shoreline protection measures both illustrate the importance of the LWQC gaining support from residents for different strategies. Although these regulations are already in place, compliance with these rules is viewed as a problem by some residents, and this noncompliance can encourage other residents to also ignore these measures. Current communication efforts of the LWQC include meetings and workshops with property owners, notices published in the community's monthly newsletter *The Peacepipe*, and postings on the community's Facebook page "Next Door Choctaw". It is unclear, however, which sources of information are most useful for residents, most relied upon, and most trusted. This information would help the LWQC either target particular sources for their communication efforts, or tailor the content of their communication to the segments of the population that rely on particular sources.

METHODS

The primary source of data was collected via an online survey, the development of which was informed by focus group meetings and an interview. Institutional Review Board exemption status was obtained before focus groups and interviews took place. Two focus group meetings and a single one-on-one interview were held with a total of eleven Choctaw Lake residents. Rescheduling and attendance issues led to having only one participant attend the first meeting. As such, this meeting became an interview instead. The second meeting (first actual focus group) included four participants: 2 females in their 50s and a male and female married couple in their 60s-70s. 39% of the Choctaw Lake population is between the ages of 50 and 79. Because the married couple's responses were given together or back and forth between the two, these responses were recorded as one respondent. The final focus group was held after the health advisory was posted at the lake. This focus group contained five current and former members of the lake's Board of Trustees and Lake Water Quality Committee and one spouse, all in their 50s and 60s. The married couple in this focus group behaved independently of one another and their responses were recorded separately. These meetings each lasted between 60 and 90 minutes. Participants were asked open-ended questions regarding sources of information about water quality and their attitudes toward the water quality problem (Appendix A).

The responses to these open-ended questions were compiled and were primarily used to inform the development of survey questions. An online survey was created using Qualtrics software and aimed at collecting data about sources of information about water quality, trust in those sources, uses of the lake, levels of concern about lake water quality, reasons for concern, and potential challenges to tackling water quality issues (Appendix B, Table 1). The survey was distributed by the chair of the Lake Water Quality Committee through an initial email and

reminder emails to all Choctaw Lake residents and posted on the community’s Facebook page, Next Door Choctaw, several times from November 2013 until January 2014, when the survey was closed.

Variable name	Measure
Residency	How would you characterize your residency, three categories: Full-time resident, summer resident, visit the lake on weekends
Age	Respondent’s age, seven categories:18-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75 years or older
Lake uses	How do you use the lake, please rank your top 3 choices; eight categories: enjoying the scenery, boating family recreation, fishing, swimming, water skiing, other, and non-usage
Concern	How concerned are you about water quality in the lake, scale from 1 (unconcerned) to 7 (very concerned)
Reasons for concern	What are the main reasons you are concerned about water quality , please rank your top 3 choices; seven categories: own health, children’s/grandchildren’s health, pet’s health, health of plants and animals that live in the lake, economic value of home, loss of recreation opportunities, and not concerned
Sources of information	Please rank your top 3 source of information about water quality in the lake, ten categories: directly from Lake Water Quality Committee members, the Peacepipe newspaper, other forms of print media, online news sources, Next Door Choctaw Facebook page, property owners’ meetings/workshops, Lake Water Quality meetings/workshops, local scientists/researchers, friends and neighbors who are not members of lake management, and friends who live outside the community
Trust in source	What is your level of trust in these sources, scale from 1 (distrust greatly) to 7 (trust greatly), eight categories: Lake Water Quality Committee members, the Peacepipe newspaper, other forms of print media, online news sources, Next Door Choctaw Facebook page, property owners’ meetings/workshops, Lake Water Quality meetings/workshops, local scientists/researchers
Potential challenges	What do you think are the potential challenges, if any, to improving lake water quality, please rank up to your top 3 choices; five categories: expenses, lack of concern in the community, the root causes are outside of the community and not within community’s control, there is nothing to do to improve the water quality, and not concerned with lake water quality
Regulations residents have most trouble following	Which regulations do you think Choctaw Lake residents have the most trouble complying with? (open-ended response)
Suggestions to improve water quality	What, if anything, would you suggest be done to improve the water quality in the lake? (open-ended response)

Table 1. Survey variables and measures

Much of the analysis was descriptive but statistical analyses were conducted using JMP 10 and Microsoft Excel. Qualitative data from open ended questions in the survey was sorted into categories based on key words and ideas, like dredging or fertilizer, and compared with results from the survey.

RESULTS

There were 126 responses to the survey from a total population of 1,203 residents over the age of 18 (a stipulation for completing the survey). Among the 126 respondents were 100 full-time residents, 5 summer residents, and 10 weekend residents (not every respondent indicated their residence status). Thus, I received responses from at least 10% of the contacted population, although it is unclear whether all residents are included on the listserv, particularly the younger residents. Half the residents at Choctaw Lake are 45 or older, but the respondent population of 45 or older was 80%.

Concern about lake water quality was found to be high in the community, with a mean concern of 6.3 out of 7 (Figure 2). 84% of respondents agreed that water quality has become worse over the past 5 years. Residents' main concerns about declining lake water quality include harm to their children's or grandchildren's health, decreases in home value, and loss of recreation activities (Figure 3). 12% of respondents also incorrectly believe that these algal blooms will affect their drinking water or air quality.

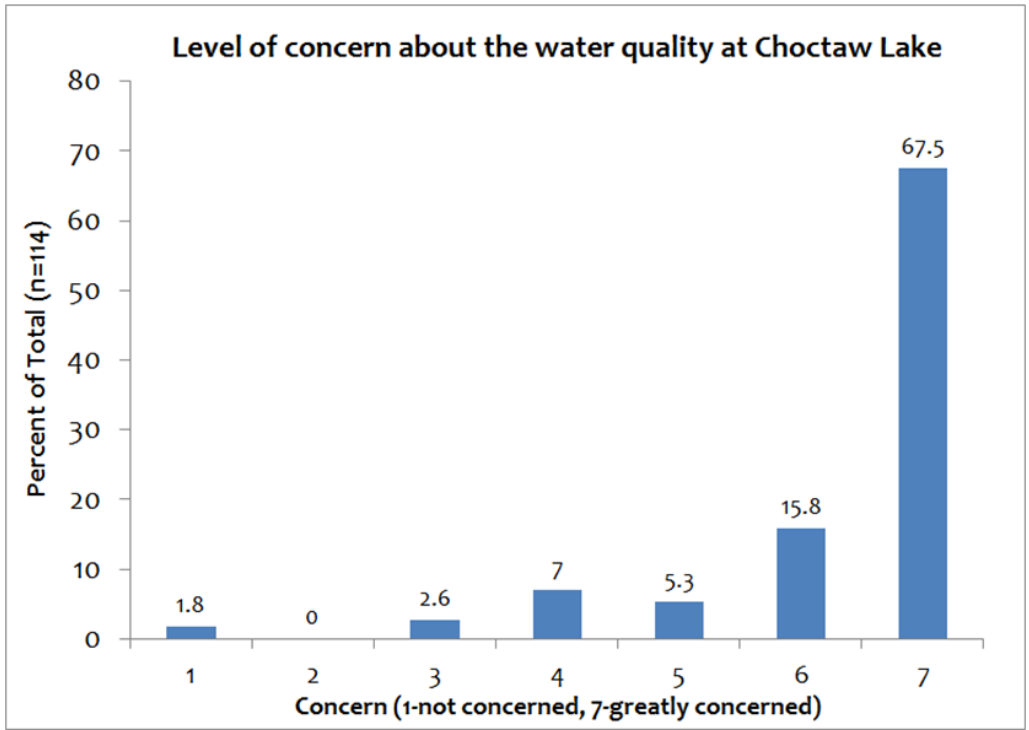


Figure 2. Levels of concern about Choctaw Lake water quality

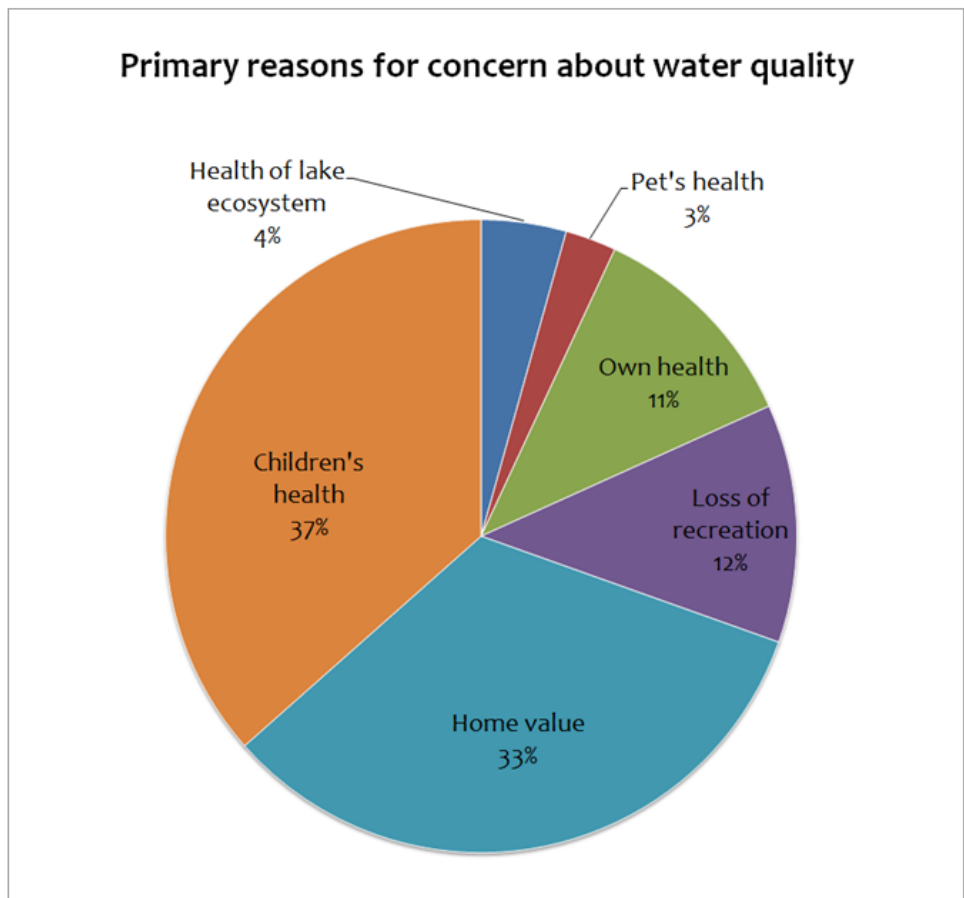


Figure 3. Primary reasons for concern about impaired water quality

The primary uses of Choctaw Lake are enjoying the scenery (aesthetics) and boating followed by other forms of recreation, like fishing, swimming, and water skiing (Figure 4).

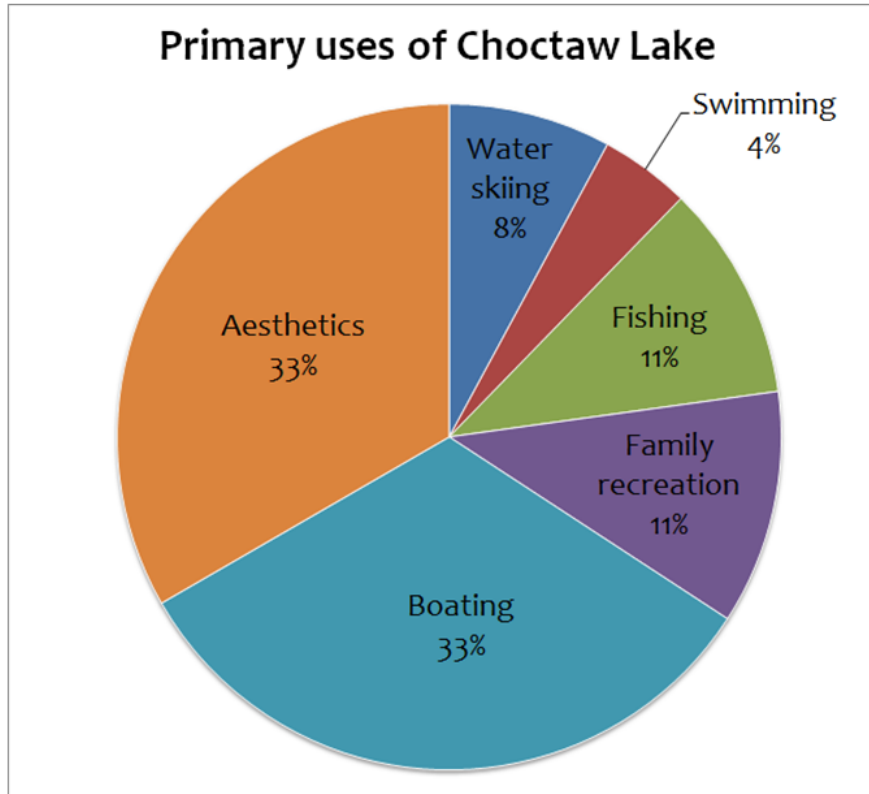


Figure 4. Primary uses of Choctaw Lake

The survey asked residents to choose their primary, secondary, and tertiary sources of water quality information. The most common primary source of information is Next Door Choctaw, the community’s private Facebook page, followed by The Peacepipe, the Choctaw Lake monthly newsletter (Figure 5). Both of these sources are available online. Another third of respondents reported Lake Water Quality Committee meetings and workshops as their first source of information. Sources outside the community, such as friends who are not residents and other newspapers, were hardly used as sources at all (Table 3).

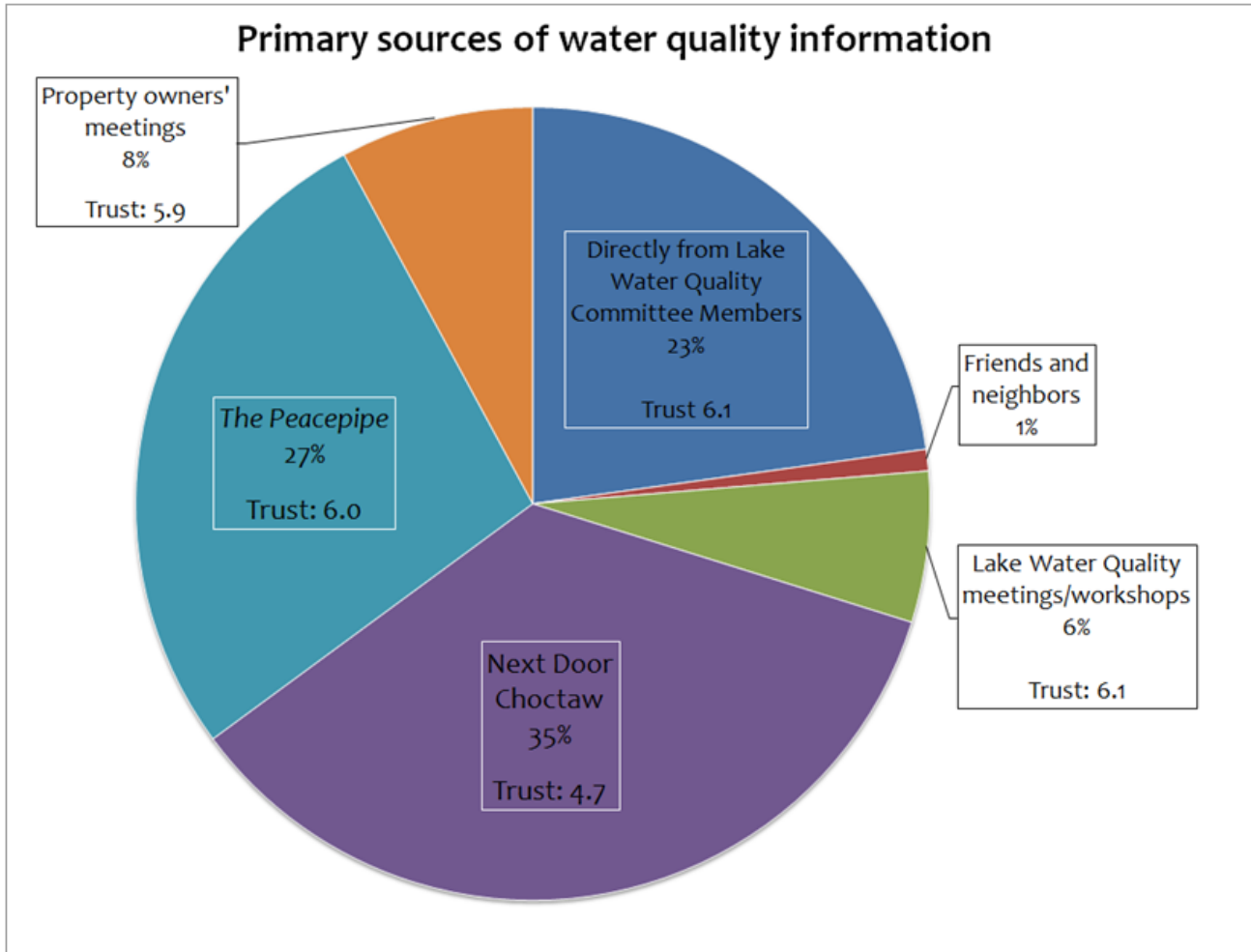


Figure 5. Sources of information on Choctaw Lake water quality with average trust values

	Next Door Choctaw	The Peacepipe	Directly from Lake Water Quality Committee	Property owners' meetings	Lake Water Quality meetings	Friends and neighbors who are not members of lake management	Other forms of print media	Online news sources	Friends who live outside the community	Local scientists/ researchers
Primary (n=114)	35.1	27.2	22.8	7.9	6.1	0.9	0	0	0	0
Secondary (n=112)	24.1	37.5	8.9	14.3	8	0.9	5.4	0.9	0	0
Tertiary (n=101)	11.9	15.8	6.9	23.8	21.7	8.9	5.9	2	2	0.9

Table 2. Primary, secondary, and tertiary sources of information on Choctaw Lake water quality by percent of primary, secondary, or tertiary responses

As previously mentioned, trust in a source of information is an indicator of the likelihood of a person absorbing and retaining the piece of information. Importantly, trust in sources of Choctaw Lake's water quality varied based on the locality of the source. A one-way ANOVA was conducted to examine differences in trust among sources of information. There was a significant difference in levels of trust among the sources [$F(7,794) = 38.14, p < 0.01$]. Post hoc comparisons using the Tukey HSD test indicated that the mean trust scores for Next Door Choctaw ($M=4.67, SD=2.09$), online news sources ($M=4.46, SD=1.41$), and other forms of print media ($M=4.67, SD=1.61$) were each significantly different than each of the mean trust scores for the Peacepipe ($M=6.01, SD=0.97$), property owners' meetings ($M=5.89, SD=1.19$), LWQC meetings and workshops ($M=6.08, SD=1.12$), local scientists ($M=5.88, SD=1.40$), and LWQC members ($M=6.13, SD=1.07$) (see Figure 6 for a plot of the means and standard errors). There were no significant differences in trust between the Peacepipe, property owners' meetings, LWQC meetings and workshops, local scientists, and LWQC members. Differences in trust values also were not significant between Next Door Choctaw, online news sources, and other forms of print media.

Sources of information from outside the community were not often accessed and trust levels for external print media and online news sources were lower than for local sources of information, except Next Door Choctaw. Most notably, Next Door Choctaw had the lowest mean trust levels among all local sources of information despite being the most accessed information outlet (Figure 6). Although respondents indicated high trust levels in local scientists and researchers, this category was the least accessed source of information among all options.

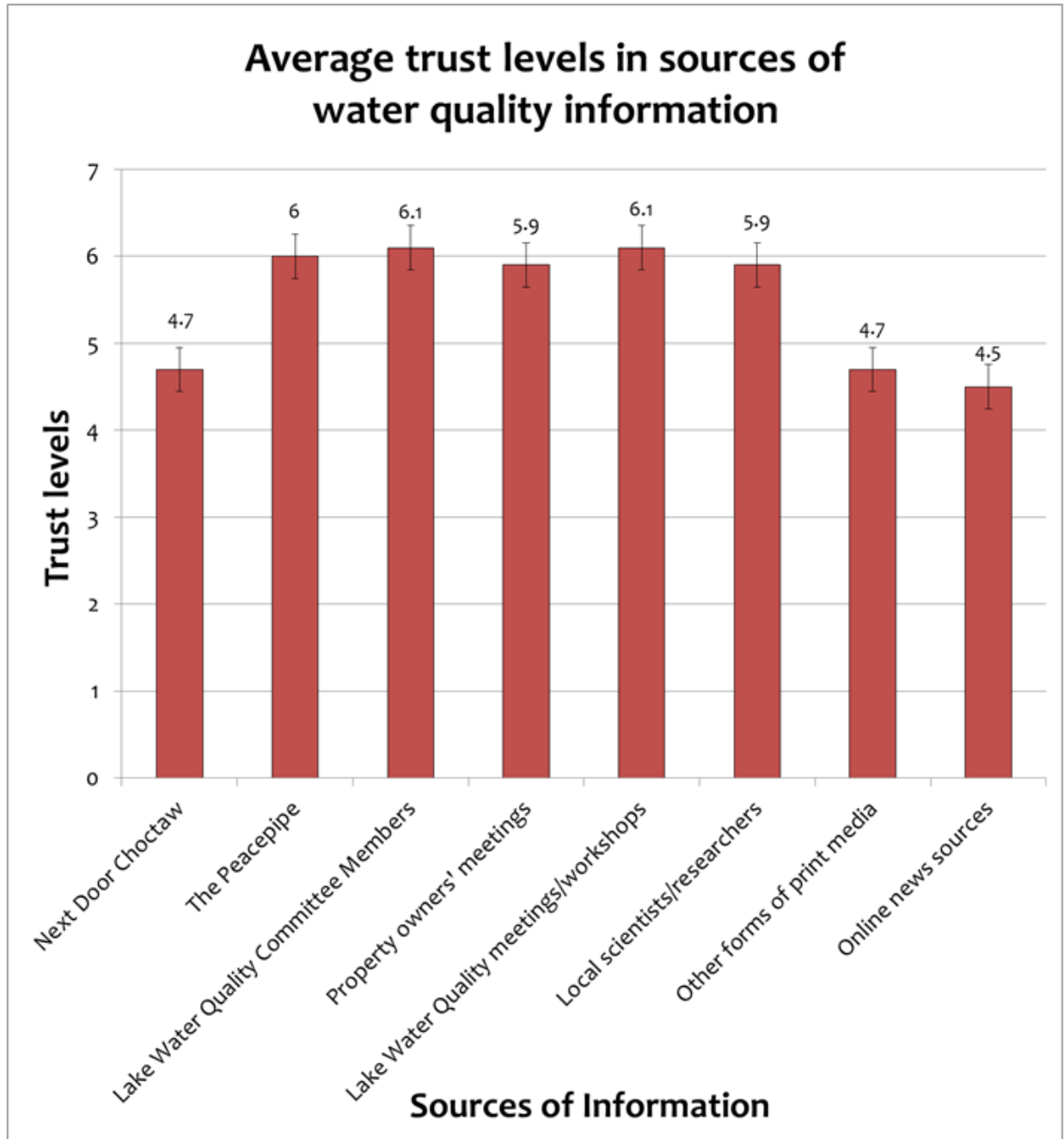


Figure 6. Trust levels of sources of water quality information on a 1-7 scale with standard error bars

Residents were asked what they think should be done to improve lake water quality. Dredging and more frequent communication from the LWQC, including with farmers in the watershed, were the most cited topics. Respondents were also asked to identify potential obstacles and challenges to improving lake water quality. The biggest challenge that residents noted is the amount of money it may take to address HABs, including the cost of treating cyanobacteria or dredging (Table 4). There is also a significant portion of the population who believes that the causes of HABs in the lake are not within their control. Focus group participants identified keeping residents interested and educated about the lake water quality and taking ownership of the problem as being the community's greatest challenges.

	Expenses	Root causes are outside the community and not within our control	Lack of concern in the community	There is nothing we can do to improve water quality
Primary (n=107)	60.7	25.2	14.0	0
Secondary (n=92)	33.7	32.6	33.7	0
Tertiary (n=61)	11.5	29.5	50.8	8.2

Table 3. Primary, secondary, and tertiary potential challenges to solving the water quality issue by percent of primary, secondary, or tertiary responses

Although fertilizer regulations have been in place since 1996, when asked about non-compliance with lake rules and regulations aimed at preventing HABs, like fertilizer and lawn waste restrictions as well as boat idling and speeds, residents indicated in both survey responses and focus group responses that they believe (1) their neighbors are not complying with these rules and (2) the property owners association is not adequately enforcing these regulations.

Unfortunately, I was unable to conduct bivariate analysis to explore relationships between key variables as planned. There was very little variation in responses for level of

concern, residency, and age. Even after combining response categories, the lack of variation led to cells having values that were too low for the use of chi-square tests and contingency tables.

DISCUSSION

This study sought to understand the sources Choctaw Lake residents turned to for lake water quality information, levels of trust in these sources, and to provide information to the LWQC to better inform their communication practices. Results from the survey showed that concern about water quality is high within this community. This suggests that the community is at least aware of the problem and the potential harmful effects of HABs. However, the sample is comprised of residents who self-selected to take the survey and who may have done so because they were very concerned about water quality. That said, the Lake Water Quality Committee may still be able to effectively gain support for policies and regulations from these concerned residents. A follow up survey to explore non-response bias was not conducted. However, it is plausible that community members who are not full-time residents (and who therefore interact differently with other community members and leaders) might rely on different sources of information, have different levels of trust in those sources, and have different levels of concern about water quality. As such, there may be a need to use different sources of information and to frame water quality communication differently for community members that are not full-time residents. These are questions that can be addressed in a future study.

While concern for the lake is high, this does not necessarily mean that support for all approaches to HABs is high. In cases in which there is resistance to regulations, the LWQC can better frame their message from understanding uses of the lake and reasons for concern. Framing

the water quality issue around the impacts it may have on children's health, property values, or boating restrictions may increase support from residents for proposed actions and regulations. This framing effort mirrors what is currently being researched in climate change communication and can increase the feeling of responsibility from residents to change their behavior and work to help the LWQC (Russill & Nyssa, 2009; Maibach, Roser-Renouf, & Leiserowitz, 2008).

Importantly, the LWQC should be concerned with the large number of respondents who do not believe their neighbors are complying with regulations. If compliance is not a social norm within the community, improving compliance or changing residents' behaviors will be a challenge (Ajzen & Fishbein, 1980).

Using stakeholder input and two-way communication is a valuable technique in environmental communication and can better inform management decisions at the lake (Belsten, 1996; Pratap et al., 2013). Property owners can provide a different perspective to management, in this case with enforcement of lake rules, and suggest improvements to communication efforts. Using this approach can reduce bias in management techniques by understanding what the community already knows, and provide solutions that work for both the lake management and the community to combat HABs in the most feasible manner. For example, in focus group meetings with residents and board members during property owners meetings and in focus groups, some participants expressed that a majority of residents did not believe that water quality had gotten worse and they were not concerned. Focus group respondents had varying opinions on whether conditions had worsened in the lake, citing events in the past decades that were viewed as larger catastrophes, such as septic tank leakage and an E. coli outbreak from swine feces contamination. However, survey results demonstrated that among respondents, a high percentage were concerned and believed water quality had decreased in the lake. The LWQC

may find it helpful to engage with residents about the lake water quality in small, focus group discussions to inform management of problems viewed by residents, such as noncompliance and low enforcement of regulations, and perhaps use it as an opportunity to address some myths about causes of lake quality.

Although electronic media are often the quickest and most efficient way to spread material to a large audience, these sources may not be the best way to influence more permanent behavior change if residents do not trust these sources (Conchie & Burns, 2009). They may, however, be the best way to quickly inform residents of important, time-sensitive issues regarding lake quality, such as health advisories.

The survey data also shows the primary sources of information were not always the most trusted sources. The two most accessed sources, The Peacepipe and Next Door Choctaw, are available electronically which may be the reason for their high access rates. Because Next Door Choctaw has a lower trust rating than other community-based sources of information, the LWQC should not expect residents to absorb information on the page or to act on this information. What may be responsible for the difference in trust levels of these sources is the input, either misinformed or otherwise, of other residents. The comments on the Facebook posts may contradict or deflect from the original intent and message from the LWQC. Some of these comments have led to misinformed and misleading discussions on the posts about how drinking water is affected by HABs or that manure runoff is causing the lake water quality issues,. Both claims are unsupported by scientists working at the lake. Instead, if the goal of the LWQC is to present information in a forum that is most likely to stick and is most likely to generate behavioral change, they should work to increase attendance and participation in Lake Water Quality Committee meetings and workshops, which are more highly trusted in the community

and therefore more likely to properly inform residents of water quality information, including rules and plans for stopping harmful algal blooms. Another option would be to provide more online resources directly from these LWQC meetings and workshops, such as videos or news postings. These should be separate from Next Door Choctaw and perhaps on a new social media site to ensure that this information is not subject to low trust levels and false commentary from residents. The LWQC should focus on frequent but short communication efforts, as requested by residents in both the focus groups and survey data, in order to keep the community involved without losing their interest in a jargon-heavy and long text.

There is also a feeling among a small but vocal minority of residents that the HABs are being caused by things outside the community like fertilizer and manure runoff, which may make a solution more difficult to formulate. Even if the commenters on Next Door Choctaw and those who express their opinion on manure as the cause of the HABs are in the minority, if these are the only represented opinions, they may be viewed by others in the community as representing a consensus. The perception that this is a majority opinion may be a factor that can affect the perceived trust of a source of information (Giffin, 1967). One challenge in combating HABs is the lack of consensus from the community and even the LWQC about the root causes of the problem. This includes the debate on whether the high levels of phosphorus in the lake result from agricultural runoff, use of lawn fertilizer, or boating practices that stir up the lake sediment making the phosphorus that has built up over the past 50 years available to cyanobacteria in the water. Although the lack of agreement among residents on the source of the problem is understandable due to multiple nutrient-loading processes, most respondents were concerned with dredging the lake, and whether or not this will prevent future blooms from occurring if they do not also address other forms of future nutrient pollution. During focus groups and in the open-

ended questions in the survey, residents seemed more concerned with inaction, rather than the proper action depending on the cause of the HABs. The LWQC should work to justify to the residents a plan of action based around the most likely causes while being mindful that high concern in residents may leave them feeling impatient for something to be done.

Some of the biggest challenges experienced in this study are related to sample size and participation. Some survey questions had such little variation in responses that significant relationships could not be explored using contingency tables. Given more time and more funding, paper surveys and random sampling could have been used in this community and perhaps yielded a greater number of respondents, and the sample would have been random instead of self-selected. Paying for a focus group moderator was not feasible for the budget of this project, but would have been helpful and more focus groups could have been held.

As with most research, new questions emerged throughout the course of the study. These questions included whether the content of messages pertaining to water quality differed among the various sources, why certain sources were accessed more than others, what factors play into each source of information (such as expertise and similarity of values to the audience), and how online access to a source might affect trust in that source. Some of these questions could be answered by getting better access to some of these sources, such as being added into the private Facebook page instead of viewing screenshots of only certain threads, and reviewing all forms of identified print or online media not present in the community. Other answers to these questions would require a follow-up survey which may ask questions about one's reason for relying on a certain source of information. Although time-consuming and potentially costly, further interviews and focus groups that reach more community members would provide comprehensive answers to many of these questions.

CONCLUSION

Understanding the community is imperative when communicating successfully with a specific audience about environmental problems. Because lake water quality is a concern in many lakes, rivers, and streams across the United States, it is important to research how different communities respond and deal with hazards like harmful algal blooms and to realize that small and rural communities react to change differently than large urban centers. Small lake communities also often lack resources to combat water quality issues in terms of number of concerned citizens as well as funding and therefore research opportunities. Studies like this can assist land managers and community leaders in gaining support and compliance with efforts to combat and reduce risks from harmful cyanobacteria and algal blooms. Research can help scientists, land managers, and community leaders do this through identifying a target audience and finding a source of information with both high trust and that is easily accessible by the public. An expansion of this study should review the content of messages received from different sources and whether different sources actually are providing different messages. Future research should look into reasons behind residents choosing one source of information over another and how sources that are accessible online play a role in water quality communication and regulation compliance.

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Appendix A

FOCUS GROUP QUESTIONS

1. How long have you lived in this community? Can you tell me whether you think conditions in the lake have changed over that period of time and if so, how?
2. Do you have any concerns about water quality in the lake? If so, what are your main concerns and if not, why not?
3. Is water quality a big topic of conversation among neighbors/the organizations you are a member of in the community? **If so, where do these conversations occur?**
4. How do you generally get information about water quality in the lake? (discuss all the sources as you use – maybe prompt them if they are unclear e.g. TV news (which channels), newspapers (which ones), internet (which sites)). **(you may need to be more specific here – information about what is causing algal blooms, information about the best way to treat or avoid algal blooms, information about whether the algal blooms are harmful?**
5. Which sources of information do you think is most trustworthy? Why?
6. How have you/your organization spread information about water quality?
7. Is there anything that you think can or should be done to improve water quality in the lake? If so, what and what do you think the most important changes will be?
8. Do you think there would be any controversy within the community about potential changes to address water quality problems? Why or why not?
9. What do you think is the greatest challenge the community faces in handling this water quality issue?

Appendix B

Default Question Block

Informed Consent

Please read this consent agreement carefully. You must be 18 years old or older to participate.

Purpose of the research: To examine Lake Choctaw residents' perceptions of water quality in the lake and sources of information about water quality to understand how information is communicated. What you will do in this study: You will have the opportunity to answer survey questions about water quality in the lake, levels of concern about water quality, perceived reasons for the potential decline in water quality, sources of information about water quality in the community, and your level of trust in different sources of information. The survey will take about 15-20 minutes to complete. The survey does not require you to provide any personally identifiable information unless you provide your email address to receive the results of the study. If you prefer not to have your responses recorded, you can request that of the researcher. You are welcome to email the principal investigator if you would like more information about the goals of this study and the hypotheses we are testing.

Risks: There are no anticipated risks, beyond those encountered in daily life, associated with participating in this study. You may take breaks at any time.

Voluntary Withdrawal: Your participation in this study is completely voluntary, and you may withdraw at any time without penalty. You may skip over any questions or procedures that you do not feel comfortable answering.

Confidentiality: Your participation in this study will be completely confidential. All data will be stored in a locked room and the researchers will not have collected any personal information through which you can be identified. Results of this study will be presented at an honor's defense presentation and may be presented at conferences and published in books, journals, and/or in the popular media.

Who to contact about your rights in this study: For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251. If you have questions about the survey, please send an email to essl@osu.edu.

Further information: If you have questions about this study, please contact:
Dr. Jeremy Brooks, School of Environment and Natural Resources, The Ohio State University, Columbus, OH 43212. Email: brooks.719@osu.edu, phone: 614-292-9787

Agreement: The purpose and nature of this research have been sufficiently explained and by clicking 'next' I voluntarily agree to participate in this study. I understand that I am free to withdraw at any time.

Q1. How would you best categorize your residency at Choctaw Lake?

- Full-time resident
- Summer resident
- Visit the Lake mostly on weekends

Q2. What is your age?

- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65-74 years old
- 75 years or older

Q3. For how many years have you lived or actively used a residence at Choctaw Lake? (enter response below)

Q4. How do you use the lake? Please rank **up to** your top 3 choices **by typing 1, 2, and 3 in the boxes below.**

- Aesthetics (enjoy the scenery)
- Boating
- Family recreation
- Fishing
- Swimming
- Water Skiing
- Other (please list)
- I don't use the lake

Q5. How concerned are you about water quality in the lake?

- 1 (Unconcerned) 2 3 4 (Somewhat concerned) 5 6 7 (Very Concerned)
-

Q6. What are the main reasons you are concerned about water quality? Please rank **up to** your top 3 choices **by typing 1, 2, and 3 in the boxes below.**

- My health
- My children's/grandchildren's health
- My pet's health
- The health of the plants and animals that live in the lake

- The economic value of my home
- Loss of recreation opportunities
- I am not concerned

Q7. Please rank your top 3 sources of information about water quality in the lake by typing 1, 2, and 3 in the boxes below.

- Directly from Lake Water Quality Committee members
- The Peacepipe newspaper
- Other forms of print media (newspapers, magazines)
- Online news sources
- Next Door Choctaw
- Property owners' meetings
- Lake Water Quality meetings/workshops
- Local scientists/researchers
- Friends and neighbors who are not members of the lake management
- Friends who live outside the community

Q8. What is your level of trust in these sources?

	Distrust greatly	Distrust	Slightly distrust	Neither trust nor distrust	Slightly trust	Trust	Trust greatly
Lake Water Quality Committee members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The Peacepipe newspaper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other forms of print media (newspapers, magazines)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online news sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Next Door Choctaw	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property owners' meetings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lake Water Quality meetings/workshops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local scientists/researchers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q9. Do you feel that you are able to get all of the information about water quality in the lake that you want?

- Yes
- Mostly yes
- Mostly no
-

No

I do not want information about lake water quality

Q10. Do you feel that the information you get about water quality in the lake is easy for you to understand?

Yes

Mostly yes

Mostly no

No

I do not get information about lake water quality

Q11. How knowledgeable do you think you are about the water quality in Choctaw Lake compared to other residents in the community?

More knowledgeable than most

About as knowledgeable as most

Less knowledgeable as most

Q12. How often do you talk to your neighbors and fellow community members about the lake *in person*?

Never

A few times a year

Once a month

A few times a month

Once a week

A few times a week

Daily

Q13. How often do you participate in *online* discussions with your neighbors and fellow community members?

Never

A few times a year

Once a month

A few times a month

Once a week

A few times a week

Q14. Over the last 5 years, has water quality been getting worse in the lake?

- Yes, it is getting worse
- No, it is about the same
- No, lake water quality has actually been improving

Q15. Why do you think water quality has been getting worse? Select as many answers that apply.

- Cooler summers
- Warmer summers
- Increased phosphorus levels
- Increased nitrogen levels
- Agricultural runoff, including manure
- Boating activity
- Other (please list)

Q16. What do you think are the potential negative effects of decreased water quality in the lake? Select as many answers that apply.

- Decreased property values
- Limits on water skiing
- Limits on boating
- Prohibited swimming and contact with the water
- Pet illnesses/deaths
- Decreased drinking water quality

Q17. How can the lake water quality affect human health?

- Drinking water contamination
- High toxin levels in the lake water
- Airborne cyanobacteria
- Lake water doesn't affect human health

Q18. How knowledgeable would you say you are about water quality issues at other lakes?

	1 (Not knowledgeable)	2	3	4 (Somewhat knowledgeable)	5	6	7 (Very knowledgeable)
Buckeye Lake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grand Lake St. Marys	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lake Erie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify) <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q19. How concerned are you about the water quality in these other lakes?

	1 (Not concerned)	2	3	4 (Somewhat concerned)	5	6	7 (Very concerned)
Buckeye Lake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grand Lake St. Marys	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lake Erie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify) <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q20. What issues, if any, would you like to have more information about in regards to Choctaw Lake?

Q21. What, if anything, would you suggest be done to improve the water quality in the lake?

Q22. What do you think are potential challenges, if any, to improving lake water quality? Please rank **up to** your top 3 choices **by typing 1, 2, and 3 in the boxes below.**

- Expenses
- Lack of concern in the community
- There is nothing we can do to improve the water quality
- The root causes are outside of our community and not within our control
- I am not concerned with lake water quality

Q23. Are you aware of the Lake Water Quality Rules and Regulations implemented in 2012?

Yes

No

Q24. How frequently do you think Choctaw Lake residents follow these rules?

	1 (never)	2	3	4 (sometimes)	5	6	7 (always)
Please rank your response	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q25. Which regulations do you think Choctaw Lake residents have the most trouble complying with?