

2017 Nebraska Water Monitoring Programs Report



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Water Quality Division
Water Quality Assessment Section
Spring 2018

2017 Nebraska Water Monitoring Programs Report

Nebraska Department of Environmental Quality – Water Quality Division

Spring 2018

Acknowledgements:

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Individual staff should be contacted with specific questions about specific programs; their contact information is provided at the end of each monitoring program description.

Please direct any general questions related to this report to the editors of this document, Marty Link, NDEQ, at (402) 471-4270 or marty.link@nebraska.gov or Ryan Chapman, NDEQ, at (402) 471-4227 or ryan.chapman@nebraska.gov.

Photo on Front Cover:

Nebraska Department of Environmental Quality (NDEQ) staff electrofishing for the Stream Biological Monitoring Program at the Middle Fork Soldiers Creek, Dawes County.



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Introduction

The Nebraska Department of Environmental Quality (NDEQ) is charged with monitoring, assessing, and to the extent possible, managing the state's water resources. The purpose of this work is to protect and maintain high quality water and encourage or execute activities to improve poor water quality. Monitoring is done on nearly 17,000 miles of flowing rivers and streams, more than 134,000 acres of surface water in lakes and reservoirs, as well as the vast storage of groundwater in Nebraska's aquifers.

This document brings together a short summary of many of the monitoring programs performed (or required) by the NDEQ. In many cases, recent results are highlighted in the descriptions. There are also examples of how the data that are collected are used. Individual program summaries, in some cases, include descriptions or explanations of water quality trends or observations.

This document is not meant to be a comprehensive or exhaustive scientific report; rather, it is a starting place for describing the numerous monitoring programs carried out by the NDEQ, its contractors, or, in some cases, the regulated community. Other NDEQ reports and documents have more in-depth data and descriptions for many of the programs. The reader will be directed to these in the individual program descriptions, or can contact the author cited at the end of each program description for further information.

Partners

NDEQ gathers much of the data discussed in this document; however, many partners have contributed as well. Without the contractual and voluntary assistance we receive from our many sister agencies and partners, we would not be able to detail the successes that we have accomplished. The state's Natural Resources Districts, Nebraska Public Power District, US Army Corps of Engineers, US Environmental Protection Agency, US Geological Survey, University of Nebraska-Lincoln, Lincoln-Lancaster County Health, Nebraska Game and Parks Commission, Nebraska Department of Agriculture, and others all contributed time, money, resources, and/or data to our water monitoring programs.

Many thanks.

Public Beach Monitoring Program

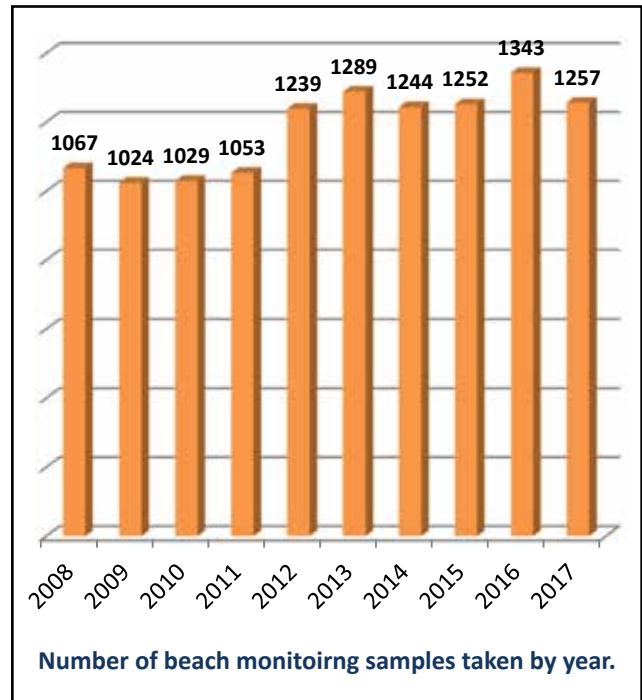
Bacteria and Microcystin

Why Does NDEQ Monitor Public Beaches?

Full contact recreation activities such as swimming, tubing, skiing, and jet skiing are popular pastimes at Nebraska's lakes and reservoirs. NDEQ and its collaborators want to ensure that the users of these waters have access to the most current water quality information possible.

When and Where is the Monitoring Conducted?

Sampling for bacteria at Nebraska's beaches has been occurring for many years. Nebraska Game and Parks Commission initiated sampling at a number of locations in the 1970s. NDEQ eventually took over the sampling program in the 1990s. In 2004, NDEQ began sampling for the toxin, microcystin, after it was determined that high levels in some Nebraska lakes attributed to the deaths of several dogs that had ingested the water. In 2005, NDEQ and its partners began a more comprehensive plan for collecting samples from publicly owned and operated lakes. Weekly sample collection of 53 sites from 50 lakes coincides with the recreation season (May 1 to September 30). Since the inception of NDEQ's comprehensive beach monitoring program in 2005, nearly 12,000 samples have been analyzed for microcystin and *E. coli* bacteria.



What is Monitored at the Beaches?

E. coli bacteria and harmful algae toxins, specifically microcystin, are monitored to give an indication of the quality of water at Nebraska swimming beaches.

E. coli bacteria are monitored to provide an "indirect" indication of potentially harmful (pathogenic) bacteria. While not all *E. coli* bacteria are considered a threat to human health, some bacteria strains are. The larger the population of *E. coli* bacteria measured, the greater are the odds of having harmful pathogenic bacteria. Using this rationale, the value of 235 colonies of *E. coli* bacteria per 100 ml of water is established as the upper limit for supporting full body contact recreation. Ingesting water with higher levels of *E. coli* bacteria may cause illness with most symptoms being exhibited within the intestinal tract.

E. coli bacteria are primarily associated with animal and human waste. Animal sources of *E. coli* bacteria commonly enter our waters from livestock and wildlife wastes that runoff the landscape during significant rainfall events. Human sources of contamination can include improperly maintained septic systems and wastewater treatment facilities that discharge untreated wastewater.



Harmful algal toxins, including microcystin, are produced by certain types of blue-green algae. Microcystin in the water can cause skin rashes, lesions, and blisters on people who have been swimming or wading. If algal toxins are swallowed they can cause headaches, nausea, muscle or stomach pain, diarrhea, or vomiting. Though rare, severe cases can include seizures, liver or respiratory failure, or even death. A microcystin level of 20 ppb is established as the criterion for full body contact recreational activities.

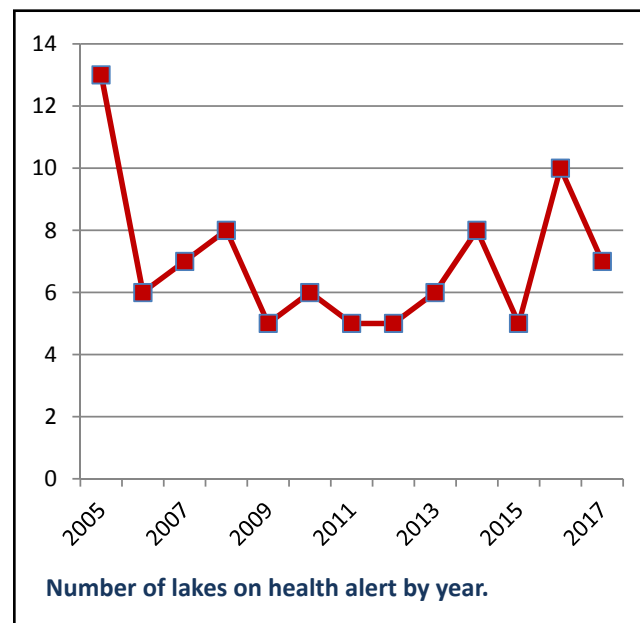
While not all types of blue-green algae are toxic, the greater the population of blue-green algae, the greater is the chance of having a harmful algal bloom. In the absence of direct microcystin toxin measurements, one should recognize a severe harmful algal bloom and treat it with caution. Blue-green algae often have a “John Deere green” or “pea green soup” color, appear as thick green paint or oil floating on the surface of the water, and usually have a strong septic odor.

How are the Data Used?

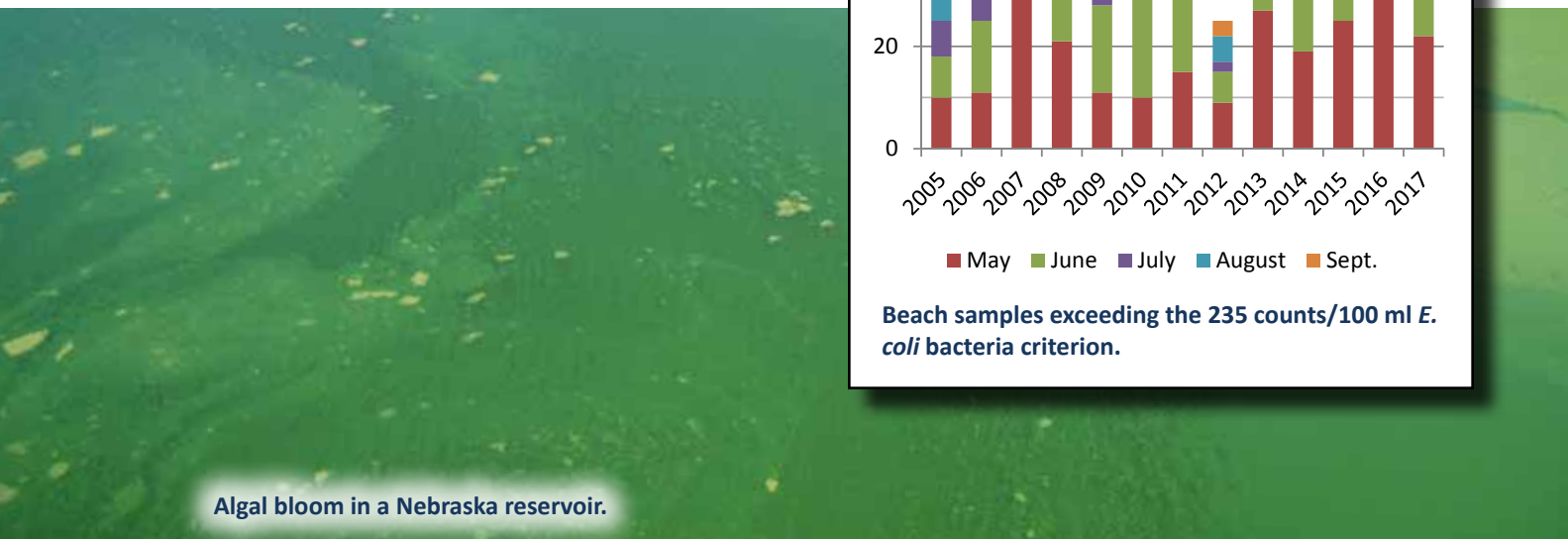
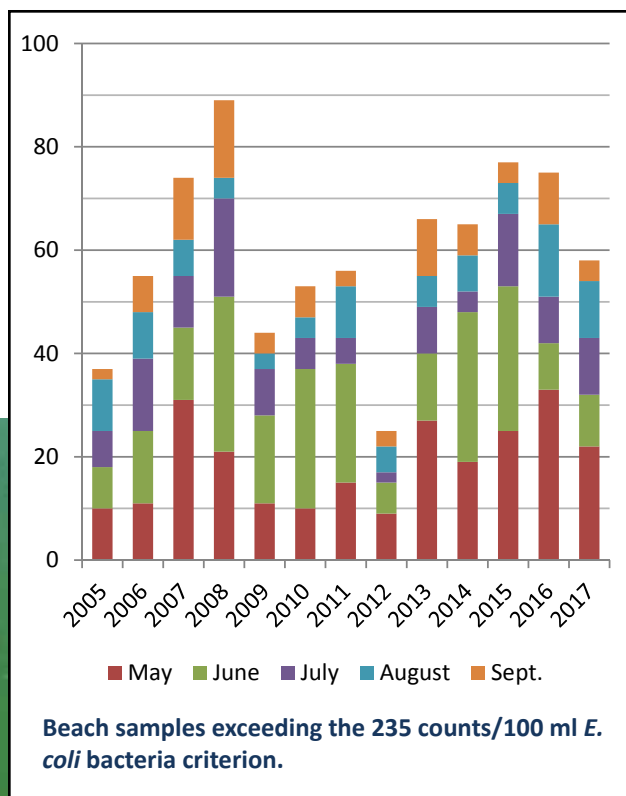
NDEQ and its partners (typically local NRDs) collect the lake water sample at the beaches early each week. Because the sample collectors do their own bacteria analysis and NDEQ analyzes the microcystin samples as opposed to sending them out to a contract lab, the results are quickly available and are posted on the Department’s internet site by Thursday of the same week (<http://deq.ne.gov>). This schedule provides information to the public prior to the weekend, when they are more likely to be using the lakes.

When levels of microcystin exceed 20 micrograms per liter ($\mu\text{g/l}$, or ppb, parts per billion), the NDEQ, Nebraska Game and Parks Commission and Health and Human Services jointly issue a Health Alert. During a Health Alert at a public lake, signs are posted advising the public to use caution and avoid full body recreational activities such as swimming, wading, skiing, jet skiing, sailing and particularly avoid drinking the water. Affected swimming beaches are closed. Camping, picnics, boating, fishing, and other non-contact recreational activities are allowed. The lake remains on Health Alert until levels of microcystin are measured below the 20 $\mu\text{g/l}$ criterion for two consecutive weeks. If one has prolonged contact with water suspected to have high levels of the microcystin toxin, it is recommended that they shower with fresh water as soon as possible.

In situations where *E. coli* bacteria exceed counts of 235/100ml of water for a single sample, the water is considered at a higher risk for illness when used for full-body contact recreation. Lakes that exceed this level are



specifically identified on the NDEQ’s website weekly, in the Environmental Alerts section. Unlike with high toxic algae levels, signs are not specifically posted and beaches are not closed for high bacteria levels. This is primarily because bacteria values change quickly while microcystin levels are more persistent and can remain for several weeks. This bacteria information, rather, is provided to allow the public to make their own decision on whether or not to use the lake.

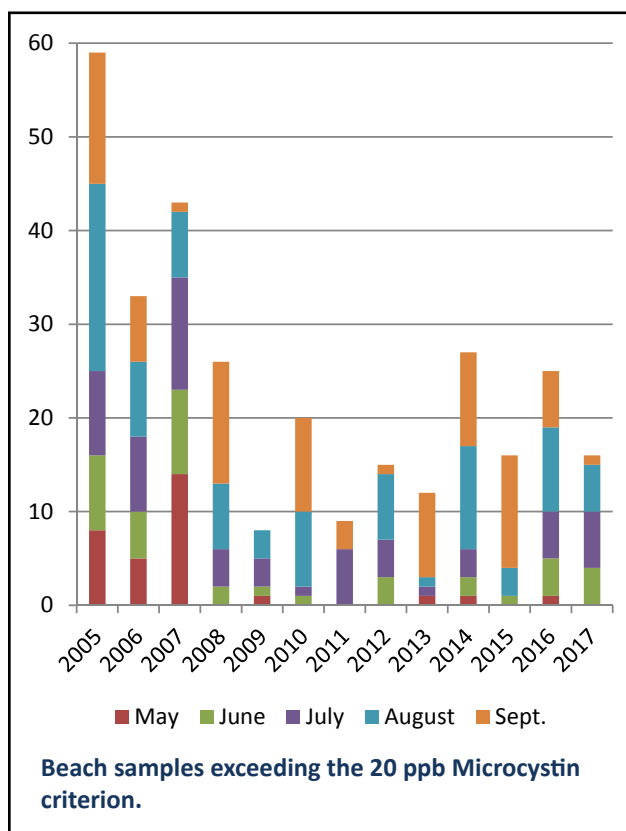


Algal bloom in a Nebraska reservoir.

Guidance provided to assist the public in the decision making process includes:

- Assess the length of time from heavy rainfall to the time of use.
- Assess the condition of a lake and consider avoiding abnormally turbid waters.
- Consider chronic problems where bacteria levels are consistently high even in the absence of rainfall.
- Avoid activities which could result in a higher potential of swallowing lake water.
- When bacteria levels are high, shower after coming in contact with the water.
- Wash hands before eating if you have been in contact with lake water.

Lakes that repeatedly exceed the *E. coli* and microcystin water quality standard may be put on Nebraska’s Clean Water Act 303d list of impaired waters.



2017 Results

In 2017, the Beach Monitoring program collected and analyzed almost 1,300 samples for *E. coli* and the microcystin toxin.

Bacteria

Of the bacteria samples taken and analyzed during 2017, 58 samples (4.6%) exceeded the 235 counts/100ml of water standard. In the adjacent figure, the number of samples that exceeded 235/100 ml criterion for bacteria by month for 2005 through 2017 is shown. This figure also provides the combined totals per month as well as per year. Note that most high levels occur in the spring and early summer months, in times of higher precipitation (and the associated higher run-off). Extremely low amounts of precipitation in 2012 led to a lower than normal number of bacteria readings that exceeded the water standard, whereas 2017 was closer to an average precipitation year which is reflected in the number of exceedances.

Harmful Algal Blooms

Of the samples collected and analyzed for the microcystin toxin during 2017, 16 samples exceeded the 20 ppb threshold for closing a beach. This accounts for 1.3 % of the total samples collected.

In 2017, six lakes were placed on Health Alert. The map below shows the lakes that had samples exceed the 20 ppb health standard and the number of weeks they were under a Health Alert.

The previous table illustrates the number of samples exceeding the 20 ppb microcystin criterion monthly for 2005 through 2017. It also shows the totals for each year as well as for each month through the years. Unlike with bacteria where high levels are more frequently observed in the springtime, blue-green algae (microcystin) impacts are usually observed later in the summer, after lake water has warmed and algae growth is more significant.

In general, algae production is affected by temperature, sunlight, and the nutrients of nitrogen and phosphorus.

Why are there problems at some lakes and not others?

Biological communities such as algae are very complex systems and are affected by many variables. The toxic algae issue gets even more complicated as some species of blue-green algae sometimes produce toxins while other times do not. Research is being conducted worldwide to answer these questions. Additionally, NDEQ is working with numerous collaborators to determine what factors are driving the growth of blue-green algae in Nebraska reservoirs and lakes. Certain conditions seem to consistently have significant effects.

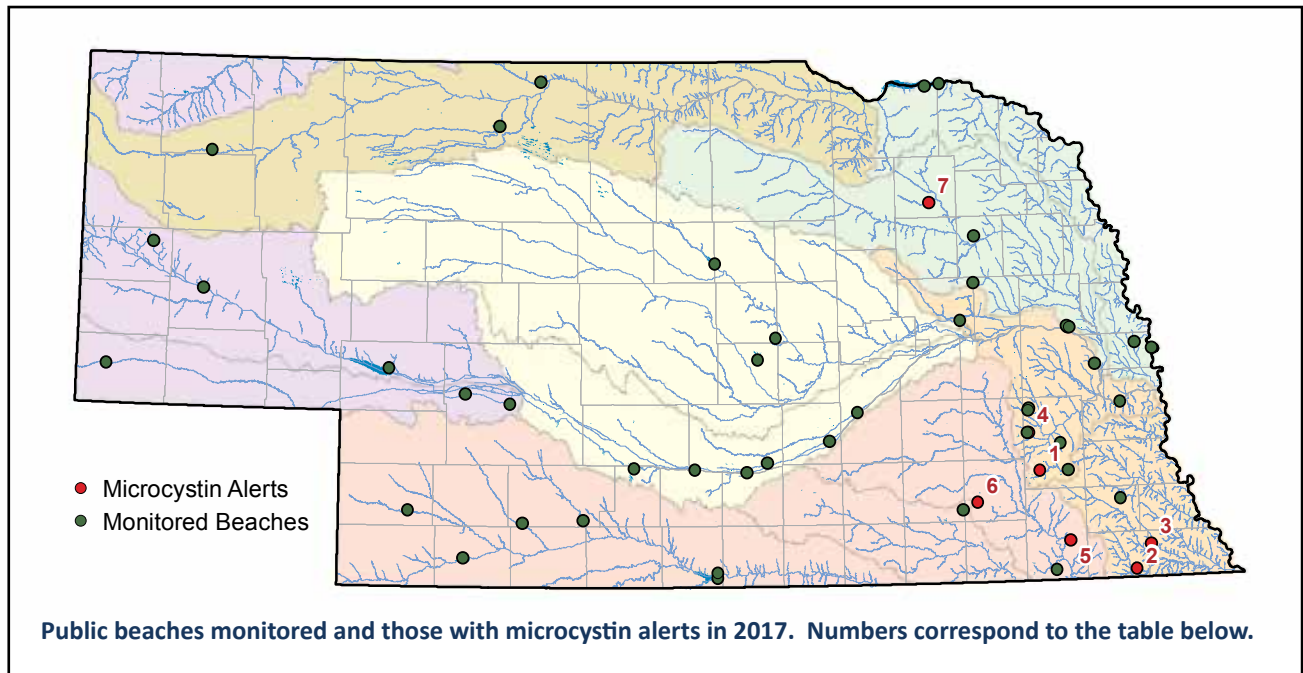
The following conditions are often associated with blue-green algae blooms:

- General weather of each year including the temperature, amount of sunlight and rainfall;
- Low lake water levels. During drought years, problems seem to be more frequent; and
- Increased cloud cover which implies reduced sunlight and lower water temperatures.

Toxic algae conditions during 2005 were significantly worse when compared to the other years. 2005 was characterized by lower rainfall, higher temperatures and was toward the end of a major drought. In general, lake levels were significantly lower across the State.

While the issue of toxic algae and its causes is quite complex, it is easier to understand by reducing the problem to simpler terms. In general, algae production is affected by temperature, sunlight and the nutrients of nitrogen and phosphorus. Higher temperature, sunlight, and excess nutrients result in greater blue-green algae production and therefore, a greater chance for toxic algae problems.

While temperature and sunlight are beyond our control, we can reduce the amount of nutrients reaching rivers, streams, and lakes. Any management practice that can be incorporated in a watershed that reduces these inputs into waters will reduce algae production and therefore the potential for toxic algae problems.



Map #	Waterbody	County	Samples Exceeding Health Limit	Weeks on Health Warning
1	Bluestem Lake at South Beach	Lancaster	3	5
2	Iron Horse Trail Lake at Beach	Pawnee	2	3
3	Kirkman's Cove at North Beach	Richardson	3	6
4	Pawnee Lake at East Beach	Lancaster	2	4
5	Rockford Lake at SW Beach	Gage	1	2
6	Swan Creek Lake # 5A at South Beach	Saline	4	7
7	Willow Creek Lake at South Beach	Pierce	1	2

More Information:

<http://deq.ne.gov/NDEQProg.nsf/Beaches2017.xsp>

Mike Archer, mike.archer@nebraska.gov or (402) 471-4201.

David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Ambient Stream Monitoring Program

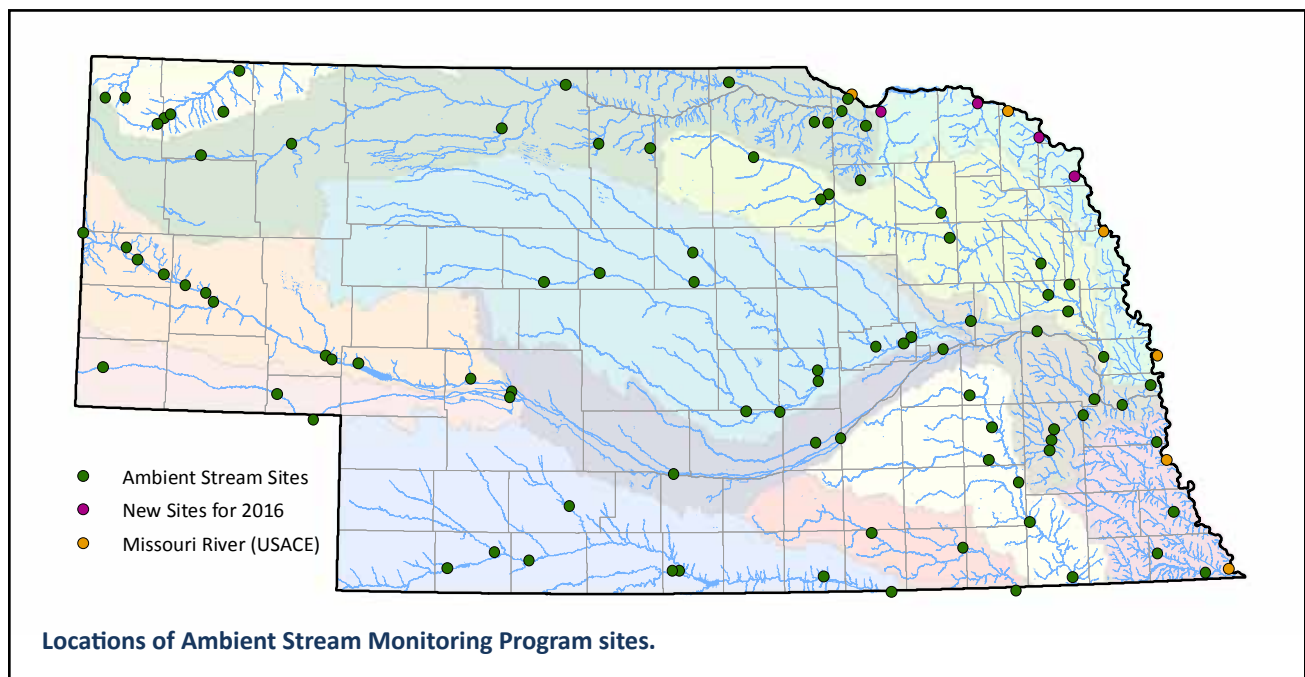
Why Does NDEQ Monitor Streams?

Nebraska's streams and rivers provide essential resources to the residents of our state. These streams supply irrigation and drinking water, support diverse fish and wildlife communities, offer numerous recreational opportunities, and are integral to the state's industry and electricity production. However, many of these streams also serve as conveyances to dispose of agricultural, industrial, and municipal wastewater and runoff. Assuring that Nebraska's streams can safely support these numerous, and at times, conflicting uses is the responsibility of the NDEQ.



Collecting field measurements from the Platte River east of Grand Island, Merrick County.

Regular stream monitoring allows NDEQ to determine if water quality conditions meet state and federal standards to safely support the assigned designated uses. If the monitoring data indicate a water quality problem, NDEQ uses these data to locate potential pollutant sources and develop point and non-point source pollution control plans. Regular monitoring also allows NDEQ to recognize trends in stream water quality that may lead to more efficient and effective pollution controls. Finally, NDEQ uses stream monitoring data to generate a portion of the Water Quality Integrated Report to submit to the United States Environmental Protection Agency, as required by the federal Clean Water Act. This report is submitted in April of even numbered years and is used by NDEQ as part of the prioritization process for the development of pollution control or watershed management plans.



Where and When is the Monitoring Done?

The Ambient Stream Monitoring Program (ASMP) consists of 101 fixed monitoring sites designed to collect data from all 13 of Nebraska's major river basins. Samples are collected from each site on the first week of each month, year-round with monitoring assistance provided by the US Army Corps of Engineers (USACE) and South Platte and Middle Niobrara NRDs. The map on the previous page shows the locations of the 101 monitoring sites sampled as part of the 2017 ASMP network.

How were the Monitoring Sites Selected?

Nebraska's ASMP was designed to evaluate surface water quality in each of the State's 13 major river basins. To achieve this goal, the 13 major basins were subdivided by geology, land-use, soil type, and topography. Three types of monitoring sites were then established in each basin: indicator sites, stream integrator sites, and basin integrator sites. Indicator sites are located on streams that drain areas of homogenous land-use, soil type, and geology, and provide background water quality information for the predominant ecoregions of each basin. Stream integrator sites are located at key intersections in the drainage network so that the most significant tributaries or contaminant sources in a basin are sampled by at least one of these sites. Basin integrator sites are located at the bottom of each major basin and provide insight into the water quality of the entire river basin.

What is Monitored?

NDEQ monitors numerous water quality parameters to establish general water quality trends and to ensure each stream is able to support its designated uses. *E. coli* bacteria was added as a parameter to the 2017 ASMP sampling network to gather information to aid in determining the significance of bacteria loading to streams throughout the entire year. The following parameters are collected at each site every month:

- water temperature
- dissolved oxygen
- pH
- conductivity
- total suspended solids
- ammonia
- nitrate/nitrite nitrogen
- kjeldahl nitrogen
- total phosphorus
- chloride
- *E. coli*



Collecting water samples from the Platte River east of Grand Island, Merrick County.



An ASMP site located on the Platte River, at Duncan, Platte County.

In addition, pesticide samples are collected at all sites from May through September. Arsenic and selenium are collected at all sites quarterly, as are a complete suite of metals at each basin integrator site.

History of the Ambient Stream Monitoring Program

NDEQ has maintained a network of stream monitoring sites since the inception of the agency in 1971. In the early 1970s, 365 sites were monitored on a quarterly basis to gather baseline data on streams where there was limited information. In 1978, the program was reorganized to consist of 90 sites that were monitored monthly. The program was again restructured in 2001 to a network of 97 sites and sampling has been conducted monthly at each of these sites ever since. Additional changes to the ASMP network were made in 2016 when four sites were added to the network, bringing the total number of sites sampled to 101. During 2017, approximately 1,212 water quality samples were analyzed for the 32 parameters collected for this program.



Filtering water sample to be analyzed for various heavy metals.

Impairments and Sources

The most recent assessment of the Ambient Stream Monitoring Network found that 79 of the 101 monitored stream segments were impaired (some segments had multiple impairments). An impairment means the stream water quality does not meet state requirements for at least one of its designated uses (either recreation, drinking water, irrigation water, or the support of aquatic life).

More information about all surface water impairments is available in the 2016 Water Quality Integrated Report. This report combines the Clean Water Act 303(d) impaired waters list with the 305(b) summary of the health of Nebraska's surface waters. This report is available on NDEQ's website at <http://deq.ne.gov> or directly at <http://deq.ne.gov/publica.nsf/pages/WAT234>



Preserving water samples collected at an ASMP site.

More Information:

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/ASM>

David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Greg Michl, greg.michl@nebraska.gov or (402) 471-4264.

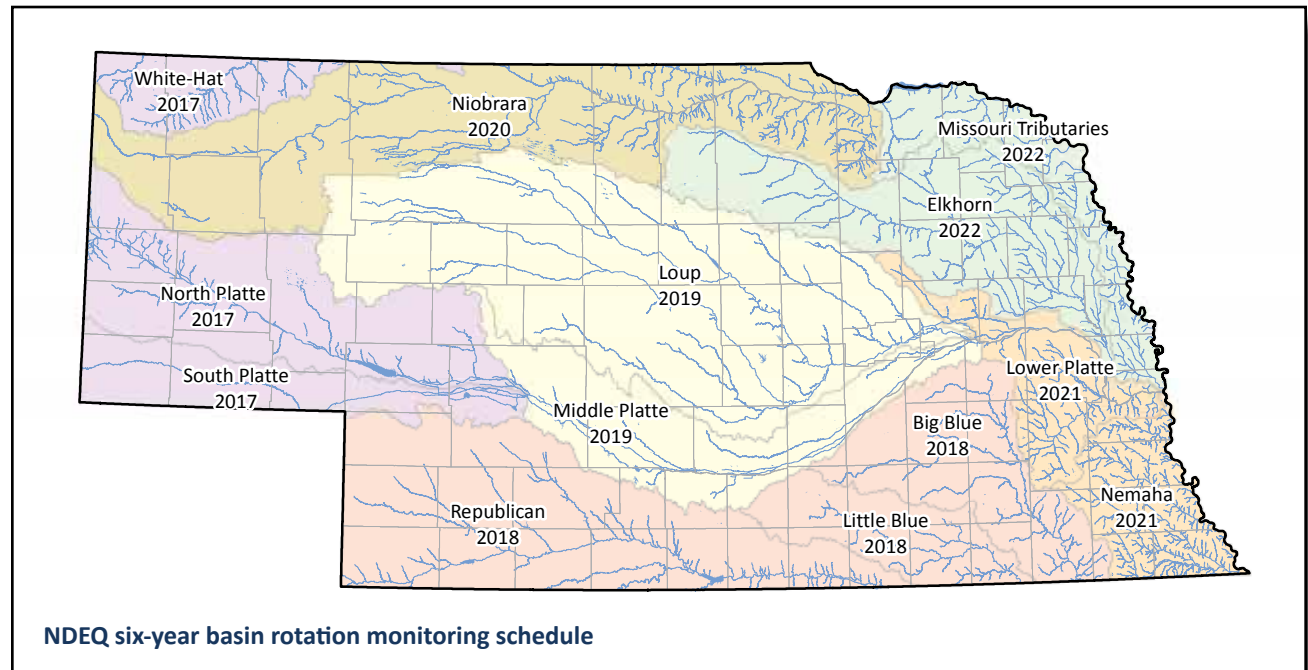
Basin Rotation Monitoring Program

Why Does NDEQ Conduct Basin Rotation Monitoring?

A goal of the federal Clean Water Act is that each state assess the water quality of “all navigable waters of the State”. In Nebraska, this means assessing nearly 17,000 miles of perennial streams and rivers, and more than 134,000 acres of lakes and reservoirs. These water quality assessments are used to determine if the sampled waterbodies are safe for recreation and if they can support aquatic life and industrial or agricultural uses. If the data shows that a waterbody cannot support all of its designated uses due to pollution, NDEQ begins a process to determine the source of the pollution and develop a pollution control strategy. This process can be both time consuming and costly, so it is imperative that NDEQ has sufficient data about a waterbody before it makes a determination on the water quality. The Basin Rotation Monitoring Program (BRMP) was developed so that NDEQ can work towards the goal of assessing all waterbodies within the state, while at the same time, insuring sufficient data is collected to determine if a waterbody is impaired by pollution. By focusing sampling efforts in 1-3 river basins each year for intensive monitoring, NDEQ can collect enough water quality samples to perform accurate assessments, while at the same time, collect data from many waterbodies because of the reduced size of the sampling area.

Where and When is the Monitoring Done?

Monitoring is done on a six-year rotation in the 13 major river basins in the state. Monitoring in each basin, during its rotation year, is done on a weekly basis from May 1 through September 30. In 2017, a total of 40 streams and two lakes were sampled in the North Platte, South Platte and White/Hat Basins with monitoring assistance provided by the South Platte NRD. This sampling resulted in 924 water quality samples being collected and analyzed for 15 parameters each. The map below shows the basins and their rotation schedule.





Collecting water samples from the West Fork Maple Creek, Colfax County.

How are the Monitoring Sites Chosen?

One of the primary objectives for the BRMP is the protection of public health. To meet this objective, NDEQ aims to assess 100% of the stream segments and public lakes that support primary contact recreation (swimming and wading). For this reason, the majority of monitoring sites in this program have been designated for recreation.

What is Monitored?

NDEQ monitors a suite of water quality parameters to establish general water quality trends and to ensure each stream is able to support its designated uses. The following parameters are collected at each stream site: ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus, chloride, total suspended solids, stream discharge and pesticides. Water temperature, pH, conductivity, dissolved oxygen, turbidity and *E. coli* bacteria are collected at both stream and lake sites.

Impairments and Sources

According to the most recent 2016 integrated report, *E. coli* is the most common water quality impairment. *E. coli* samples are collected from water bodies used for recreational uses such as swimming and boating. *E. coli* in lake water can cause gastrointestinal problems if swallowed. *E. coli* exists naturally in the environment and can become elevated in lakes and rivers from runoff following a rainfall event. A few sources of *E. coli* include wildlife and livestock feces and failing septic systems. The herbicide atrazine is the second most common impairment detected. Atrazine is a widely used herbicide that is commonly applied in the spring when rain events can cause cropland runoff to enter nearby streams and rivers.

Data from the BRMP are combined with the Ambient Stream, Ambient Lake and other surface water monitoring programs to make up the data package used for all assessments of the status of Nebraska's waters.

More Information

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/ASM>
Dave Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.
Greg Michl, greg.michl@nebraska.gov or (402) 471-4264.



Obtaining field measurements with a multi-parameter meter in the Elkhorn River, Holt County.

Stream Biological Monitoring Program

Why Biological Monitoring?

Nebraska has over 81,000 miles of streams of which nearly 17,000 miles flow continuously. Streams in Nebraska are capable of containing a rich diversity of aquatic life including aquatic macroinvertebrates (i.e. small animals living in water that can be seen with a naked eye), fish, amphibians, and mammals. Nitrogen, phosphorus, pesticides, sediment, and other pollutants are stressors that can degrade stream conditions for aquatic life, and can be potentially harmful to people. The aim of the Stream Biological Monitoring Program (SBMP) is to provide accurate statewide assessments of the biological conditions of Nebraska's streams so that sound decisions in management, planning, and regulation can be made.

History of the Stream Biological Monitoring Program

The Department began biological monitoring in 1983 with a targeted approach for classifying stream segments for Title 117 (Nebraska Surface Water Quality Standards). These sites were typically located at stream bridge crossings.

Over 900 stream sites were sampled for fish and macroinvertebrates over a 14 year period. In 1997, the Department added a probabilistic monitoring design that involved the sampling of randomly selected sites to its SBMP in order to address statewide and regional questions about water quality. Data to answer such questions as "How good is the water quality in Nebraska?" are best obtained such that all streams have an equal chance of being sampled.

Where is the Monitoring Conducted?

Each year, 33-40 randomly selected wadeable stream sites (i.e. streams that are shallow enough to sample without boats) are chosen for study in one to three river basins throughout Nebraska. During a six-year cycle, all 13 major river basins in the state are intensively monitored (see previous map on page 9).

What is Monitored?

The "health" of a stream depends not only on the contaminants present or absent, but the quality of the habitat and the creatures living there. NDEQ's SBMP assesses the health of streams by evaluating the composition and numbers of resident aquatic macroinvertebrate and fish communities. Assessments are made by comparing the macroinvertebrate and fish communities at "reference condition" streams where there are no significant disturbances, to the communities collected from the randomly selected stream sites.



Electrofishing in the Middle Fork Soldiers Creek, Sioux County.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are small creatures that live in streams attached to rocks, vegetation, woody debris, or burrowed into the stream bottom. They include aquatic larval stages of insects such as mayflies and dragonflies; crustaceans such as crayfish, as well as worms, clams, and snails. Because they may be extremely sensitive to pollutants, macroinvertebrate populations often respond to changes in water quality caused by the introduction of various contaminants into the stream. Department personnel have collected nearly 600 different species of macroinvertebrates since 1997 through the sampling effort associated with the SBMP. In addition, numerous new species not previously found in Nebraska have been recorded.



Collecting macroinvertebrates from Larabee Creek, Sheridan County.

Fish

From small coldwater trout streams to large warm rivers, Nebraska streams support more than 80 species of fish. As with macroinvertebrates, fish display varying habitat requirements and water quality tolerances making them excellent indicators of stream health. The majority of Nebraska's species are small, with adults generally less than five inches long. The Department's fish surveys have also provided information on changing abundances and ranges of fish in the state. Some species occur in many more places than previously thought, while others have shown dramatic declines over the last 30 years.



Fish collected from the South Platte River, Deuel County.

How are the Data Used?

The biological data collected through the SBMP are used to inform a variety of management activities, such as:

- Documenting current statewide biological conditions in Nebraska's streams to track water quality status and trends.
- Identifying streams that do not attain their assigned environmental goals and are in need of restoration or remedial action. Where significant problems were found (i.e. streams were assessed as having poor biological conditions), these stream segments are placed on the 303(d) List of Impaired Water Bodies (as required by the federal Clean Water Act) with regard to aquatic life.
- Identifying exceptional stream segments (reference conditions).
- Providing accurate biological distribution information.
- Serves as a benchmark to measure BMP success.

Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation’s waters and to adopt water quality standards to restore and maintain that integrity. States are required to prepare a biennial water quality report called the Integrated Report, which provides a comprehensive summary of the status and trends of surface water quality and includes a list of impaired surface waters that do not support their assigned beneficial uses. The information collected by the Department’s SBMP satisfies these requirements for assessing the biological integrity of Nebraska’s streams.



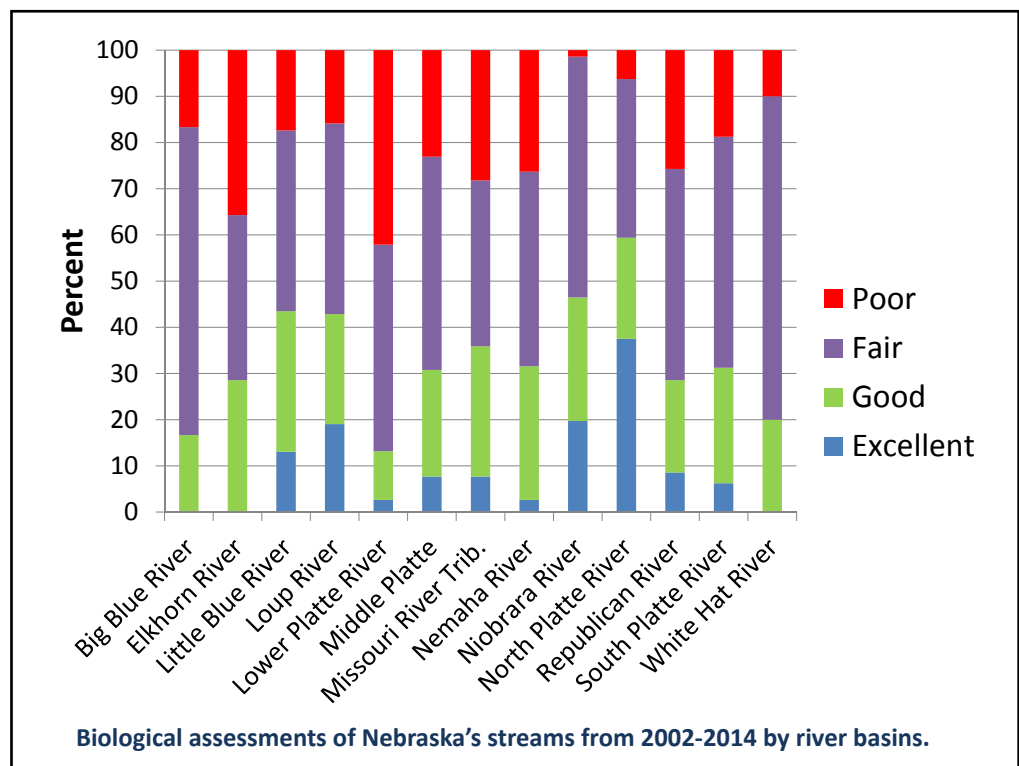
Collecting water chemistry field parameters, in Middle Fork Soldiers Creek, Sioux County.

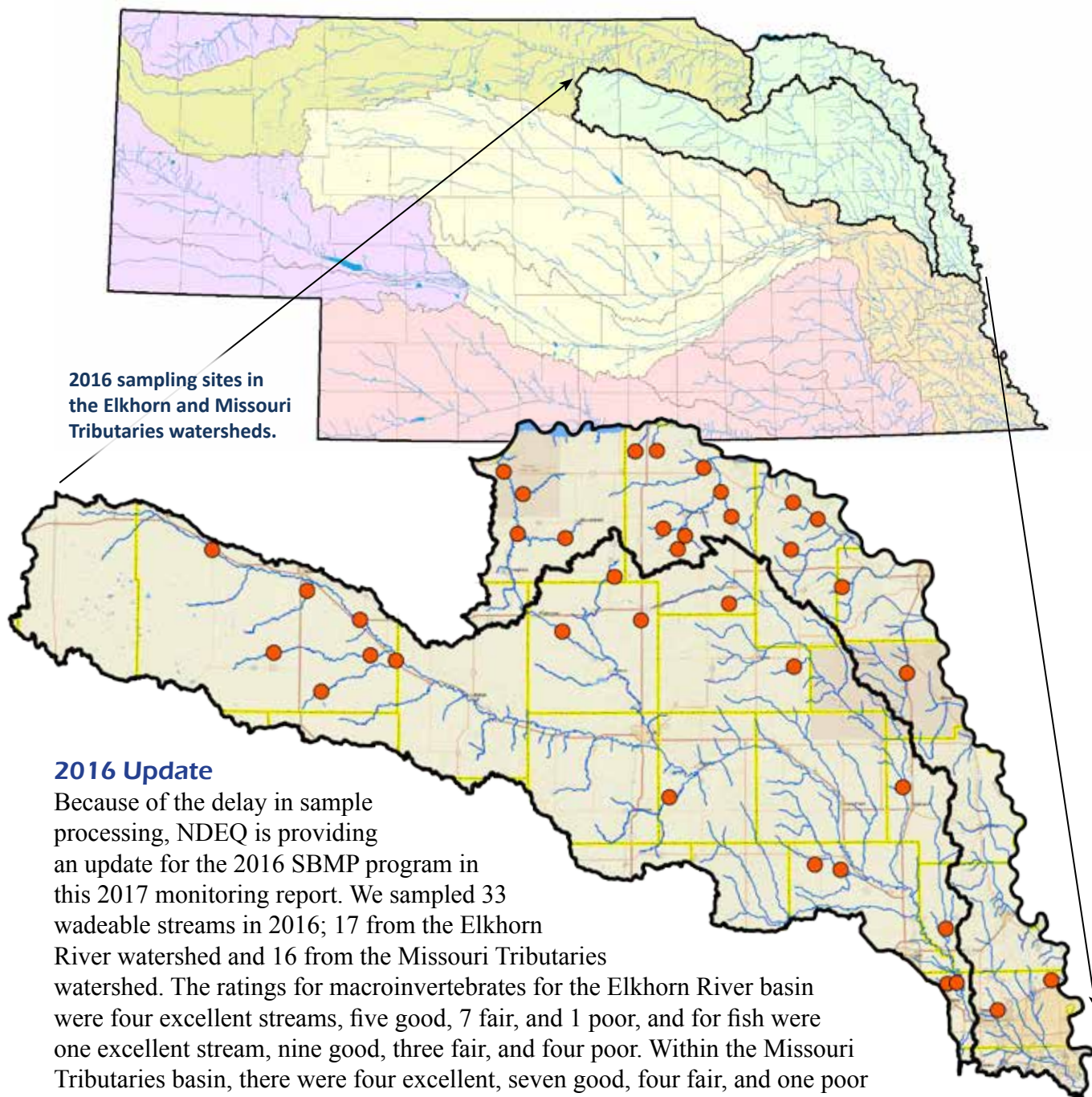
Results

Biological data from 459 random sites were used to characterize the condition of wadeable streams in the 13 major river basins in Nebraska (see bar graph). The results of the survey show the North Platte and Niobrara Basins are in the best condition of the basins evaluated with 59% and 47% of the streams in good condition, respectively. The streams in the Lower Platte Basin present the most concerns with only 14% of the streams in good condition and 42% of the streams in poor condition.

The Wadeable Streams Assessment done in 2004-2005 by EPA reported that increases in nutrients (e.g., nitrogen and phosphorus) and streambed sediments have the highest negative impact on biological condition. These contaminants are commonly introduced into the streams by non-point source pollution from agricultural practices such as crop production and livestock operations and by point source pollution such as discharge from sewage treatment facilities. In order to protect and improve

the condition of the streams in Nebraska, it is important that proper management measures are implemented to reduce the impacts of these pollutants. Analyses within Nebraska have shown that the availability of quality habitat may be more important than nutrients for promoting aquatic biodiversity in some cases.





2016 sampling sites in the Elkhorn and Missouri Tributaries watersheds.

2016 Update

Because of the delay in sample processing, NDEQ is providing an update for the 2016 SBMP program in this 2017 monitoring report. We sampled 33 wadeable streams in 2016; 17 from the Elkhorn River watershed and 16 from the Missouri Tributaries watershed. The ratings for macroinvertebrates for the Elkhorn River basin were four excellent streams, five good, 7 fair, and 1 poor, and for fish were one excellent stream, nine good, three fair, and four poor. Within the Missouri Tributaries basin, there were four excellent, seven good, four fair, and one poor stream for macroinvertebrates, and three excellent, five good, five fair, and three poor streams for fish. There were 233 different macroinvertebrate taxa and 55 different fish species collected in 2016. Sand shiners (*Notropis stramineus*), red shiners (*Cyprinella lutrensis*), and brassy minnows (*Hybognathus hankinsoni*) were the most common fish species. *Physella* snails, worms of the family tubificidae, bugs of the family corixidae, *Caenis* and *Tricorythodes* mayflies, flies of the family chironomidae, and *Cheumatopsyche* and *Nectopsyche* caddisflies were all common in the two basins.

More Information:

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/SBMP>

Tom Heatherly, tom.heatherly@nebraska.gov or (402) 471-2192.

Erik Prenosil, erik.prenosil@nebraska.gov or (402) 471-4234.

Ambient Lake Monitoring Program

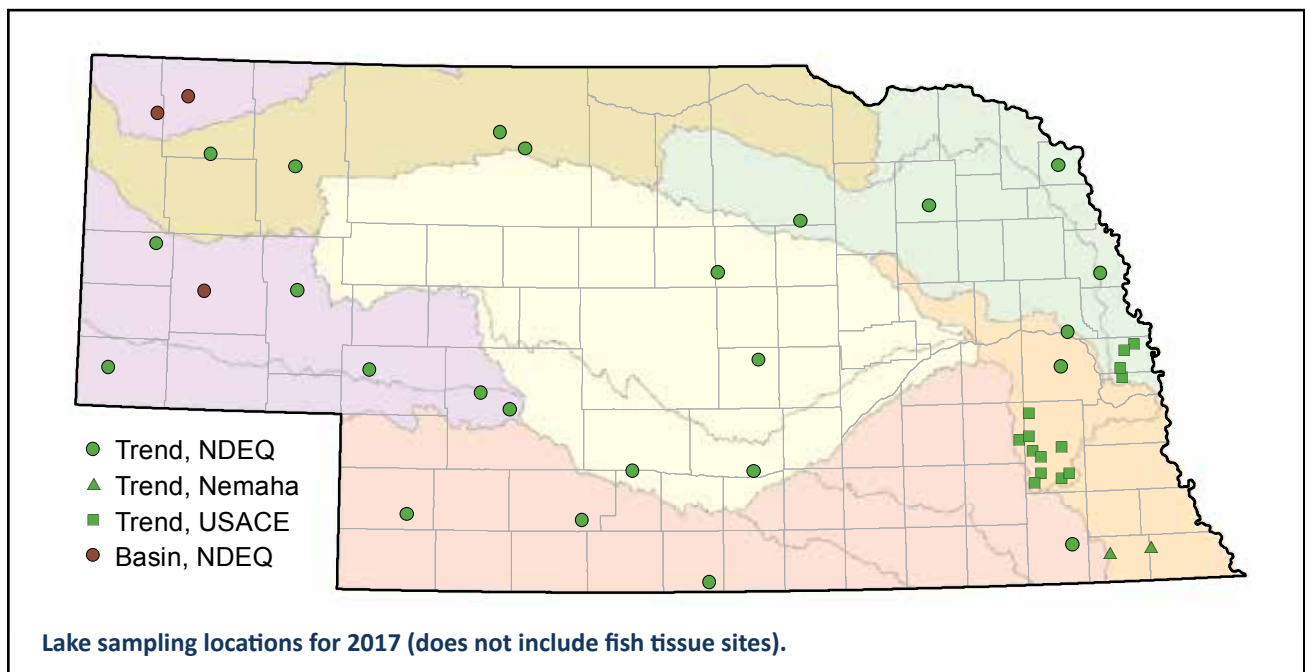
Why Monitor Lakes and Reservoirs?

Nebraska's natural lakes and man-made reservoirs have different public usage throughout the year. NDEQ monitors these resources to determine if water quality is sufficient for recreational activities such as swimming and water skiing, and suitable for fish and other aquatic organisms to survive and reproduce.

Monitoring involves the collection of monthly water samples from May through September from publicly owned lakes and reservoirs across the state. In some cases, the streams that flow into reservoirs are also monitored. Since reservoirs are a reflection of their watersheds, data on streams that flow into reservoirs can provide useful information in evaluating water quality problems. In 2017, 44 lakes were sampled for physical/chemical parameters by NDEQ (27) and its lake monitoring partners which currently include the US Army Corp of Engineers (15) and Nemaha NRD (2). In 2017, we made a slight shift in the Ambient Lake Monitoring Program. We will now be doing long-term trend sampling in more lakes (24) across the state. These lakes represent the diversity of lake types, geography, and watersheds found across Nebraska. In addition to these Trend Lakes we will also sample 3-5 basin lakes each year.



Sample set collected from Rockford Lake, Gage County.



What is monitored?

To determine if water quality is sufficient to meet its intended uses in these lakes, samples are taken monthly near the surface at the deep water site (deepest area) of each lake. These sites are sampled for physical/chemical parameters such as water temperature, dissolved oxygen (DO), pH, conductivity, water clarity, total suspended solids, ammonia, nitrate-nitrite nitrogen, kjeldahl nitrogen, total and dissolved phosphorus, alkalinity, chlorophyll a, and select pesticides. In addition, surface to bottom profiles are collected for temperature, DO, pH, and conductivity. Profile data is collected every 0.5 meters starting at the water surface and are used to determine at what depth lake stratification may take place. Profiles are collected at deep water sites and mid-lake sites (approximately in the middle of the lake).



Determining water clarity at Merritt Reservoir, Cherry County.



Measuring field parameters at Rockford Lake, Gage County.



Filter disc for chlorophyll analyses.

How are the Data Used?

Collected data are compared to a Water Quality Standard or a benchmark that will indicate if there is a concern. For most parameters, a minimum number of violations or excursions will be allowed before the waterbody is considered to be impaired or not to have sufficient quality. If a waterbody is considered to be impaired, it will be placed on Nebraska's Section 303(d) List of Impaired Waters. Once on this list, more information is collected to develop water quality targets and pollutant reduction goals. These targets and reductions are incorporated into a document called a Total Maximum Daily Load (TMDL). The TMDL then provides the basis for water quality improvement projects sponsored by various resource management and funding agencies such as Natural Resources Districts, Municipalities, Nebraska Game and Parks Commission, and USDA-Natural Resources Conservation Service to name a few. While the Section 303(d) list is revised every two years, assessments on each lake or reservoir are conducted on an annual basis. Results of the assessments are presented in the Water Quality Integrated Report that is prepared by NDEQ on even numbered years. Recent reports are available on-line at <http://deq.ne.gov/NDEQProg.nsf/OnWeb/TMDL>.

Statewide Concerns

Nutrients and algae related issues are the most common lake impairments. Excessive algae growth can increase the pH of the water which can make some things, like ammonia, more toxic to aquatic organisms. Excessive nutrients can also lead to blooms of blue green algae and high concentrations of microcystin, which is a toxin produced by this algae.

The accumulation of contaminants in the tissue of fish is a growing concern across the country. Approximately 35 percent of the lakes assessed had unacceptable concentrations of contaminants in fish tissue (see “Fish Tissue Monitoring” section of this report). In most cases, the impairments were due to mercury which is believed to be entering lakes through atmospheric deposition.



Filtering water for a dissolved phosphorous sample at Lake Wanahoo, Saunders County.

Lake Improvement Programs

When water quality programs were first initiated at NDEQ, most efforts were aimed at reducing the impacts of point source discharges. From the early 1970s through the present, lake and reservoir management has evolved to include nonpoint sources. Several programs administered by NDEQ, as well as other local, state, and federal programs, work to protect impounded waters. Some of the programs administered by NDEQ that are protective of the quality of impounded waters include Livestock Waste, Wastewater, Storm Water, and Nonpoint Source.

Numerous agencies, including local, state, and federal, are involved in different aspects of lake and reservoir management whether it be the collection and/or assessment of data, water quality planning, or implementing projects to address water quality problems. The coordination of efforts among these entities has allowed for a more comprehensive and cost effective approach to lake and reservoir management.

More Information:

Mike Archer, mike.archer@nebraska.gov or (402) 471-4224.

Dave Bubb, dave.bubb@nebraska.gov or (402) 471-2810.



Carter P. Johnson Lake, Dawes County.

Fish Tissue Monitoring Program

Why NDEQ Does this Monitoring

Each year fish samples are collected from numerous streams and lakes across Nebraska to determine their suitability for human consumption. This is important because certain contaminants have a tendency to bio-concentrate in fish tissue and, when eaten, can cause an increased risk for human health problems. In waterbodies where contaminant levels in fish are of concern, “fish consumption advisories” are issued. These advisories do not ban the consumption of fish from a particular waterbody. Rather, advisories are designed to inform the public of how to safely prepare and eat what they catch, and provide suggested guidelines for limiting consumption. As a food source, fish are a high quality protein, low saturated fat, and high omega-3 fatty acid food source, so anglers should not be discouraged from consuming fish in moderation.



History of Fish Tissue Program

Fish tissue sampling in Nebraska was initiated in the late 1970s, primarily to identify potential pollution concerns throughout the State. Monitoring efforts were focused on whole fish samples collected on large rivers near the bottom of their drainage areas. In the late 1980s, more emphasis was placed on evaluating human health concerns and the Department began analyzing the fillet portions from fish that are most-often consumed. These efforts have continued to the present day.

Where is the Monitoring Conducted?

Monitoring is generally conducted at locations where most fishing occurs; therefore, where the potential risk to human health is greatest. Fish species targeted for collection included those that



Fish collected at Iron Horse Trail Lake, Pawnee County.

are most frequently sought by fisherman, including: catfish, largemouth bass, walleye, crappie, and carp. From July 1 to September 30 each year, the Department collects fish samples from approximately 40-50 pre-selected streams and publicly owned lakes in one to three of Nebraska’s 13 major river basins (see map and table on the following pages for historic sampling locations and information). Fish tissue sampling activities are rotated through all 13 basins on a six-year cycle. In 2017, a total of 75 fish tissue samples were collected from 7 streams and 33 lakes in the North Platte, South Platte, and White/Hat River basin’s for analysis of contaminants.

What is Monitored?

Fish tissue samples prior to 2014 were analyzed for a variety of parameters including heavy metals, pesticides, and other organic compounds. Of the parameters screened, those of primary concern are:

- *polychlorinated biphenyl compounds* (PCBs) – prior to 1971, they were used in heat transfer fluids, hydraulic fluids, lubricants, and wax extenders, and later in electrical transformers and capacitors.
- *methyl mercury* (organic mercury) – occurs naturally and is released into the environment from mining operations, fossil fuel combustion, refuse incineration, and industrial waste discharges.
- *dieldrin* – a breakdown product of the insecticide Aldrin, generally used on corn prior to 1974.



Fish tissue sample preparation at Zorinsky Lake, Douglas County

Monitoring by the U.S. Environmental Protection Agency (U.S. EPA) Region 7

laboratory will only be for one contaminant, mercury. Like other states across the nation, mercury is responsible for the majority of our fish consumption advisories (>95%). Locations where other contaminants are of concern will be given special consideration for additional contaminant analysis.

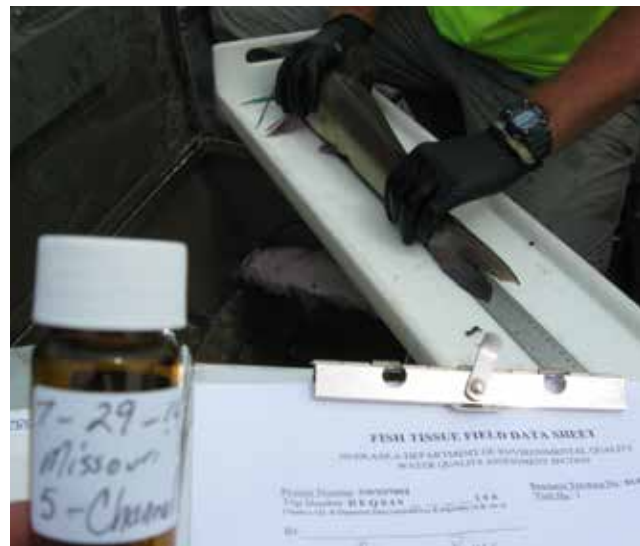
How are the Data Used?

Fish tissue data collected are used to assess human health risks utilizing a risk-based assessment procedure. For non-cancer (noncarcinogenic) effects, the assessment procedure results in a *Hazard Quotient* (HQ) value for each contaminant and takes into account an average adult body weight, ingestion rate, exposure frequency and duration, and percent absorption of contaminants. If more than one contaminant is present in the fish tissue, then the HQs are summed to derive a Hazard Index (HI). If the HI is less than 1.0, then adverse noncarcinogenic effects are not anticipated. If the HI equals or exceeds 1.0 then an advisory is issued.

For a contaminant that may also be associated with a cancer risk, the risk-based assessment procedure results in a *Cancer Risk* (CR) estimate that represents the probability of an individual developing cancer during their lifetime as a result of exposure to the potential carcinogen. If more than one potential carcinogen is present in fish tissue then the risk estimates are summed. Advisories are issued if the estimated CR equals or exceeds 0.0001 (1 in 10,000).

While mercury (methylmercury) is a contaminant accounted for in the HI, Nebraska also utilizes a fish tissue residue criterion (TRC) in place of a water column criterion for the protection of human health. Nebraska's TRC represents the mercury (0.215 mg/kg) concentration in fish tissue that should not be exceeded on the basis of a consumption rate of eight ounces (0.227 kg) per week. Advisories are issued if the mercury concentration in fish tissue equals or exceeds the TRC of 0.215 mg/kg. Exposure to high levels of mercury have been shown to adversely affect the developing nervous system, so women of child-bearing age, pregnant women, and children less than 15 years of age are the most sensitive to the effects of mercury.

Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate a health risk for consumers. Waterbodies where sampling has revealed exceedances of health risk criteria and subsequent consumption advisories have been issued will be re-sampled following the six-year rotating basin monitoring approach. Re-sampled sites will be removed from the advisory list if their respective samples indicate contaminant levels below health risk criteria.

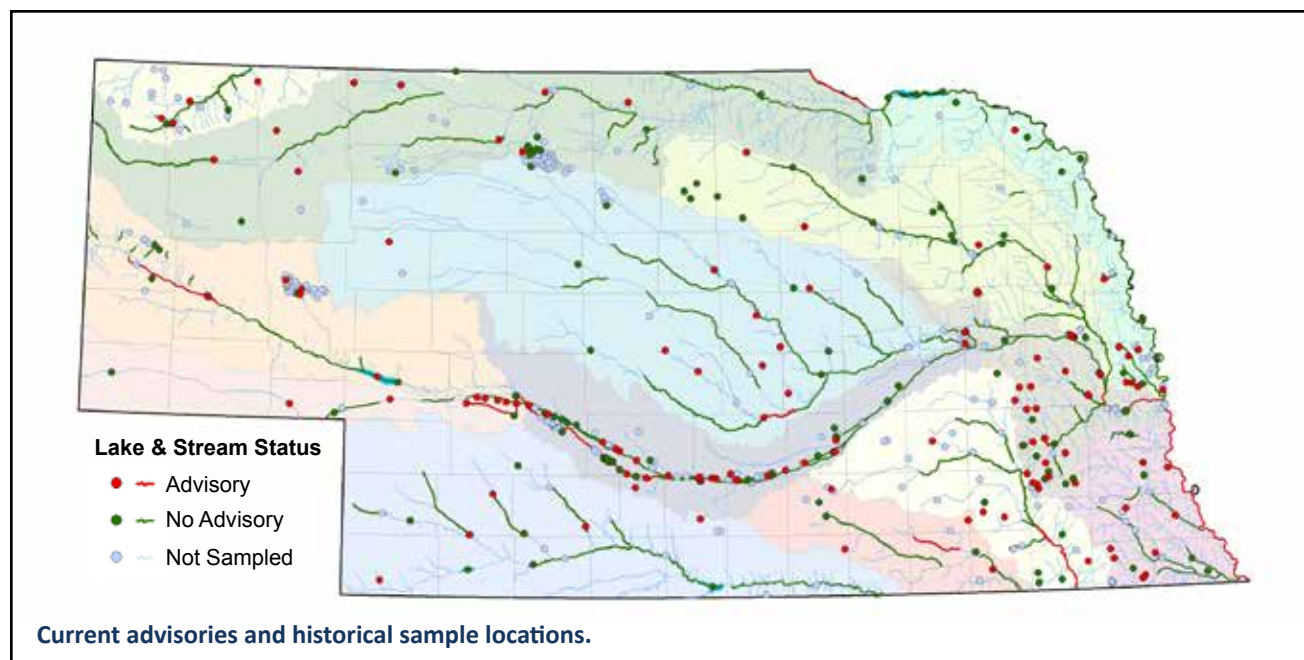


Fish tissue sample preparation.

Fish tissue data are also utilized to assess impairment of Nebraska’s waterbodies. Where fish consumption advisories exist, the NDEQ places those waters on the State’s Section 303(d) List of Impaired Waterbodies with regard to aquatic life. Nebraska does not have an assigned beneficial use of “fish consumption” in Title 117 Surface Water Quality Standards, therefore the assumption is made that if contaminant loads to fish can affect human health, it is probable that these contaminants can impact aquatic life health.

Current Advisories

As of October 2017, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 141 waterbodies, which includes 13 designated stream segments and 128 lakes/reservoirs. These advisories are not bans on eating fish, rather a warning to limit the consumption of specified fish. The map below and following table display advisory locations and information.



Nebraska Fish Consumption Advisories Through 2016

WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
Lake Hastings	Adams	Common Carp	PCBs
Bassway Strip Lake No. 5	Buffalo	Largemouth Bass	Mercury
Blue Hole Lake - WMA	Buffalo	Largemouth Bass	Mercury
Coot Shallows Lake - WMA	Buffalo	Largemouth Bass	Mercury
Cottonmill Lake	Buffalo	Largemouth Bass	Mercury
Kea Lake	Buffalo	Largemouth Bass	Mercury
Kea West Lake - WMA	Buffalo	Largemouth Bass	Mercury
Ravenna Lake	Buffalo	Largemouth Bass	Mercury
Sandy Channel Lake - SRA	Buffalo	Largemouth Bass	Mercury
South Loup River	Buffalo	Channel Catfish	Mercury
Union Pacific Lake - SRA	Buffalo	Largemouth Bass	Mercury
War Axe Lake -SRA	Buffalo	Smallmouth Bass	Mercury
Yanney Park Lake	Buffalo	Largemouth Bass	Mercury
Summit Lake	Burt	Largemouth Bass	Mercury
Homestead Lake	Butler	Largemouth Bass / Bluegill	Mercury
Redtail Lake	Butler	Largemouth Bass	Mercury
Timber Point Lake	Butler	Largemouth Bass	Mercury
Platte River	Cass	Channel Catfish	PCBs, Mercury
Cottonwood Lake	Cherry	Largemouth Bass	Mercury
Duck Lake	Cherry	Largemouth Bass	Mercury
Merritt Reservoir	Cherry	Walleye / Largemouth Bass	Mercury
Schoolhouse Lake	Cherry	Northern Pike / Largemouth Bass / Black Crappie	Mercury
Shell Lake	Cherry	Largemouth Bass	Mercury
Valentine Mill Pond	Cherry	Largemouth Bass / Bluegill	Mercury
West Point City Lake	Cuming	Largemouth Bass	Mercury
Ansley City Lake	Custer	Largemouth Bass	Mercury
Melham Park Lake	Custer	Largemouth Bass	Mercury
Pressey Pond -WMA	Custer	Largemouth Bass	Mercury
Box Butte Reservoir	Dawes	Northern Pike / Largemouth Bass	Mercury
Grabel Pond No. 5	Dawes	Largemouth Bass	Mercury, Selenium
Whitney Reservoir	Dawes	White Bass	Mercury
Cozad Lake - WMA	Dawson	Largemouth Bass	Mercury
Darr Lake -WMA	Dawson	Largemouth Bass	Mercury
Dogwood Lake -WMA	Dawson	Largemouth Bass	Mercury
East Gothenburg Lake - WMA	Dawson	Largemouth Bass	Mercury
Plum Creek Canyon Reservoir	Dawson	Common Carp	PCBs
West Cozad Lake - WMA	Dawson	Largemouth Bass	Mercury
Chappell Interstate Lake	Deuel	Largemouth Bass	Mercury, Selenium
Buckskin Hills Lake	Dixon	Largemouth Bass	Mercury

Fremont Lake No. 1	Dodge	Largemouth Bass	Mercury
Fremont Lake No. 11 - SRA	Dodge	Largemouth Bass	Mercury
Fremont Lake No. 20E - SRA	Dodge	Largemouth Bass	Mercury
PrairieView Lake	Douglas	Largemouth Bass	Mercury
Standing Bear Lake	Douglas	Largemouth Bass / Black Crappie	Mercury
Two Rivers Lake No. 1 - SRA	Douglas	Largemouth Bass	Mercury
Glenn Cunningham Lake	Douglas	Largemouth Bass	Mercury
Lawrence Youngman Lake	Douglas	Largemouth Bass / Black Crappie / Bluegill	Mercury
Rock Creek Lake	Dundy	Largemouth Bass	Mercury
Lone Star Reservoir	Fillmore	Largemouth Bass	Mercury
Medicine Creek Reservoir	Frontier	Largemouth Bass	Mercury
Big Blue River	Gage	Common Carp	PCBs, Dieldrin
Rockford Lake	Gage	Largemouth Bass	Mercury
Wolf-Wildcat Lake	Gage	Largemouth Bass	Mercury
Crescent Lake	Garden	Largemouth Bass	Mercury
Island Lake	Garden	Largemouth Bass	Mercury
Smith Lake	Garden	Largemouth Bass	Mercury
Elwood Reservoir	Gosper	Northern Pike / Largemouth Bass	Mercury
Phillips Lake	Gosper	Common Carp	Mercury
Tri-County Supply Canal -below J1 Hydro	Gosper	Common Carp	PCBs
Frey Lake - WMA	Grant	Largemouth Bass	Mercury
Cheyenne Lake - SRA	Hall	Largemouth Bass	Mercury
L.E. Ray Lake	Hall	Largemouth Bass	Mercury
Mormon Island Middle Lake - SRA	Hall	Largemouth Bass	Mercury
Frenchman WMA West Lake	Hayes	Largemouth Bass	Mercury
Hayes Center WMA Lake	Hayes	Largemouth Bass	Mercury
Goose Lake	Holt	Largemouth Bass	Mercury
Atkinson Lake	Holt	Largemouth Bass	Mercury
Farwell South Reservoir	Howard	Largemouth Bass / Common Carp	Mercury
Crystal Springs NW Lake	Jefferson	Channel Catfish	PCBs, Mercury
Wirth Brothers Lake	Johnson	Largemouth Bass / Black Crappie	Mercury
Lake McConaughy	Keith	Walleye	Mercury, Selenium
Ogallala City Park Lake	Keith	Channel Catfish	PCBs, Chlordane
Cub Creek Lake	Keya Paha	Largemouth Bass	Mercury
Missouri River	Knox	Flathead Catfish	Mercury
Bowling Lake	Lancaster	Largemouth Bass	Mercury
Cottontail Lake	Lancaster	Largemouth Bass	Mercury
Hedgefield Lake - WMA	Lancaster	Largemouth Bass	Mercury
Holmes Lake	Lancaster	Largemouth Bass	Mercury
Merganser Lake	Lancaster	Largemouth Bass	Mercury
Oak Creek	Lancaster	Channel Catfish	Mercury
Olive Creek Lake	Lancaster	Largemouth Bass	Mercury
Pawnee Lake	Lancaster	Largemouth Bass	Mercury

Wild Plum Lake	Lancaster	Largemouth Bass / White Crappie	Mercury
Wildwood Reservoir	Lancaster	Largemouth Bass	Mercury
Yankee Hill Lake	Lancaster	Largemouth Bass / Bluegill	Mercury
Birdwood Lake	Lincoln	Largemouth Bass	Mercury
East Hershey Lake	Lincoln	Largemouth Bass	Mercury
East Sutherland Lake	Lincoln	Largemouth Bass	Mercury
Fort McPherson Lake	Lincoln	Largemouth Bass	Mercury
Fremont Slough - WMA	Lincoln	Largemouth Bass	Mercury
Hershey Lake	Lincoln	Largemouth Bass	Mercury
Interstate Lake - North Platte	Lincoln	Largemouth Bass	Mercury
Maloney Res. Outlet Canal - above hydro	Lincoln	Common Carp	PCBs, Mercury
Maloney Res. Outlet Canal - below hydro	Lincoln	Channel Catfish / Smallmouth Bass	PCBs / Mercury
North Platte River	Lincoln	Largemouth Bass	Mercury
Pawnee Slough Lake	Lincoln	Largemouth Bass	Mercury
Sutherland Cooling Pond	Lincoln	Common Carp / Largemouth Bass	Mercury, Selenium / Mercury
Sutherland Outlet Canal	Lincoln	Channel Catfish	PCBs, Mercury
Sutherland Reservoir	Lincoln	Common Carp	PCBs, Mercury
Calamus Reservoir	Loup	Common Carp	Mercury
Bridgeport Middle Lake	Morrill	Largemouth Bass	Mercury
North Platte River	Morrill	Common Carp	Mercury, Selenium
Auburn Rotary Club Lake	Nemaha	Largemouth Bass	Mercury
Steinart Park Lake	Otoe	Largemouth Bass	Mercury
Wilson Creek 2X - WMA	Otoe	Largemouth Bass / Black Crappie	Mercury
Burchard Lake	Pawnee	Largemouth Bass	Mercury
Mayberry Lake - WMA	Pawnee	Largemouth Bass	Mercury
Iron Horse Trail Lake	Pawnee	Largemouth Bass	Mercury
Prairie Knoll Lake	Pawnee	Largemouth Bass / Bluegill	Mercury
Holdredge Park Lake	Phelps	Largemouth Bass	Mercury, Selenium
Columbus City Park Pond	Platte	Largemouth Bass	Mercury
Lake Babcock	Platte	Common Carp	Mercury
Maple Creek Recreation Area Lake	Platte	Largemouth Bass	Mercury
Kirkman's Cove Lake	Richardson	Largemouth Bass / Common Carp	Mercury
Missouri River	Richardson	Flathead Catfish	Mercury
Willard L. Meyer - Swan Creek Lake 5A	Saline	Largemouth Bass	Mercury
Swanton Lake - Swan Lake No. 67	Saline	Largemouth Bass	Mercury
Walnut Creek Lake No. 2	Saline	Largemouth Bass	Mercury
Offutt Lake	Sarpy	Channel Catfish / Common Carp	PCBs
Walnut Creek Lake	Sarpy	Largemouth Bass / Bluegill	Mercury
Wehrspann Lake	Sarpy	Largemouth Bass	Mercury
Prairie Queen Lake	Sarpy	Largemouth Bass	Mercury
Czechland Lake	Saunders	Largemouth Bass	Mercury
Lake Wanahoo	Saunders	Largemouth Bass	Mercury
Memphis Lake	Saunders	Largemouth Bass	Mercury

Red Cedar Lake	Saunders	Largemouth Bass	Mercury
Morrill Sandpit - North	Scottsbluff	Largemouth Bass	Mercury, Selenium
Morrill Sandpit - Southwest	Scottsbluff	Largemouth Bass	Mercury
Meadowlark Lake	Seward	Largemouth Bass / Bluegill	Mercury
Isham Dam Lake	Sheridan	Largemouth Bass	Mercury
Smith Lake	Sheridan	Largemouth Bass	Mercury
Walgren Lake	Sheridan	Largemouth Bass	Mercury
Sherman Reservoir	Sherman	White Bass	Mercury
Carter P. Johnson Lake	Sioux	Largemouth Bass	Mercury
Maskenthine Lake	Stanton	Largemouth Bass / Bluegill	Mercury
Big Sandy Creek	Thayer	Channel Catfish	Mercury
Auble Pond	Valley	Largemouth Bass	Mercury
Davis Creek Lake	Valley	Common Carp / White Bass	Mercury
Liberty Cove	Webster	Largemouth Bass	Mercury
Pibel Lake	Wheeler	Largemouth Bass	Mercury
Recharge Lake	York	Largemouth Bass	Mercury

Eat Safe Fish in Nebraska brochure available online.

Why Eat Fish?

- S** Smaller fish are better (They tend to contain fewer contaminants)
- A** Avoid large predator fish & bottom-feeders (They accumulate more contaminants)
- F** Fat, skin & organs should be removed (Most contaminants are stored in the fat, skin & organs of the fish)
- E** Eat fish that have been broiled or grilled on a rack (So more fat can drip away while cooking)

Why Are There Contaminants In Fish?

- Contaminants can persist in the environment and accumulate in living things, such as fish
- Contaminants like PCBs and some insecticides build up in the fat of the fish
- Mercury is one contaminant that stores in fish muscle or the fillet

Note: Pregnant or nursing women, and young children especially, should follow these guidelines, as a developing nervous system is particularly sensitive to mercury.

See the Eat Safe Fish Webpage for more detailed information, including local fish consumption advisories.

www.nebraska.gov/eatsafefish

More Information:

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/FTMP>

Greg Michl, NDEQ, greg.michl@nebraska.gov or (402) 471-4264.

Nebraska Game and Parks Commission, (402) 471-5553.

Nebraska Department of Health and Human Services, (402) 471-8880.

Monitoring for Fish Kills and Surface Water Complaints

Why do we sample after fish kills and complaints?

The agency responds to numerous fish kills and surface water complaints annually. In many cases, the investigations surrounding a fish kill may require sampling to document the cause of the water quality problem, the magnitude and extent of the water quality problem, the source of pollution and/or a responsible party. Because a fish kill could result in legal action, sampling requires a relatively high level of data quality.

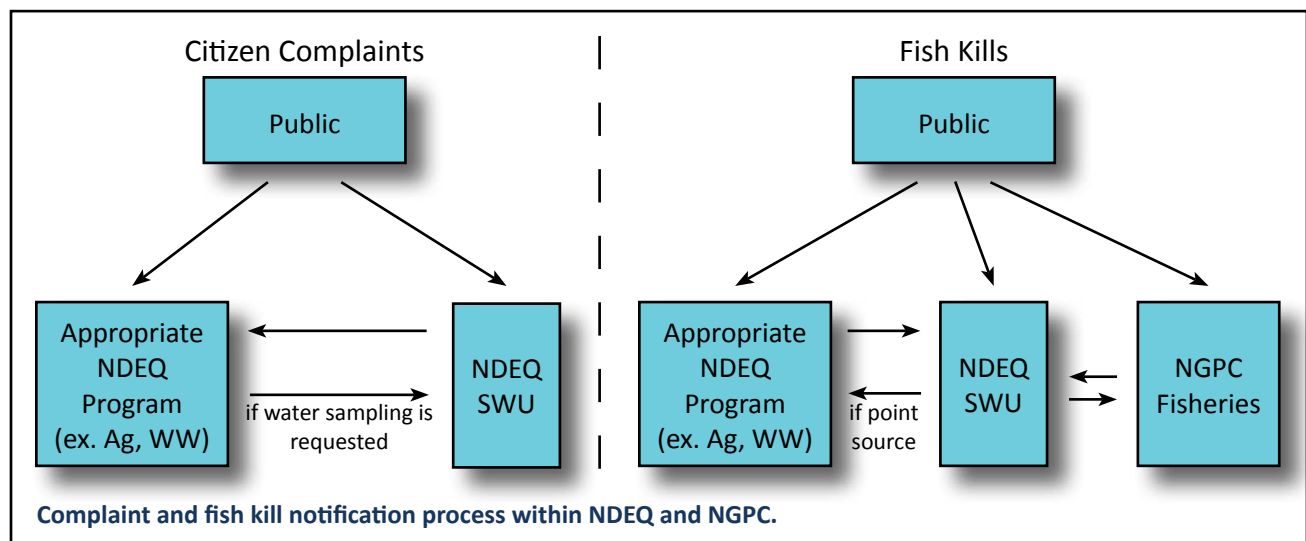
How does the notification process work?

If a call comes in from the public regarding a surface water complaint to NDEQ's Surface Water Unit (SWU) the SWU notifies NDEQ personnel within the program most closely related to the problem (ex. Agriculture, Waste Water). That program may then ask for SWU assistance in the investigation if water samples are requested.



Pawnee Creek impacted by nonpoint source run-off, Adams County.

Nebraska Game and Parks Commission (NGPC) fisheries personnel become involved upon notification of a fish kill. If NGPC personnel receive a call of a fish kill from the public they will notify the SWU who will in turn notify the appropriate NDEQ program unless the cause is natural and not the result of pollution. Natural fish kills can be the result of such stresses as spawning, disease, and oxygen depletion due to snow and ice cover on surface waters in winter or from the decay of abundant algae or aquatic vegetation within the waterbody which typically occurs during the summer months. If the SWU receives the call from the public, SWU staff will notify the NGPC of all fish kills and the appropriate NDEQ program if the kill is related to a pollution event. Within the NDEQ, the SWU is always notified of a fish kill regardless of cause or water body affected.





Confluence of Pawnee Creek (right) and the Little Blue River (left), with Pawnee Creek being impacted by nonpoint source run-off, Clay County.

What types of data are collected?

The cause of fish kills is determined from information collected from the reporting party and/or follow-up investigation and sampling. The types of data collected are determined on a case-by-case basis. Initially, the types of data to be collected are based on information provided by the person who reports the problem. A final determination of data needed is made by the investigator once an initial site evaluation has been made. In many cases, field measurements of pH, temperature, conductivity, and dissolved oxygen are used as screening parameters to determine if a problem exists, but further sampling and investigation may be needed to determine the cause of the fish kill.

Fish Kills Reported

From July 1, 2016 through June 30, 2017 a total of seven fish kills were reported to NDEQ. Four of the reported fish kills were attributed to low dissolved oxygen levels within the waterbody, whereas two were the result of disease, and one was the result of an undetermined pollutant.

Fish kills in the summer are typically caused by low dissolved oxygen concentrations stemming from “eutrophic” conditions. Eutrophication is a term that describes water quality conditions as a lake or reservoir ages. Lakes or reservoirs that are eutrophic tend to be shallow with high nutrient concentrations and exhibit frequent algae blooms, warmer water temperatures, and lower dissolved oxygen concentrations. Winter fish kills are often caused by low dissolved oxygen concentrations which are the result of prolonged ice and snow cover on lakes and ponds. When lakes are frozen over and have significant snow cover, the amount of oxygen slowly decreases due to decreased photosynthetic activity, low light, and no exposure to atmospheric oxygen.

Citizen Complaints

Between July 1, 2016 and June 30, 2017 the SWU received 47 notifications of concern regarding surface water issues. While many of these cases were referred to other agency programs that more closely relate to the problem, the SWU provided assistance through investigations and/or sample collection to help document conditions.

More information:

David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Dave Bubb, dave.bubb@nebraska.gov or (402) 471-2810.

Mike Archer, mike.archer@nebraska.gov or (402) 471-4224.



Junk dumped from a bridge in Bell Creek, Dodge County.

Surface Water Sampling Summary

As discussed in the previous short reports, the NDEQ performs surface water monitoring throughout the state. This section summarizes the number of samples and parameters analyzed for each monitoring program in 2017. Several of the State's 23 Natural Resources Districts (NRDs) (among other partners) provide monitoring support; the NRD abbreviations and headquarter cities are listed at the end of this section.

Ambient Stream Monitoring Program

Network: 101 sites statewide.

Frequency: monthly, 12 months per year.

Parameters:

- **Field Measurements:** water temperature, dissolved oxygen (DO), pH, conductivity, turbidity, stream discharge.
- **Traditional:** total suspended solids (TSS), chloride, ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus.
- **Pesticides:** monthly, May – September; atrazine and metolachlor.
- **Quarterly Metals:** 4 times per year (January, April, July, October).
- **Bottom of Basin Sites:** all metals, 17 sites (11 NDEQ + 6 USACE).

Total – selenium, mercury and; Dissolved – sodium, magnesium, calcium, arsenic, cadmium, chromium, copper, lead, nickel, silver, zinc.

- **All other Sites:** “partial metals list”, Total – selenium; Dissolved - sodium, magnesium, calcium, arsenic.



Collecting water samples from the Little Blue River.



Collecting water samples from the Little Blue River.

Total Number of Individual Field Measurement Readings and Sample Parameter Analyses:

- **Field Measurements:** 7,272
- **Traditional:** 7,272
- **Pesticides:** 1,010
- **Metals (all metals):** 884
- **Metals (partial metals list):** 1,680

Assistance: MNNRD, SPNRD, US Army Corps of Engineers (USACE).

Basin Rotation Monitoring Program

Network: 42 stream sites (including 23 shared Ambient Stream sites) and 2 lake sites in the North Platte, South Platte, and White/Hat Basins.

Frequency: weekly, May 1 - September 30 (22 weeks).

Year	River Basin(s)
2017	North Platte, South Platte, & White-Hat
2018	Big Blue, Little Blue and Republican
2019	Loup and Middle Platte
2020	Niobrara
2021	Lower Platte and Nemaha
2022	Elkhorn and Missouri Tributaries

Parameters (streams):

- **Field Measurements:** water temperature, DO, pH, conductivity, turbidity, stream discharge.
- **Traditional:** TSS, chloride, ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus.
- **Pesticides:** weekly, May – June; atrazine and metolachlor.
- **Bacteria:** *E. coli*.

Parameters (lakes):

- **Field Measurements:** water temperature, DO, pH, conductivity, turbidity.
- **Bacteria:** *E. coli*

Total Number of Individual Field Measurement Readings and Sample Parameter Analyses:

- **Field Measurements:** 5,500
- **Traditional:** 5,280
- **Pesticides:** 640
- **Bacteria (*E.coli*):** 924

Assistance: SPNRD.

Public Beach Monitoring Program

Network: 53 sites statewide from 50 lakes

Frequency: weekly, May 1 - September 30 (22 weeks)

Parameters: bacteria, toxic algae (microcystin)

Total Number of Routine Individual Sample Parameter Analyses:

- **Bacteria (*E. coli*):** 1,166
- **Toxic Algae (microcystin):** 1,166

Additional Toxic Algae Samples:

- **Fish Kill/Complaint Samples:** 3

Assistance: MNNRD, NNRD, URNRD, LRNRD, LLNRD, LENRD, SPNRD, Nebraska Public Power District (NPPD), Central District Health Department (CDHD), USACE.



Blue-green algae bloom at Merritt Reservoir, Cherry County.

Ambient Lake Monitoring Program

Network: 44 lakes statewide

NDEQ: 27 lakes

USACE: 15 lakes

NNRD: 2 lakes

Frequency: Monthly from May through September.

Parameters:

- **Traditional:** TSS, total phosphorus, dissolved orthophosphorus, ammonia, nitrate/nitrite, kjeldahl nitrogen, alkalinity, water clarity.
- **Pesticides:** atrazine and metolachlor..
- **Chlorophyll-a**
- **Field Measurements (depth profiles taken at deep-water and mid-lake locations):** pH, conductivity, water temperature, DO, turbidity.



Filtering water for a phosphorous sample at Merritt Reservoir, Cherry County.

Total Number of Individual Field Measurement Readings:

- **Deep-water:** 1,100
- **Mid-lake:** 1,100

Total Number of Individual Sample Parameter Analyses:

- **Traditional:** 1,550
- **Pesticides:** 440
- **Chlorophyll-a:** 220

Assistance: University of Nebraska-Lincoln (UNL), NNRD, USACE.

Fish Tissue Monitoring Program

Network: 75 fish samples collected from 40 sites (7 rivers/streams and 33 lakes) in the North Platte, South Platte, and White/Hat Basins.

Assistance: Nebraska Game and Parks Commission (NGPC), Nebraska Dept. of Health & Human Services, Nebraska Dept. of Agriculture, and USEPA.



Preparing a fish tissue sample collected from the Missouri River, Knox County

Stream Biological Monitoring Program

Network: 34 stream sites in the North Platte, South Platte, and White/Hat Basins.

Field measurements: water temperature, pH, DO, conductivity, turbidity and stream discharge, fish and aquatic insect communities, and habitat assessments.



Electrofishing for the Stream Biological Monitoring Program at Leander Creek, Cherry County.

Fish Kills and Surface Water Complaints

Timeframe: July 1, 2016 to June 30, 2017

A total of 7 fish kills were reported between July 1, 2016 and June 30, 2017. During this same timeframe, the Department received 47 notifications of complaints concerning surface water issues. Many of these cases were referred to other agency programs that more closely relate to the problem, sometimes the Surface Water Unit assisted by providing observations or samples to help document conditions.



Fish kill at a private pond, Saline County.

Assistance: NGPC and NRDs

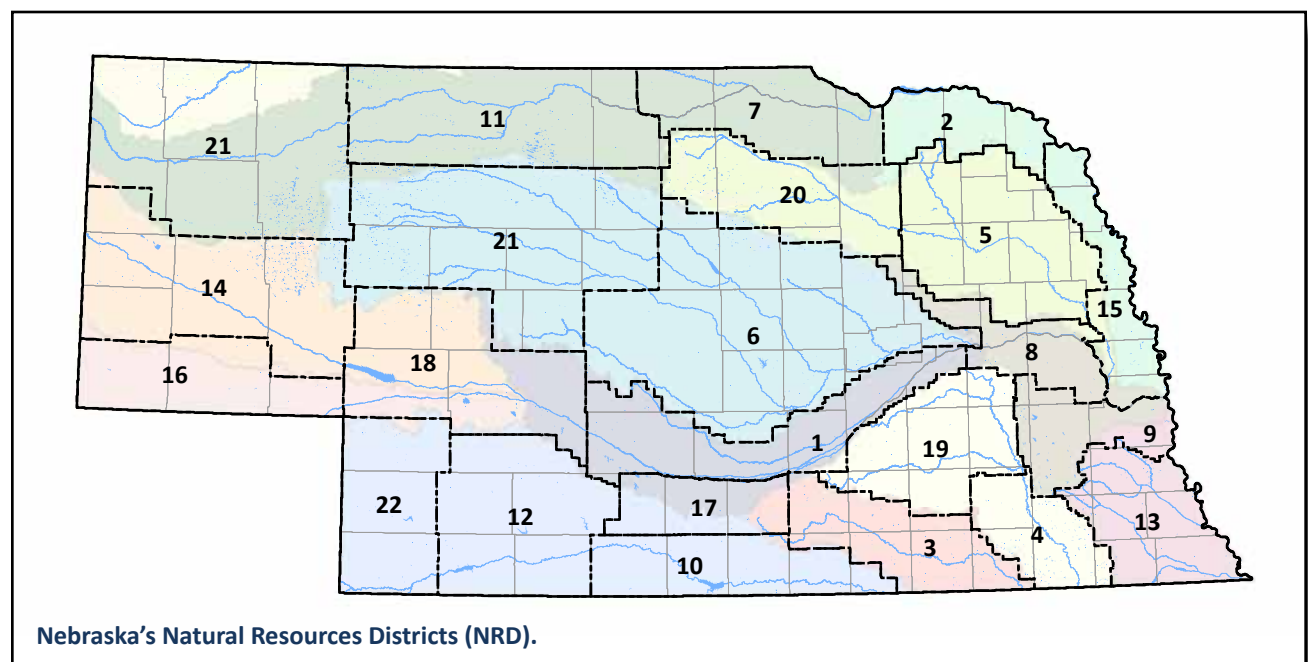
More Information: David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709. More information about the State's 23 Natural Resources Districts can be found at www.nrdnet.org.



Big Cottonwood Creek, Dawes County.

Natural Resources Districts, Abbreviations, and Headquarter Cities

Map #	Natural Resources District	Abbreviation	Headquarter City
1	Central Platte NRD	CPNRD	Grand Island
2	Lewis and Clark NRD	LCNRD	Hartington
3	Little Blue NRD	LBNRD	Davenport
4	Lower Big Blue NRD	LBBNRD	Beatrice
5	Lower Elkhorn NRD	LENRD	Norfolk
6	Lower Loup NRD	LLNRD	Ord
7	Lower Niobrara NRD	LNNRD	Butte
8	Lower Platte North NRD	LPNNRD	Wahoo
9	Lower Platte South NRD	LPSNRD	Lincoln
10	Lower Republican NRD	LRNRD	Alma
11	Middle Niobrara NRD	MNNRD	Valentine
12	Middle Republican NRD	MRNRD	Curtis
13	Nemaha NRD	NNRD	Tecumseh
14	North Platte NRD	NPNRD	Scottsbluff
15	Papio-Missouri River NRD	PMRNRD	Omaha
16	South Platte NRD	SPNRD	Sidney
17	Tri-Basin NRD	TBNRD	Holdrege
18	Twin Platte NRD	TPNRD	North Platte
19	Upper Big Blue NRD	UBBNRD	York
20	Upper Elkhorn NRD	UENRD	O'Neil
21	Upper Loup NRD	ULNRD	Theadford
22	Upper Niobrara-White NRD	UNWNRD	Chadron
23	Upper Republican NRD	URNRD	Imperial



Nebraska's Natural Resources Districts (NRD).

Stream Nutrient Assessment Procedure (SNAP) Pilot Study

What is SNAP?

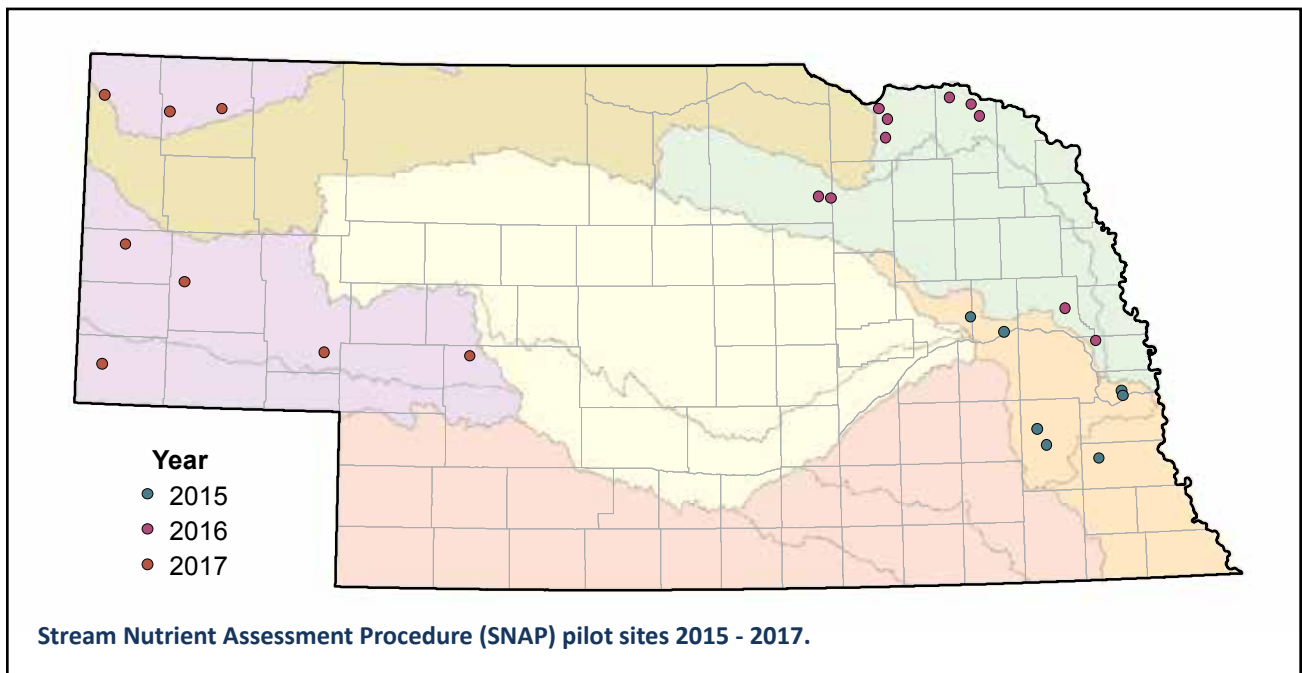
Increased nutrient enrichment can directly and indirectly affect the ecology of aquatic ecosystems by degrading water quality and changing communities of primary producers. High algae and macrophyte (rooted aquatic vegetation) biomass may be associated with severe swings in dissolved oxygen (DO). Low DO concentrations can increase the availability of toxic substances (e.g. ammonia), thereby reducing quality habitat for aquatic organisms.

Most existing numeric aquatic life water quality assessments are based upon criteria developed from well-defined dose-response relationships between individual pollutants and aquatic organisms. However, nutrient pollution and its effects on aquatic life are often indirect and not predictable through simple dose-response relationships. Because of these indirect effects, the impacts of nutrients can best be assessed with a weight of evidence approach that combines several metrics related to nutrients to determine whether nutrients are impairing the aquatic life use.

Ohio EPA has developed a methodology that is independent of highly variable instream nutrient concentrations and looks at three metrics that relate to impacts caused by nutrients (Ohio EPA, 2014). The Stream Nutrient Assessment Procedure (SNAP) evaluates biological criteria, dissolved oxygen (DO) swings, and benthic chlorophyll values in a step-wise matrix that determines whether the aquatic life condition of a stream is likely impacted by excess nutrients.



An engaged audience gathers to observe benthic chlorophyll and periphyton sample collection at Howe Creek, Knox County.



NDEQ's pilot

During the summer of 2015, the Department adapted Ohio's SNAP methodology and piloted it to assess impacts from nutrients on the biology of wadeable streams in Nebraska. The purpose of the pilot program was to see whether the methodology could be successfully implemented in Nebraska and whether meaningful data could result from the effort. The sampling sites were the same sites sampled in the Basin Rotation Monitoring Program (BRMP), and included fish, aquatic macroinvertebrates, 24-hour dissolved oxygen variation, habitat, and benthic chlorophyll-*a* and algal composition. In addition, the Department added analyses of benthic algal biomass and an additional measure of sestonic algal community composition using environmental DNA analyses. Ten more sites were sampled in 2016, and another eight sites were sampled in 2017 to facilitate the nutrient sampling of the Basin Monitoring Program.

The biological metrics are a pass/fail measure based on Nebraska's fish and macroinvertebrate bio-indices that meet or exceed the fair level (see the Stream Biological Monitoring portion of this report). The 24-hour dissolved oxygen swing is based on swings that are less than or equal to 6.5 mg/L or those greater than 6.5 mg/L. Benthic chlorophyll metrics are based on three levels: less than or equal to 182 mg/m²; greater than 182 mg/m² but less than or equal to 320 mg/m²; and greater than 320 mg/m². Results of these metrics in the matrix produces an assessment that indicates a stream is:

- attaining use, not threatened,
- attaining use, but may be threatened,
- impaired, but causes are other than nutrients,
- impaired, likely nutrient enriched, or
- impaired, nutrient enriched.

These categories will be evaluated based on other factors to determine whether the SNAP holds promise in Nebraska for determining nutrient impact in streams or whether modifications are needed before adopting this methodology for stream assessments.



Multi-parameter meter deployed to measure 24 hour dissolved oxygen variation at Antelope Creek, Cedar County.



Multi-parameter meter and benthic algae tiles at Monroe Creek, Sioux County.



Benthic algae tiles used to collect benthic chlorophyll and algal composition data at Antelope Creek, Cedar County.

24-Hour Dissolved Oxygen

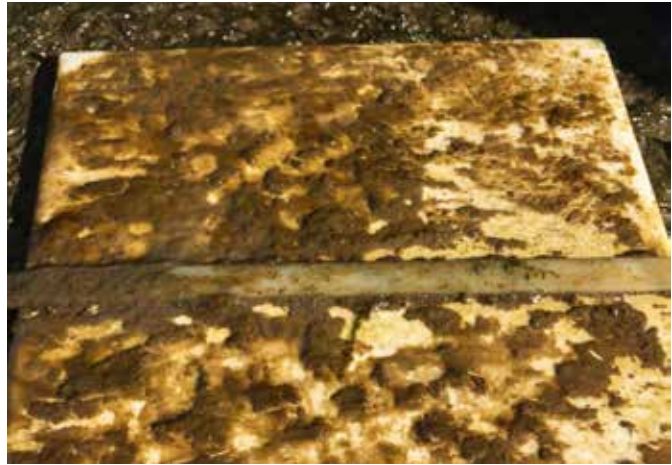
Continuous monitoring of dissolved oxygen was conducted at every site using a multi-parameter meter. The meter was placed in a secure location that would receive constant flow through the duration of the 24-hours. Readings were taken every 15 minutes.

Benthic Chlorophyll and Periphyton Collection

Periphyton is a complex mixture of organisms including algae, fungi, and microbes, and other materials that are attached to submerged surfaces in most aquatic ecosystems.

Periphyton is an important food source, and its growth in streams is strongly linked to the nutrients within that system. Periphyton samples were collected at all stream sites from colonized tiles. Two ceramic tiles were attached to cement blocks and placed at the bottom of the stream channel and left to colonize for two to three weeks. At least one tile was collected from each site, and the periphyton scraped from the tile was analyzed for algal taxonomic composition, chlorophyll-*a* content and algal biomass.

Environmental DNA (eDNA) sampling was added in 2016 as a separate pilot study within the SNAP pilot study. The eDNA sampling was performed by filtering stream water from the center of the channel to collect the algal genetic material suspended in the water column (sestonic) and sending these filters for analysis at Jonah Ventures, Inc. in Boulder, CO. This approach is attractive because of the ease of sampling and relatively inexpensive analysis of algal community structure. We also believe this sample may prove to be a nice supplement to the SNAP study because the sestonic sample is not influenced by the factors that may affect algal growth on tiles (benthic) besides nutrient concentrations, such as the depth at which the tiles were placed, the water velocity over the tiles, and the potential for herbivorous fish and insects to eat grown algae.



Benthic algae tile retrieved from White River, Dawes County.



Removing benthic algae from colonized tiles.



Removing benthic algae from colonized tiles.



Preparing to filter a benthic chlorophyll sample collected from Maple Creek, Dodge County.



Preparing to filter a benthic chlorophyll sample collected from Tub Springs Drain, Scotts Bluff County.

2017 Update

Sample collections from 2015 and 2016 have received preliminary analyses, and we are awaiting sample identifications from tiles from 2017. The primary producers in Nebraska streams generally appeared to be limited by nitrogen concentration. Several parameters in different basins correlated with nitrogen availability (especially nitrate + nitrite), including tolerant and sensitive algal species, the ratio of cyanobacteria to diatom cells, and overall algal assemblage structure. In some basins there was also increased sestonic chlorophyll-*a* with increased nitrogen. NDEQ has two more years of sampling planned to acquire a representation of streams from across the state.

More Information:

Tom Heatherly, tom.heatherly@nebraska.gov, (402) 471-2192

David Schumacher, david.schumacher@nebraska.gov, (402) 471-4709

John Bender, john.bender@nebraska.gov, (402) 471-4201



eDNA filter attached to syringe at Tub Springs Drain, Scotts Bluff County.

Surface Water Quality Report Card

Nebraska's Assessment of Lakes and Rivers

The federal Clean Water Act (CWA) requires states to assess the water quality of their lakes and rivers to determine if they meet state and federal water quality objectives. Nebraska's water quality objectives are defined in Title 117- Nebraska Surface Water Quality Standards (NDEQ, 2014). Title 117 defines the beneficial uses that are to be supported by each of Nebraska's lakes and streams. Examples of beneficial uses for Nebraska's waterbodies include:

- drinking water (public drinking water supply)
- recreation (swimming, wading)
- aquatic life (health of water insects, fish, and wildlife)
- agricultural supply (livestock water supply)

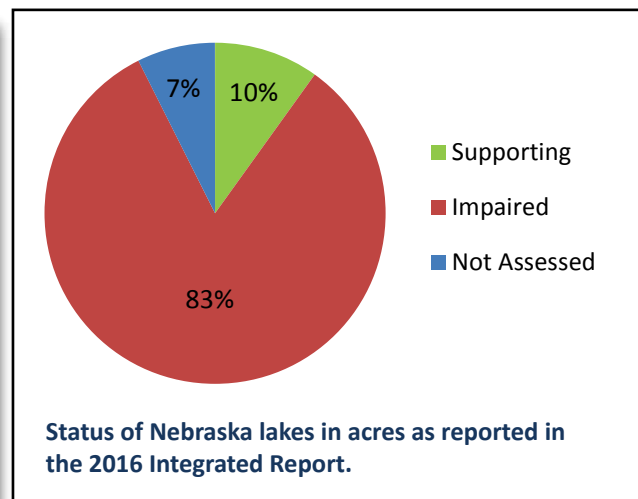
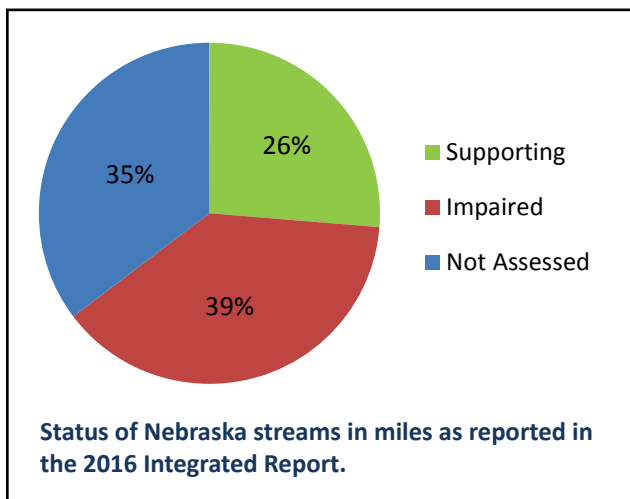
Title 117 also specifies the numeric levels of pollutants such as *E. coli* bacteria and nitrate that can be present in a waterbody without impairing the assigned beneficial uses. When determining the water quality for a specific waterbody, NDEQ assesses the water quality data against the pollutant criteria defined in Title 117 for each assigned beneficial use.



Lake under health in 2015, eventually impaired for Microcystin in 2016 integrated report.

Reporting Water Quality Conditions

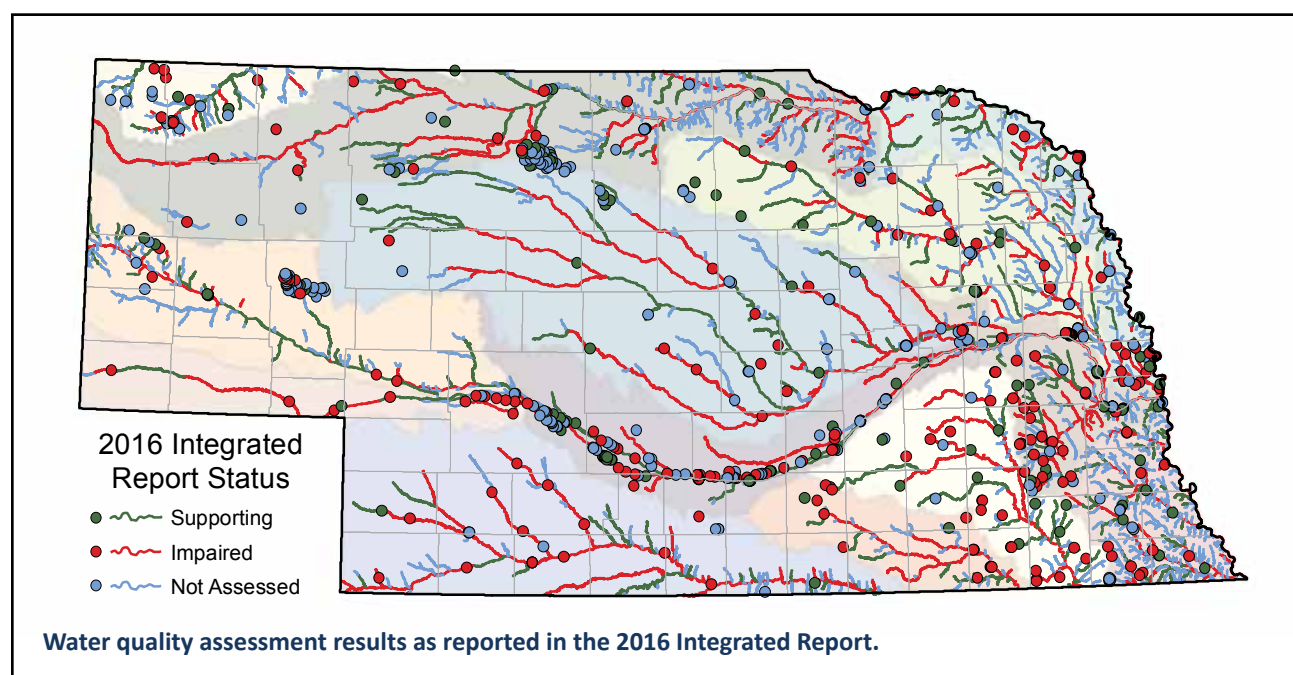
Every two years the CWA requires that states develop an “Integrated Report” (NDEQ, 2016) that summarizes the water quality condition of all surface waterbodies in the state. For this report, states evaluate all available water quality data and determine which waterbodies are or are not supporting their designated beneficial uses. Waters that do not fully support all of their assigned beneficial uses are considered “impaired” and place on an impaired waterbodies list (303(d) list); waters that support assigned uses are considered “supporting” or good quality waters.



Summary of Nebraska's 2016 Integrated Report

Nebraska has 1558 stream segments flowing over 16,670 miles and 539 lakes and reservoirs that cover more than 134,389 acres. As of the 2016 Integrated Report (issued April, 2016), NDEQ staff had conducted assessments on 564 stream segments and 322 lakes equating to more than 10,780 miles of streams and 124,425 lake acres being assessed (see figures below). While numerous waterbodies still need assessment, NDEQ has made a concerted effort to focus sampling and assessments on the waterbodies used more widely by the public. This has resulted in assessments on all lakes over 50 surface acres in size and all main stem rivers (see map, below).

Of the 564 stream segments assessed, 289 were supporting their assigned uses, while 275 were impaired. Lake assessments found 193 of the 322 lakes assessed were impaired while 129 lakes were supporting their uses (see figures below).



Common Stream Impairments

The most common impairments for Nebraska's streams and lakes can be seen in the following figures. *E. coli* bacteria impaired more than three times as many streams as the next leading cause, impaired stream biology. Natural selenium, atrazine, and fish consumption advisories were also common stream impairments. The most common lake impairment was high nutrients followed closely by fish consumption advisories and elevated pH. Low dissolved oxygen and *E. coli* bacteria were also notable causes of lake impairments.

Summarizing the assessment information as simple percentages of impaired waterbodies does not tell the entire story. However, because Nebraska's water quality criteria are designed to be fully protective, impairment of one beneficial use does not mean the waterbody is not supporting other beneficial uses.

Strategies to Resolve Water Quality Impairments

Once a waterbody is determined to be impaired, the CWA requires the state to develop a plan or method to reduce pollutant levels so that waterbody is able to support its designated uses. Three types of pollution control plans are commonly implemented: Point source pollution is managed by the National Pollutant Discharge and Elimination System (NPDES) permitting program, the development of Total Maximum Daily Loads (TMDLs), and Watershed Management Plans (WMPs). Both TMDLs and WMPs involve determining the cause and sources of the water quality impairment, while Watershed Management Plans also incorporate working with stakeholders to develop and implement on the ground pollution control strategies. Continuous water quality monitoring provides the needed data to determine if the plan is working or if modifications are required.

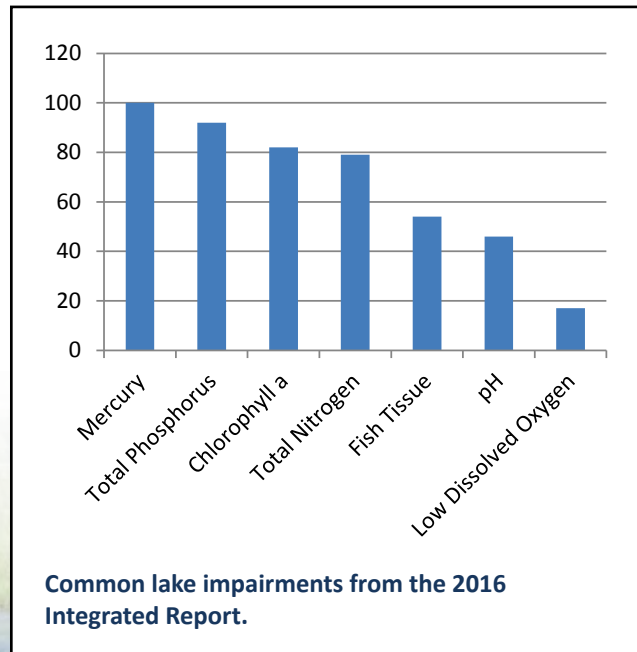
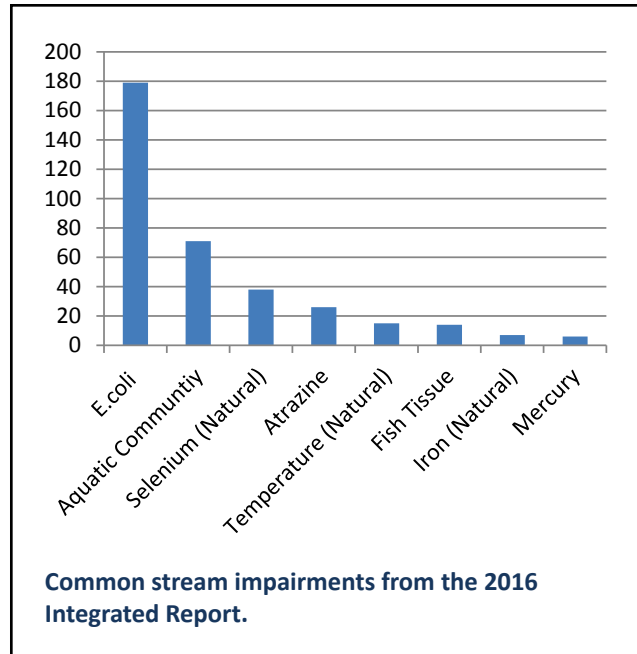
References

NDEQ, 2014. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

NDEQ, 2016. 2016 Water Quality Integrated Report. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

More Information

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/TMDL>
 Laura Johnson at, laura.r.johnson@nebraska.gov
 or (402) 471-4249.



White River, Sioux County.

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Groundwater Quality Monitoring Report to the Legislature

Why NDEQ Does this Report

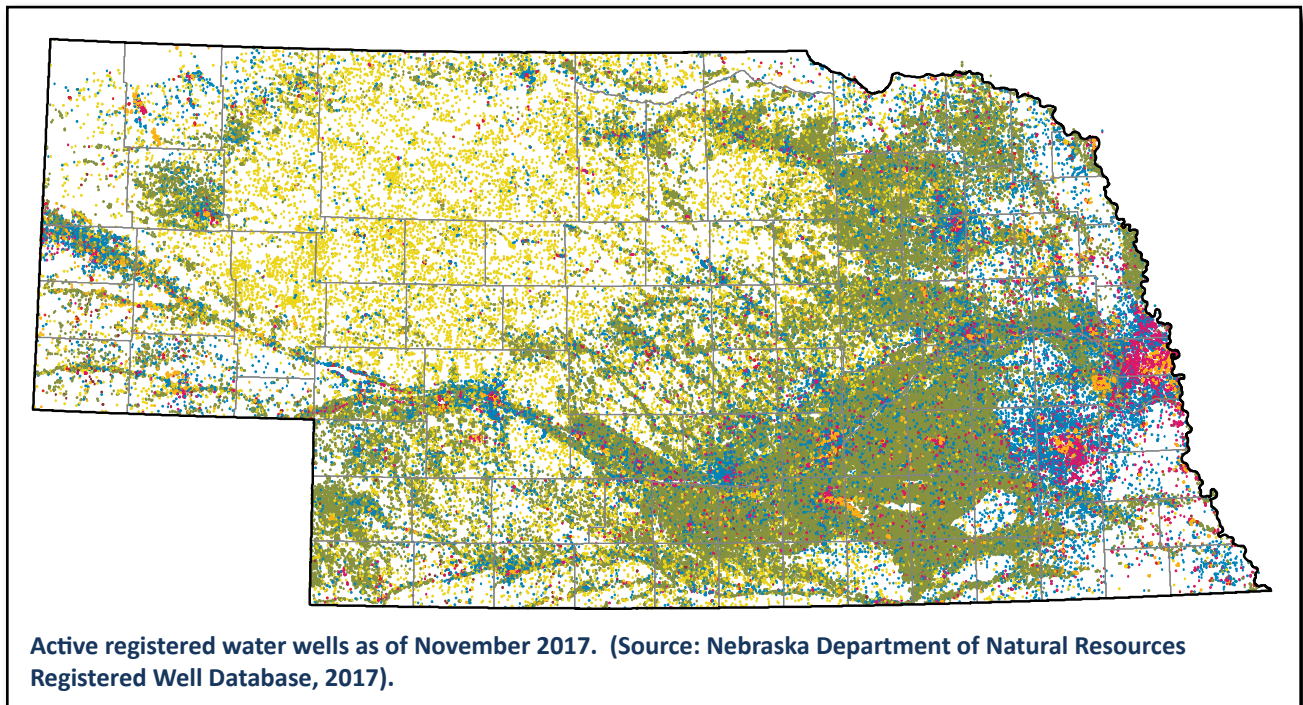
The 2001 Nebraska Legislature passed LB329 (Neb. Rev. Stat. §46-1304) which, in part, directed the Nebraska Department of Environmental Quality (NDEQ) to report on groundwater quality monitoring in Nebraska.

History of this Report

Beginning in December 2001, the Department has prepared a report outlining the extent of groundwater quality monitoring conducted by Natural Resources Districts (NRDs) during the preceding calendar year. The Department uses the data submitted by the districts in conjunction with all other readily available and compatible data for the purpose of the annual ground water quality trend analysis.

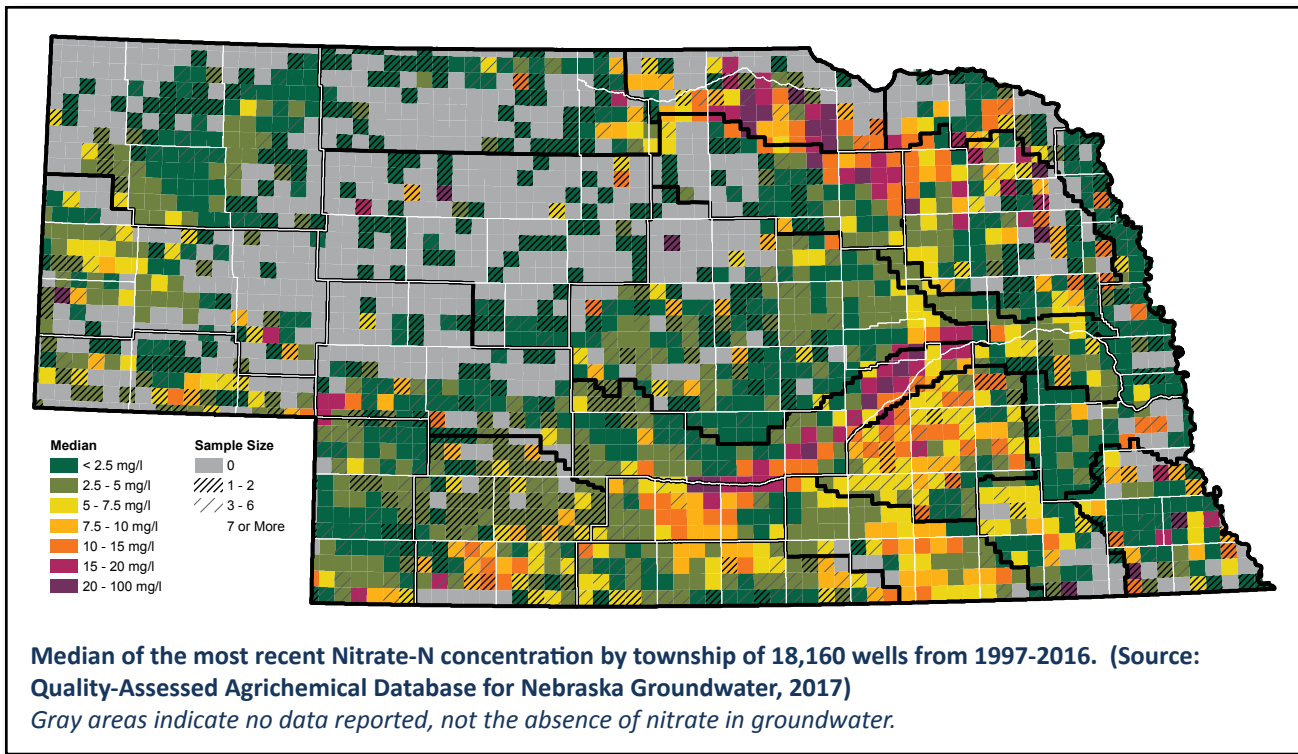
Where is the Monitoring Conducted?

The State of Nebraska is a large geographic area, over 77,000 square miles. There are over 183,000 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2016, 4,194 wells were sampled. Since 1974, over 25,000 wells across the state have been sampled by state agencies, University of Nebraska, federal agencies, and local NRDs. Monitoring is typically conducted in areas of Nebraska with groundwater problems.



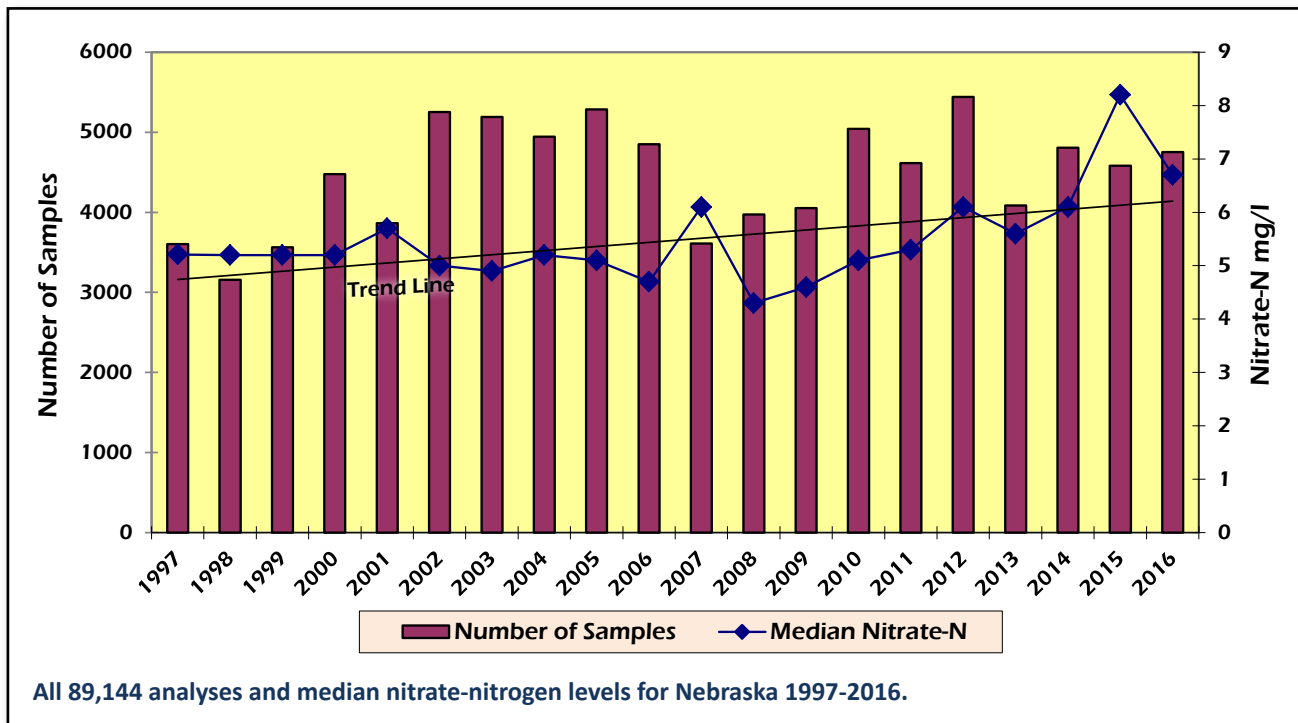
What is Monitored?

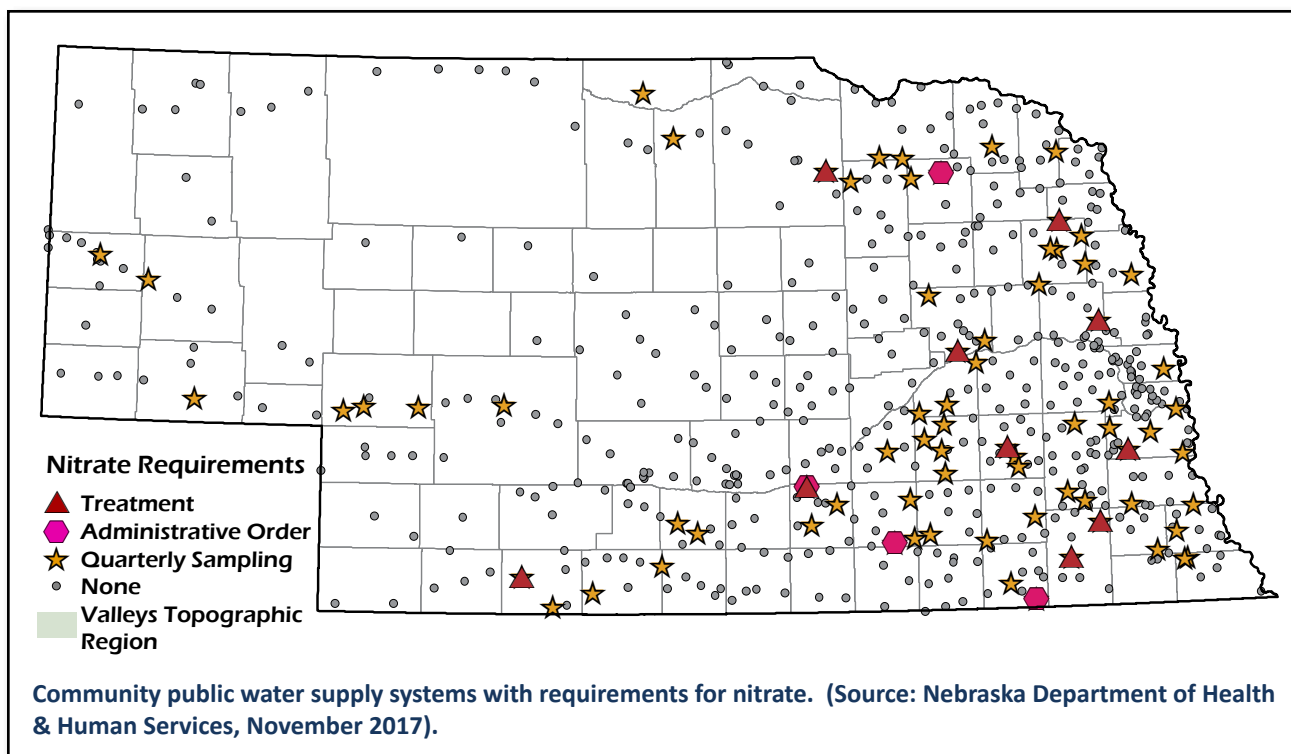
There are over 240 compounds monitored for since 1974 and used in this report. Some of the compounds that have been detected more than just a few times throughout this period include nitrate-nitrogen and atrazine. Nitrate is a form of nitrogen common in human and animal waste, plant residue, and commercial fertilizers. Atrazine is a herbicide used for weed control in a variety of crops such as corn and sorghum.



How is the Data Used?

The Department analyzes the data collected for the purpose of determining whether or not groundwater quality is degrading or improving and presents the results to the Natural Resources Committee of the Legislature beginning December 1 of each year. The State's 23 NRDs use the data to make decisions on the management of groundwater. Within the next year, all NRDs will have designated Groundwater Management Areas over part or all of their districts to address groundwater quality problems.





Results as of 2016

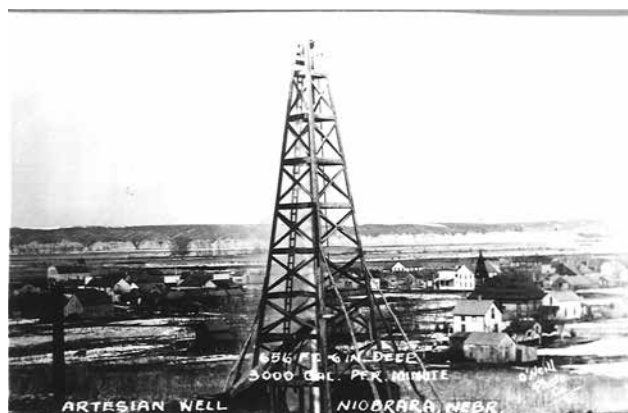
The majority of Nebraska’s residents rely on groundwater for drinking water, agriculture, and industry. Most public water supplies that utilize groundwater do not require any form of treatment for drinking water before serving it to the public. Nitrate is Nebraska’s number one groundwater contaminant. There are some limited areas in Nebraska where the nitrate concentration is greater than the drinking water standard of 10 mg/L (see map below).

The most representative picture of the statewide nitrate concentration is from the time period from 1997 to 2016 due to the number and spatial relationship of the samples collected. The overall trend indicates only a slight increase in nitrate median concentrations statewide (see chart above).

All of the results for agricultural chemicals (including nitrate) can be found on the Nebraska Department of Natural Resources (NDNR) website (<http://clearinghouse.nebraska.gov>). The entire database can be accessed at NDNR’s website, where the database may be searched or ‘queried’ for numerous subsets of data, such as results by county, type of well, Natural Resources District, etc.

More Information:

<http://deq.ne.gov/Publications/Pages/WAT248>
 David Miesbach, david.miesbach@nebraska.gov
 or (402) 471-4982.



Public Water Supply well in Niobrara, NE.

Groundwater Monitoring at Permitted Livestock Facilities

Why require monitoring at livestock facilities?

Nebraska's groundwater may be negatively impacted by leakage from holding ponds or lagoons at livestock waste control facilities (LWCFs). The liquid waste in the holding ponds has elevated levels of nitrate-nitrogen, ammonia, and chloride ions. The NDEQ requires monitoring of these chemical parameters to document any impact to groundwater. The contaminated groundwater may negatively impact public water supplies and domestic wells. The NDEQ oversees the investigation and remedial measures conducted by the owners of the facilities if groundwater has been impacted.

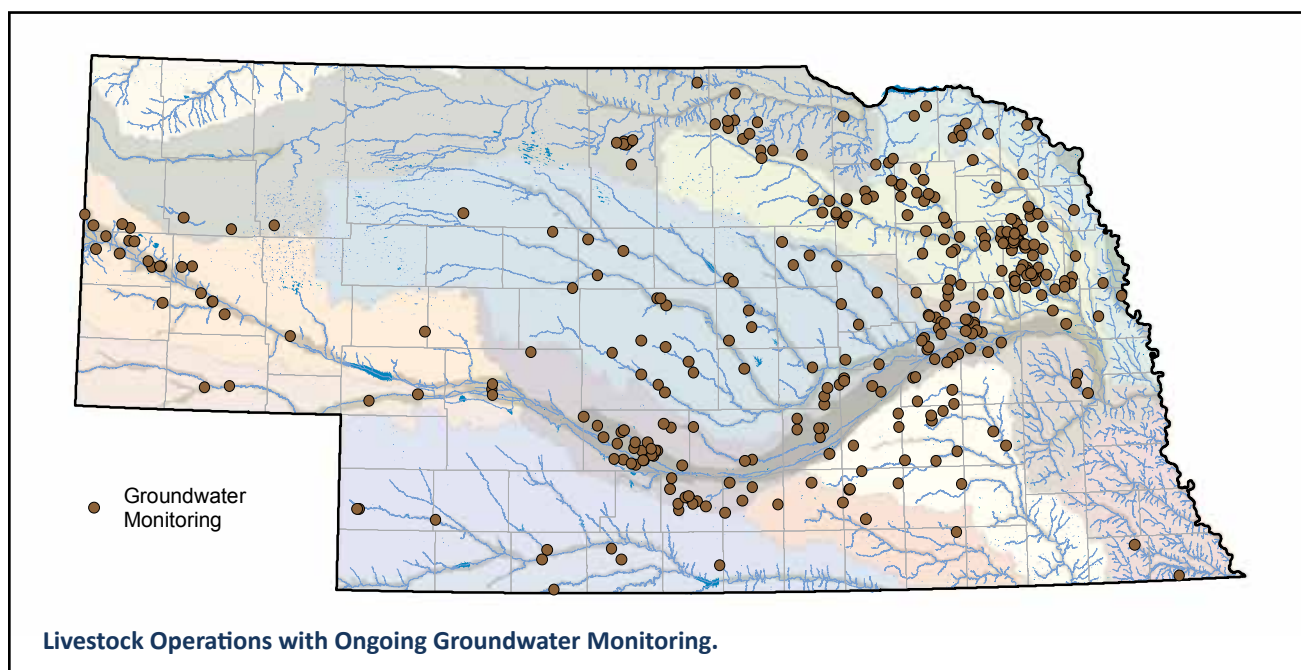


Feedlot in Central Nebraska.

History of the monitoring program

The NDEQ's Groundwater Unit began reviewing permitting plans for LWCFs in 1997. The site-specific hydrogeology, soils, depth to water, and use of the groundwater are reviewed to determine the vulnerability of the groundwater.

The Groundwater Unit has reviewed 1,280 LWCFs (as of the beginning of November 2017) and recommended monitoring at 450 of them. Currently, there are 431 approved groundwater monitoring plans with 327 operations where semi-annual monitoring is conducted. Twenty-two operations conduct annual sampling due to little or no change in the water quality. The map below shows the locations of the facilities where groundwater monitoring is conducted.



What is monitored?

Groundwater samples are collected from monitoring wells installed around the lagoons or holding ponds and analyzed at a laboratory for

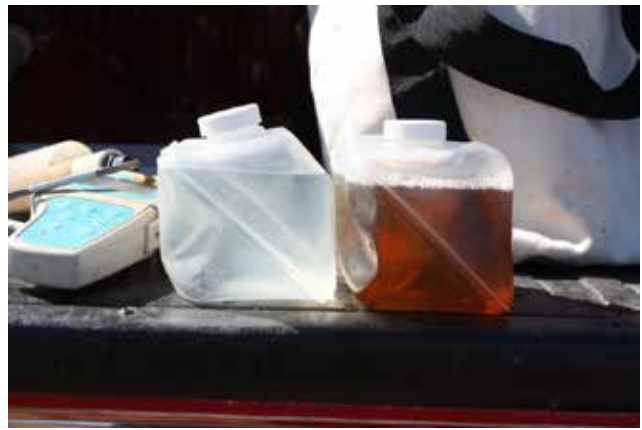
- nitrate-nitrogen,
- ammonia, and
- chloride concentrations.

Groundwater naturally has low concentrations of chloride and nitrate-nitrogen while ammonia is not naturally present in groundwater.

Additionally,

- depth to water,
- pH,
- temperature, and
- specific conductivity

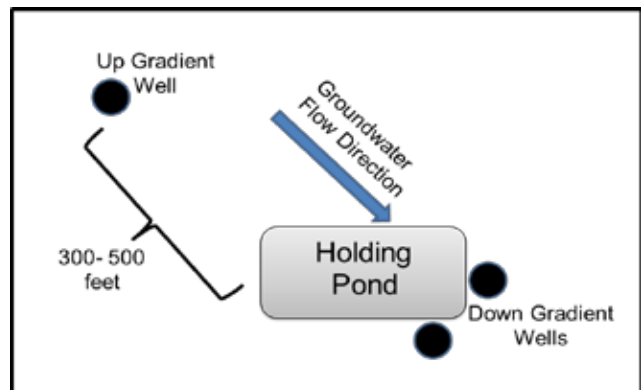
are collected from each monitoring well. The groundwater quality and the flow direction are monitored in the spring (before irrigation season) and the fall (after irrigation season).



Samples from groundwater monitoring wells near a failing lagoon.

Where are the wells installed?

A typical livestock facility with groundwater monitoring has three monitoring wells. One well is located 300-500 feet up gradient of the holding pond to record the water quality conditions prior to flowing down gradient under the lagoon. Two monitoring wells are located adjacent to each holding pond in the down gradient flow direction to more quickly identify possible impacts to groundwater. The adjacent diagram shows a generic map of recommended locations for groundwater monitoring wells.



Recommended locations for groundwater monitoring wells.

How are the data used?

The LWCF is responsible for conducting the semi-annual monitoring and submitting a report to NDEQ twice a year. Monitoring is conducted either by a hired consulting firm or by the owner of the livestock operation. Groundwater Unit staff review the results from the groundwater sampling. A facility that has had at least three sampling events is evaluated to determine if groundwater has been negatively impacted. In the event a facility has impacted groundwater, the facility is required to address the issues. Currently there are less than five LWCFs with more comprehensive groundwater investigations underway. To date, NDEQ does not know of any private or public drinking water wells that have been contaminated from a livestock waste control facility.

More Information:

Dan Inman, dan.inman@nebraska.gov or (402) 471-0294.

David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.

Crow Butte Resources, Inc. Groundwater Monitoring



Crow Butte Resources, Inc. in-situ recovery uranium facility. Dawes County.

Crow Butte Resources, Inc. uranium mine has been operating in western Nebraska for over three decades. The site consists of several thousand Class III injection wells used for In-Situ Recovery (ISR) uranium mining, and it has been regulated and monitored by the Nebraska Department of Environmental Quality (NDEQ) since active mining began in 1985. Part of this regulation includes a local ban on drilling any water wells in the permitted area other than those associated with the mining process.

The Class III production/injection wells are used in the ISR method of uranium mining. The U.S. Nuclear Regulatory Commission (NRC) defines ISR uranium mining as a process using a

leaching solution to extract uranium from underground ore bodies in place (in other words, in-situ). The leaching agent, called lixiviant, contains an oxidant such as oxygen with sodium bicarbonate. The uranium in the aquifer is in a reduced environment and therefore in a solid state, occupying some of the pore spaces in the aquifer. The lixiviant is injected through injection wells into the ore body in a confined aquifer to oxidize the reduced environment and liberate the uranium. The solution is then pumped via other wells, called production wells, to the surface for processing.

Groundwater Monitoring at the facility

There are two types of groundwater monitoring wells at the CBR uranium mining facility – deep (production zone) monitoring wells and shallow (Brule Formation) monitoring wells. The wells are screened through the entire aquifer to ensure that the mining fluids do not migrate laterally or vertically outside the portion of the aquifer being mined. Deep monitoring wells are drilled into the Chadron Formation, where the mining is occurring. These deep wells surround each mine unit and are located no more than 300 feet from the mine unit (or production zone) and approximately 400 feet apart. Shallow monitoring wells are spatially distributed throughout the mine units, with at least one well every four acres. These wells are drilled into the Brule Formation aquifer, which locally serves as a drinking water source, to ensure mining fluids are not migrating upward. Both the shallow and the deep monitoring wells are sampled biweekly (once every two weeks) for chloride, conductivity, alkalinity, water level, and barometric pressure. The shallow monitoring well samples are also, at a minimum, analyzed annually for uranium and radium-226 to the lowest detection limit available. Currently, 381 monitoring wells are actively sampled on a biweekly basis, 180 of these are deep monitoring wells and 201 are shallow monitoring wells.



Drilling rig at Crow Butte Resources Inc., Dawes County.

Reporting Requirements

CBR submits monitoring well analyses to the NDEQ in a quarterly report, and each quarter NDEQ randomly checks laboratory analyses by splitting samples from the monitoring wells with the facility. The samples are collected by NDEQ field staff and are sent to the State Health Lab to be analyzed for chloride, conductivity, and alkalinity. The analytical result from both CBR laboratory and the State Health Lab are statistically compared for quality assurance purposes. NDEQ takes a duplicate sample of one well during each split sampling event to ensure the quality of the lab analyses.

Quality Assurance/Quality Control in 2017

Groundwater monitoring well samples are collected and analyzed by the laboratory at CBR. In 2017, the NDEQ randomly split 56 of those groundwater samples (7 from deep monitor wells and 7 from shallow wells each quarter) with CBR. Samples collected by NDEQ are sent to the State Health Lab for analysis. Comparisons between CBR laboratory's analyses and NDEQ's analyses for the samples were within a statistically reasonable margin of error.

During the 2017 calendar year, CBR Deep Disposal Well #1 (DDW #1) reported decreasing annulus pressure and seal pot fluid levels three times and required three separate well workovers to correct the issues. These workovers were performed successfully and DDW #1 is fully operational. CBR reported one excursion and is working towards being brought back into compliance in this area. CBR reported all parameters exceedances to the NDEQ and the Nuclear Regulatory Commission (NRC). In all cases, corrective action was taken immediately.

Future Expansion

Crow Butte Resources, Inc. (CBR) operates on a "3-5-5" rule. This means that no more than three units can be constructed in advance of active mining, no more than five mine units may be engaged in active mining, and no more than five mine units can be in restoration. There are currently 11 mine units constructed at the facility. Mine Unit 1 has reached restoration and stabilization goals as determined by NDEQ. Mine Units 2 and 3 are being monitored for stabilization. Mine units 4, 5, and 6 are currently undergoing restoration activities. Mine units 7, 8, 9, 10, and 11 are being actively mined. To date, CBR has no plan to extend mining at their current facility beyond Mine Unit 11.



Well field at Crow Butte Resources, Inc., Dawes County.

Future expansion is planned at two satellite facilities, Marsland and Three Crow. Applications have already been received and initial review conducted for Marsland. These satellite facilities are expected to have similar groundwater monitoring plans and requirements as the current CBR mining operation.

More Information:

<http://deq.ne.gov/NDEQProg.nsf/OnWeb/UIC>

Amanda Jones, amanda.c.jones@nebraska.gov or (402) 471-4290.

David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.

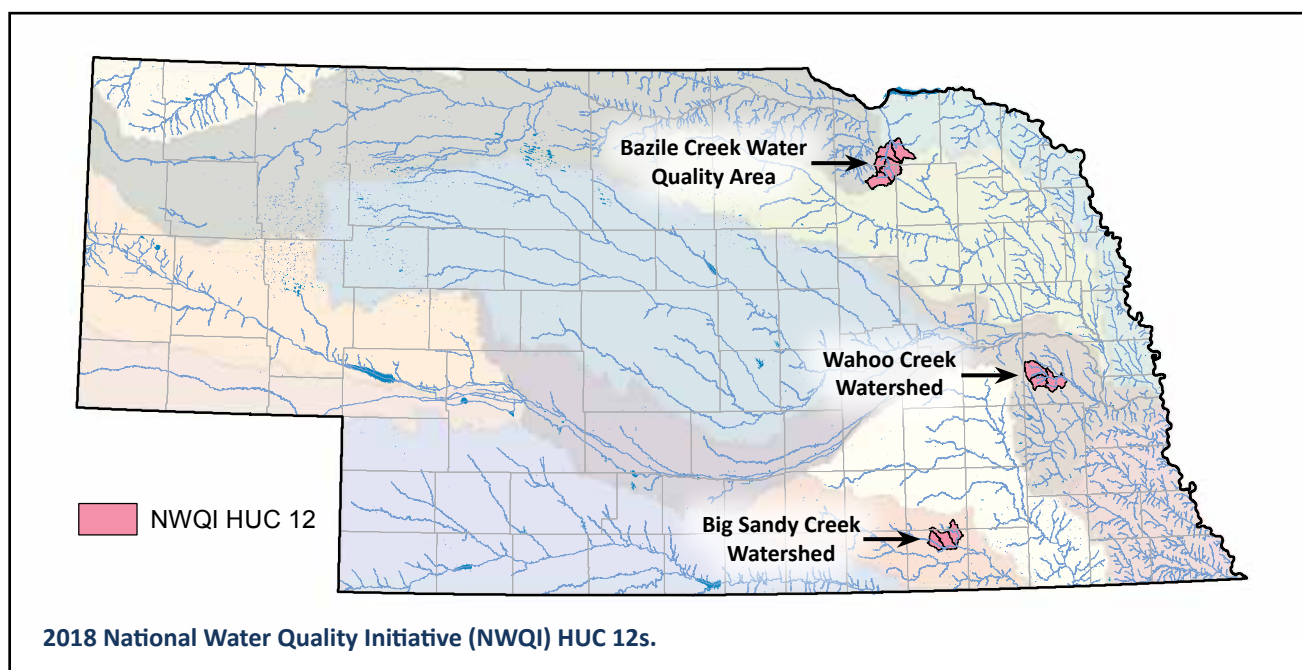
National Water Quality Initiative

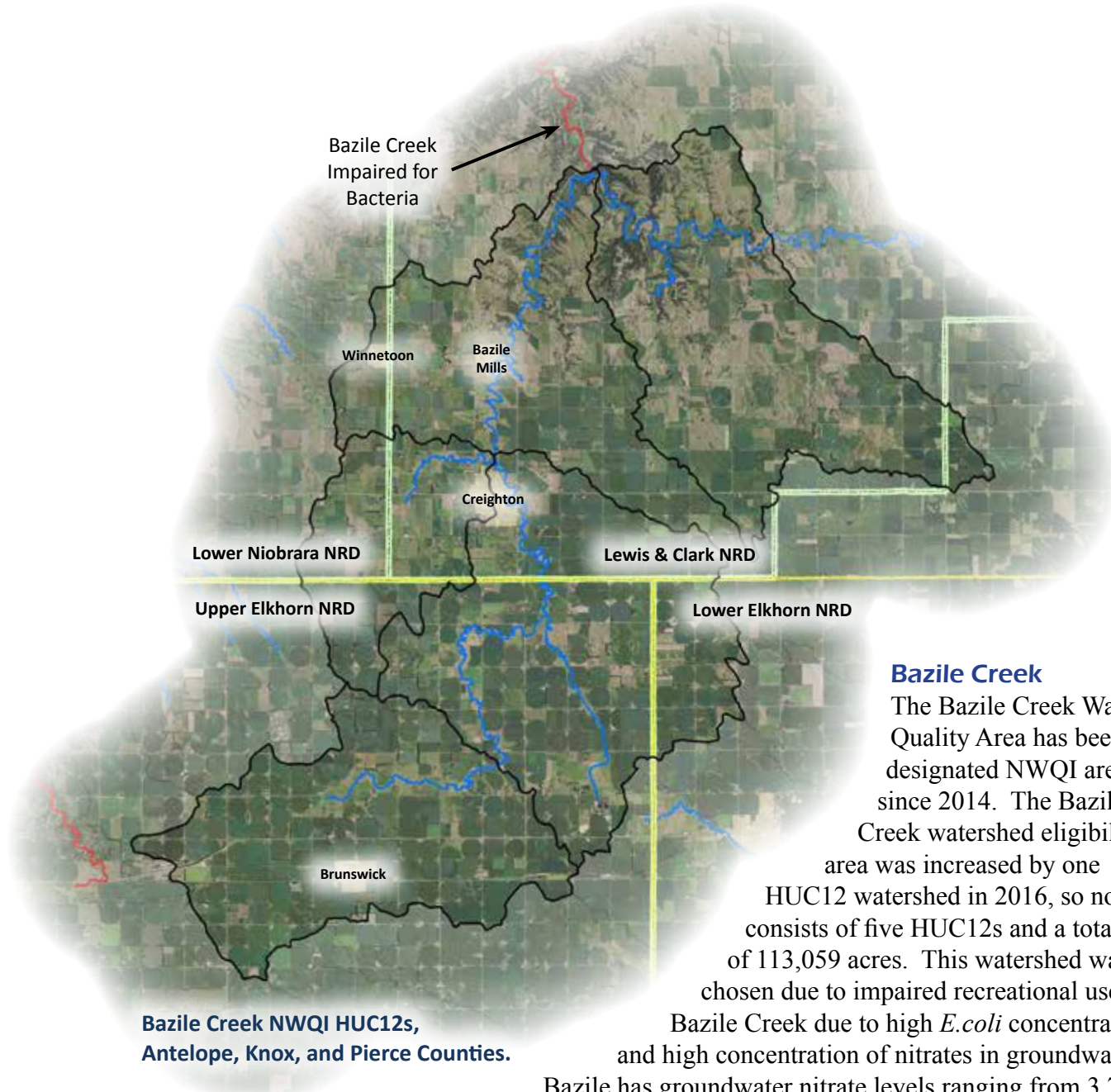
Launched in 2012, the National Water Quality Initiative (NWQI) is a partnership among Natural Resources Conservation Service (NRCS), state water quality agencies and the US Environmental Protection Agency (EPA) to help producers voluntarily improve water quality in priority watersheds while maintaining agricultural productivity.



NRCS provides financial and technical assistance to implement conservation systems that help avoid, trap and control run-off and erosion from agricultural fields in NWQI targeted watersheds. Practices may include nutrient management, cover crops, conservation cropping systems and filter strips. State water quality agencies and other partners contribute additional resources for watershed planning, monitoring, implementation, and outreach.

In Nebraska, collaboration between NRCS and the NDEQ Section 319 Program has resulted in leveraging funding from both programs for NWQI watersheds. USDA NRCS and NDEQ have worked closely together to select three NWQI areas for Nebraska: Bazile Creek Water Quality Area, Wahoo Creek Watershed, and Big Sandy Creek Watershed. This is the fourth year Wahoo Creek and Bazile Creek were selected to participate in this program. Big Sandy Creek watershed in the Little Blue River basin was selected as a 2017 NWQI Pilot project for enhanced watershed planning and was accepted as a new NWQI area for 2018.





Bazile Creek NWQI HUC12s, Antelope, Knox, and Pierce Counties.

Bazile Creek

The Bazile Creek Water Quality Area has been a designated NWQI area since 2014. The Bazile Creek watershed eligibility area was increased by one HUC12 watershed in 2016, so now consists of five HUC12s and a total of 113,059 acres. This watershed was chosen due to impaired recreational use of Bazile Creek due to high *E.coli* concentration and high concentration of nitrates in groundwater.

Bazile has groundwater nitrate levels ranging from 3.7 to 18.9 mg/L and an average of 13 mg/L across the area. There are four Natural Resources Districts in this NWQI area that are serving as sponsors for the Clean Water Act Section 319 portion of the program: Lewis and Clark NRD, Lower Elkhorn NRD, Lower Niobrara NRD, and Upper Elkhorn NRD. In addition, a local technical and community advisory council was established for this project to review information and establish goals and objectives for the area. Conservation practices funded through NWQI in this area include cover crops, nutrient and irrigation management.

Wahoo Creek

The Wahoo Creek Watershed has been a designated NWQI area since 2014. The area consists of three Hydrologic Unit Code subwatersheds (HUC 12) for a total of 70,245 acres. No additional HUC 12s were added in 2016 or 2017. This watershed was chosen due to impairment of recreation by *E.coli* and lack of aquatic habitat. The primary conservation practices targeted for funding in this watershed are cover crops, no till, and terraces. In this NWQI area, the Lower Platte North Natural Resources District is the sponsor of the Clean Water Act Section 319 portion of the program and the Wahoo Creek Watershed Stakeholder Group is involved in the planning process.

Big Sandy Creek

The Big Sandy Creek Watershed was selected as a 2017 NWQI Pilot project for watershed management planning due to impairment of recreation by *E. coli* and impairment of aquatic life by Atrazine. Through the pilot planning process, three HUC 12 sub-watersheds (City of Belvidere, Big Sandy Creek, Outlet Dry Sandy Creek) were identified as critical areas within the Big Sandy Creek watershed that contribute significant loads of *E. coli* and Atrazine to the impaired segments of Big Sandy Creek. The total size of the target

sub-watersheds is approximately 58,000 acres. An application was accepted by USDA to initiate an implementation project in 2018. The implementation project will focus on reduced tillage, cover crops, integrated pest management, and buffer strips to reduce Atrazine runoff from cropland. Controlled grazing, exclusion fencing, stream crossings, and facility management will be targeted to livestock operations to reduce *E. coli* runoff. The Little Blue Natural Resources District will be the local sponsor for the NWQI project.

Wahoo Creek NWQI HUC12s, Saunders County.

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Impacts to water quality in NWQI watersheds will be modeled annually as practices are installed. Water quality data collected on Wahoo Creek, Bazile Creek, and Big Sandy Creek through existing NDEQ monitoring programs will be assessed biennially for the Integrated Report. Groundwater quality data will be collected annually through existing groundwater monitoring programs by NDEQ and local Natural Resources Districts.

More Information:

Elbert Traylor, elbert.traylor@nebraska.gov or (402) 471-2585.

Carla McCullough, carla.mccullough@nebraska.gov or (402) 471-3382.



Big Sandy Creek NWQI HUC12s, Thayer and Filmore Counties.