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2023 Nebraska Water Monitoring Programs Report

Niobrara River, Western Cherry County

Groundwater Section · Monitoring Section · Water Planning Section

Based on data from 2020 & 2021

2023 Nebraska Water Monitoring Programs Report

Nebraska Department of Environment and Energy

Water Planning Section • Groundwater Section • Monitoring Section

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Acknowledgments:

The following Nebraska Department of Environment and Energy staff have contributed to this report with their photos, maps, numbers, words, and editing. Their efforts are greatly appreciated and gratefully acknowledged here: Tara Anderson, Mike Archer, Brian Barnes, Brandon Beethe, Dave Bubb, Tom Heatherly, Justin Haas, Dan Inman, Greg Michl, Dave Miesbach, Amanda Osbourn, Erik Prenosil, Daniel Ross, David Schumacher, Elbert Traylor, and Amanda Woita.

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

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This report was revised May 7, 2024, to correct phone numbers.

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Introduction

The Nebraska Department of Environment and Energy (NDEE) is charged with monitoring, assessing, and to the extent possible, managing water quality of the state's water resources. The purpose of this work is to protect and maintain high quality water and encourage or implement actions to improve poor water quality. Monitoring is done on nearly 18,000 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 NDEE. 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 NDEE, its contractors, or the regulated community. Other NDEE 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

NDEE 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 Department, 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

Why does NDEE monitor public beaches?

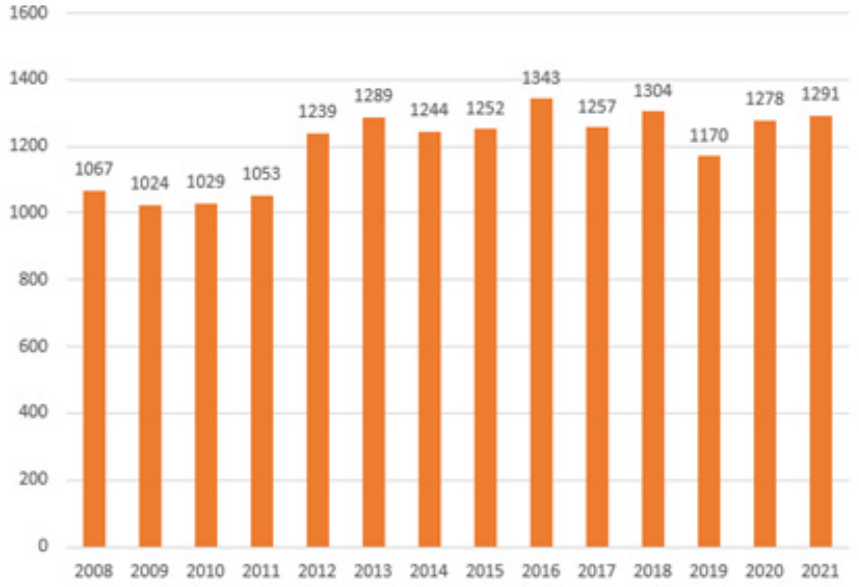
Full contact recreation activities such as swimming, tubing, skiing, and jet skiing are popular pastimes at Nebraska's lakes and reservoirs. The Nebraska Department of Environment and Energy (NDEE) and its collaborators want to ensure those using these waters have access to the most current water quality information possible.

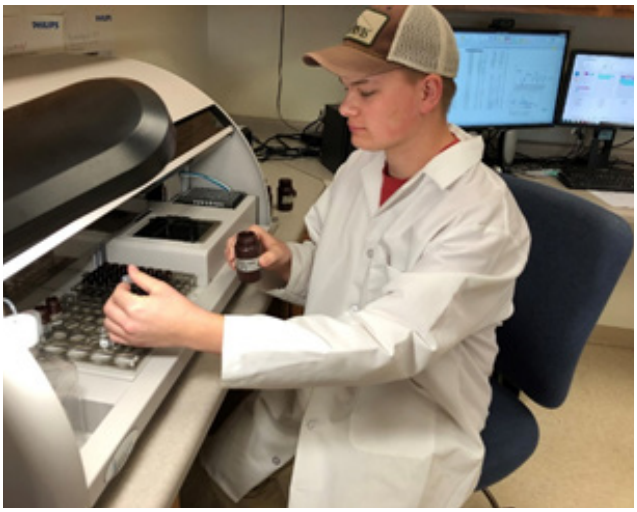
A Harmful Algae Bloom (HAB) at a Nebraska reservoir.

When and where is the monitoring conducted?

Sampling for bacteria at Nebraska's beaches has been occurring for many years. The Nebraska Game and Parks Commission (NGPC) initiated sampling at several locations in the 1970s. NDEE eventually took over the sampling program in the 1990s. In 2004, NDEE began sampling for the toxin microcystin after it was determined several dogs had ingested Nebraska lake water with high levels of the toxin, attributing to their deaths. In 2005, NDEE and its partners began a more comprehensive plan for collecting samples from publicly owned and operated lakes. Weekly sample collection of 54 sites from 51 lakes coincides with the recreation season (May 1 to September 30). Since the inception of NDEE's comprehensive public beach monitoring program in 2005, over 20,000 samples have been analyzed for microcystin and *E. coli* bacteria.

Number of beach monitoring samples taken by year





Preparing samples for microsystin analysis in the NDEE's Bio Lab.

What is monitored at public 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 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 Cyanobacteria, commonly referred to as blue-green algae. Excessive growth of cyanobacteria can lead to harmful algal blooms (HABs). 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, respiratory failure, or even death. A microcystin level of 8 micrograms per liter (µg/l, or ppb, parts per billion) is established as the criterion for full body contact recreational activities. Based on the most current studies available, the U.S. Environmental Protection Agency (EPA) reduced the criterion in 2019 from 20 ppb to 8 ppb. While not all types of cyanobacteria are toxic, the greater the population of cyanobacteria, the greater the chance of having a harmful algal bloom. NDEE adopted this new criterion beginning in 2020. In the absence of direct microcystin toxin measurements, one should recognize a severe HAB and treat it with caution. HABs often have a "John Deere green" or "pea green soup" color. HABs appear as thick green paint or oil floating on the surface of the water and usually have a strong septic odor.

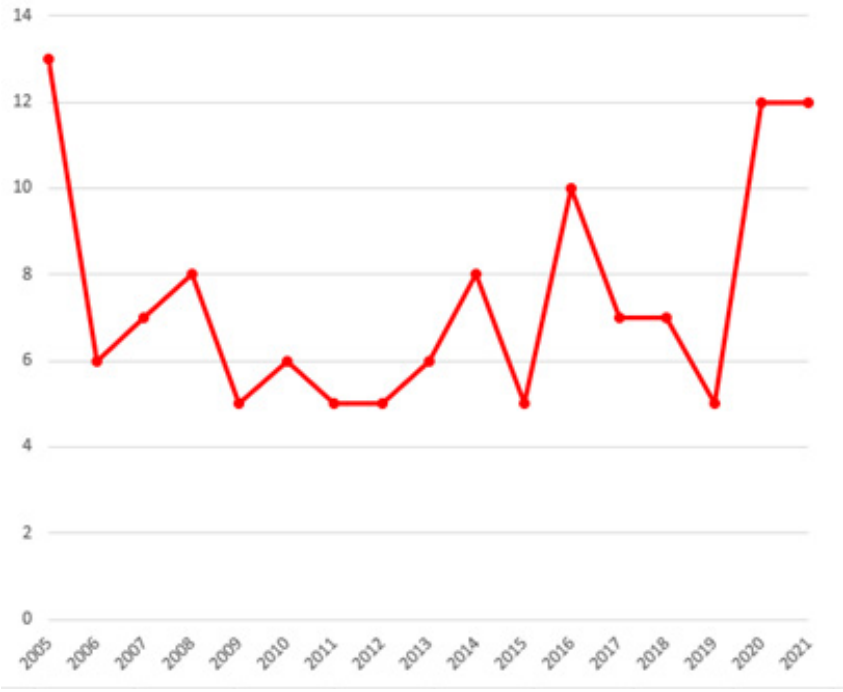
How are the data used?

NDEE and its partners collect the lake water sample at the beaches early each week from May through September. Because sample collectors do their own bacteria analysis and NDEE 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 website by Thursday of the same week (http://dee.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 8 ppb, NDEE and the Nebraska Department of Health and Human Services issue a Health Alert. During a Health Alert at a public lake, the affected swimming beaches are closed. 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. 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 8 ppb criterion. 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 at a higher risk for illness when used for full-body contact recreation. Lakes that exceed this level are specifically identified on NDEE's website weekly in the Environmental Alerts section. Unlike with dangerous levels of HABs, 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 is provided to allow the public to make their own decision on whether to use the lake.

Number of lakes on Health Alert by year



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 into 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.

2020 and 2021 results

Over the two years, the Beach Monitoring Program collected and analyzed over 2,500 samples for each *E. coli* and the microcystin toxin.

Bacteria

Of the bacteria samples taken and analyzed, 124 samples (9.6%) exceeded the 235 colonies/100 ml of water standard. Figure 1 shows the number of samples that exceeded 235/100 ml criterion for bacteria by month from 2005 through 2021. 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 run-off. Results for May of 2020 are reflective of a fewer number of samples collected due to the COVID pandemic.

A sign posting a Health Alert for microcystin at Rockford Reservoir in Gage County.

Harmful Algal Blooms

Of the samples collected and analyzed for the microcystin toxin. 114 samples exceeded the 8 ppb threshold for issuing a Health Alert. This accounts for 5.24 % of the total samples collected. In 2021 and

2022, 15 different lakes were placed on Health Alert. Figure 2 below shows the samples that exceed the 8 ppb health standard, which triggered a Health Alert. It also shows the totals for each year as well as for each month through the years. For the years prior to 2020, the Health Alert level was 20 ppb, while the 8 ppb of microcystin criteria was used for 2020 and 2021. Unlike with bacteria where high levels are more frequently observed in the springtime, HAB (microcystin) impacts are usually observed later in the summer, after lake water has warmed and algae growth is more significant.

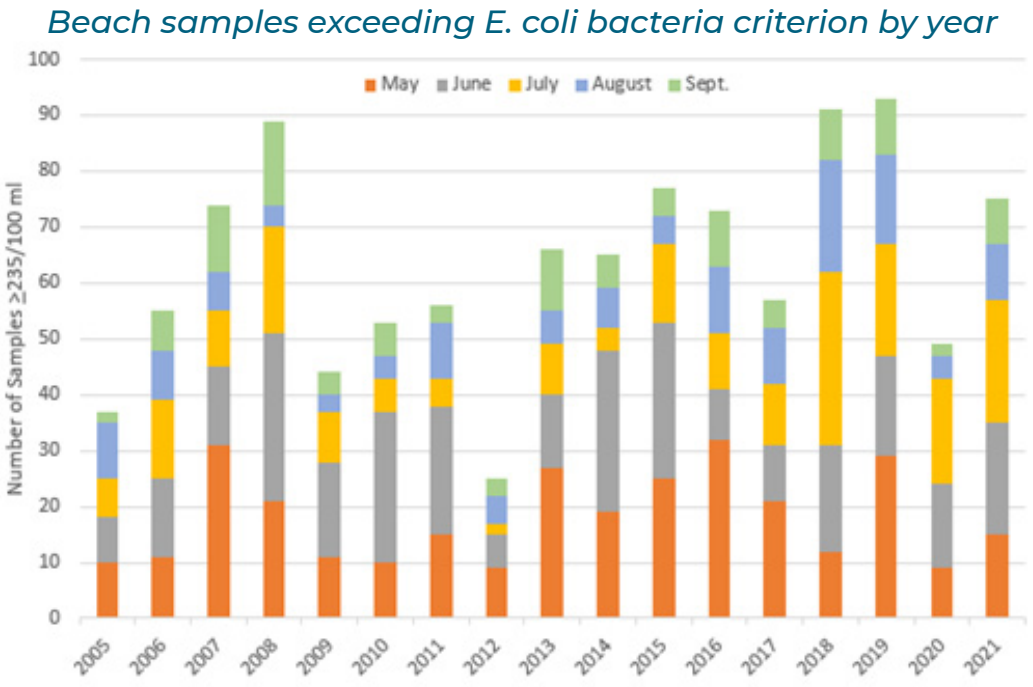


Figure 1. *Beach samples exceeding the 235 counts/100 ml E. coli bacteria criterion by year.*

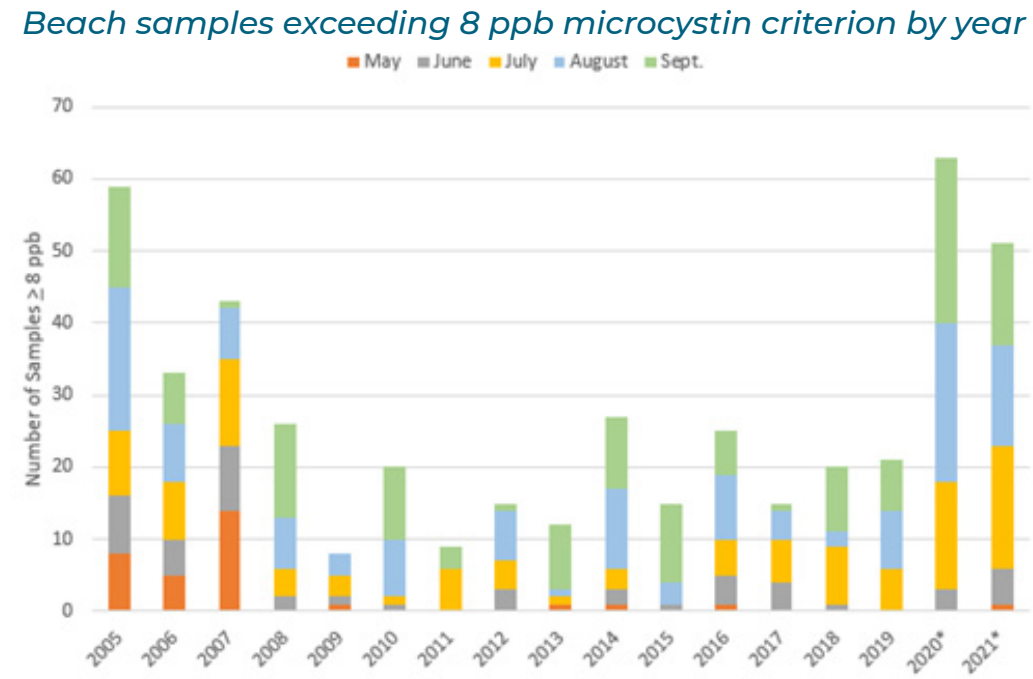


Figure 2. *Beach samples exceeding 8 ppb microcystin criterion by Year.*
** Denotes years in which 8 ppb triggered a Health Alert, instead of 20 ppb in previous years.*

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 HAB 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, NDEE 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 harmful 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.
- Increased cloud cover, which implies reduced sunlight and lower water temperatures.
- Increased nutrients in the water.

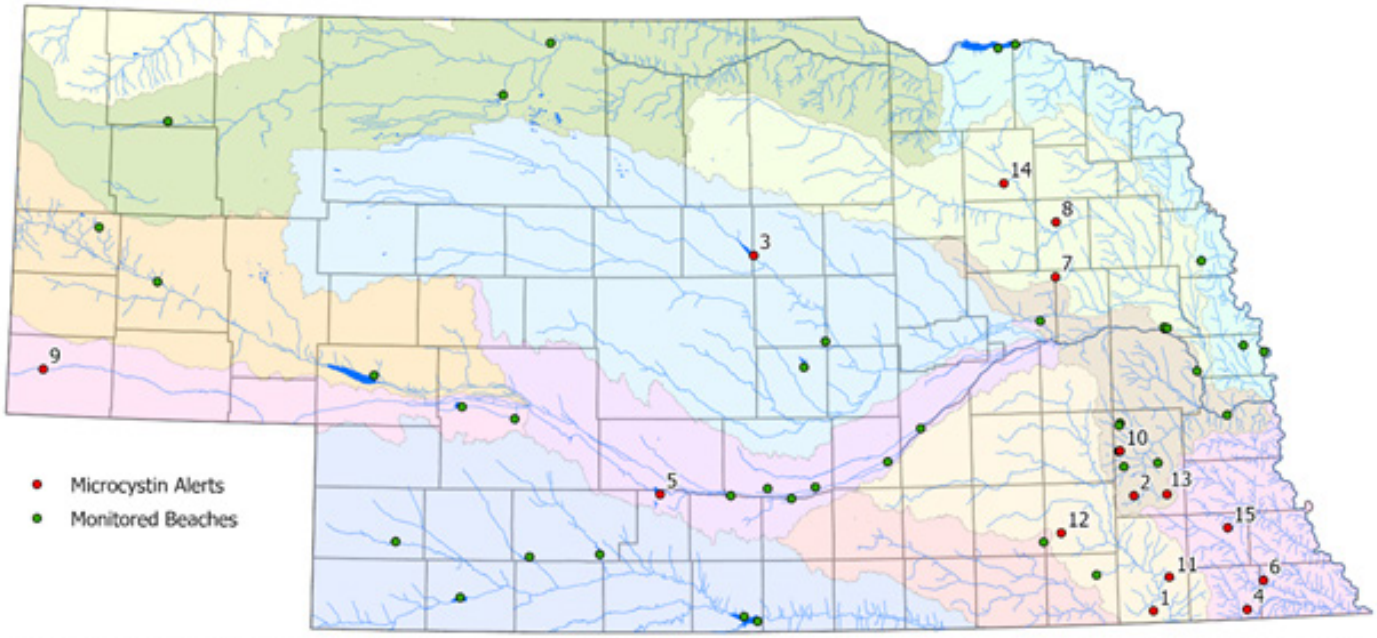
Harmful algal blooms during 2005, 2020, and 2021 were significantly worse when compared to the other years. These years were characterized by lower rainfall, higher temperatures, and drought. In general, lake levels were significantly lower across the state.

The issue of HABs and its causes are 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 HABs to become problematic. While temperature and sunlight are beyond our control, we can reduce the amount of nutrients reaching streams, rivers, 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 HABs to occur.

More information

NDEE's Public Beach Monitoring Program webpage: http://dee.ne.gov/NDEQProg.nsf/OnWeb/beach
NDEE's Beach Watch page: https://deq-iis.ne.gov/zs/bw/
Justin Haas, justin.haas@nebraska.gov or (402) 471-4224.
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Public beaches monitored and beaches with microcystin alerts in 2020 and 2021



Public beaches monitored and those with microcystin alerts in 2020 and 2021. Numbers correspond to the table below.

Map #	Waterbody	County	Samples Exceeding Health Limit	Weeks on Health Alert
1	Big Indian Creek Lake @ South Beach	Gage	1	1
2	Bluestem Lake @ South Beach	Lancaster	7	7
3	Calamus Reservoir @ Homestead Beach	Loup	8	8
4	Iron Horse Trail Lake @ Iron Horse Beach	Pawnee	9	9
5	Johnson Lake @ SE Beach	Gosper	2	2
6	Kirkman's Cove Lake @ North Beach	Richardson	11	11
7	Maple Creek Lake @ East Beach	Colfax	7	7
8	Maskenthine Reservoir @ Swimming Beach	Stanton	1	1
9	Oliver Reservoir @ Swimming Beach	Kimball	2	2
10	Pawnee Lake @ Swimming Beaches	Lancaster	10	10
11	Rockford Lake @ SW Beach	Gage	5	5
12	Swan Creek Lake @ Swimming Beach	Saline	13	13
13	Wagon Train Lake @ Swimming Beach	Lancaster	13	13
14	Willow Creek Lake @ South Beach	Pierce	18	18
15	Wirth Brothers Lake @ SE Beach	Johnson	7	7

Ambient Stream Monitoring Program

Why does NDEE 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 NDEE.

Collecting water samples from the Platte River near Louisville, Cass/Sarpy County.

Collecting field measurements from Middle Creek, Dixon County.

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

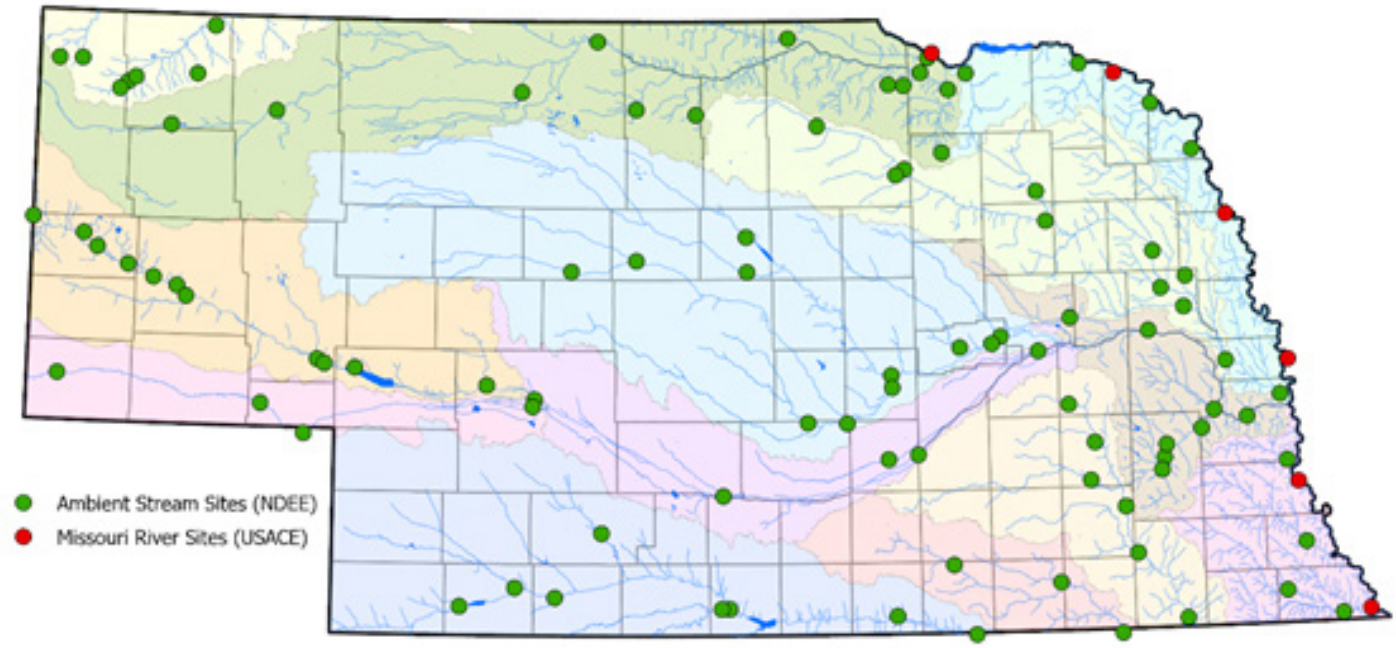
Where and when is the monitoring done?

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 U.S. Army Corps of Engineers (USACE) and South Platte and Middle Niobrara natural resources districts (NRDs). Most of these sites have been sampled in this manner since 2001.

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.

Locations of Ambient Stream Monitoring Program sites



What is monitored?

NDEE monitors numerous water quality parameters to establish general water quality trends and to ensure each stream can support its designated uses. The following parameters are collected at each site every month:

- water temperature
- dissolved oxygen
- pH
- conductivity
- turbidity
- stream discharge (cfs)
- total suspended solids
- ammonia
- nitrate/nitrite nitrogen
- kjeldahl nitrogen
- total phosphorus
- chloride
- sulfate
- *E. coli*

Filtering water sample to be analyzed for various heavy metals.

In addition, atrazine samples are collected at all sites in May and June. Arsenic, selenium, calcium, magnesium, and sodium are collected at all sites quarterly, as are a complete suite of additional metals at each basin integrator site.

Monthly sampling for dissolved aluminum began in January 2020 at basin integrator sites to aid in determining the extent of this pollutant in Nebraska's rivers and streams. Prior to this, aluminum sampling in Nebraska only occurred at monitoring locations on the Missouri River and was conducted by the USACE. The dissolved aluminum data acquired by the USACE from these locations indicated possible impairments for aquatic life. Additionally, because the toxicity of aluminum in water is determined largely by associated levels of dissolved organic carbon (DOC) and pH, DOC was also added as a parameter at integrator sites at this time.

History of the Ambient Stream Monitoring Program

NDEE 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 2020 and 2021, approximately 19,870 individual field measurements and water quality samples were collected each year for the 35 program parameters.

Measuring stream discharge at Middle Creek, Dixon County.

More information about all surface water impairments is available in the 2020 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 NDEE's website at http://dee.ne.gov or directly at http://dee.ne.gov/publica.nsf/pages/WAT352.

More information

http://dee.ne.gov/NDEEProg.nsf/OnWeb/ASM
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.
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Basin Rotation Monitoring Program

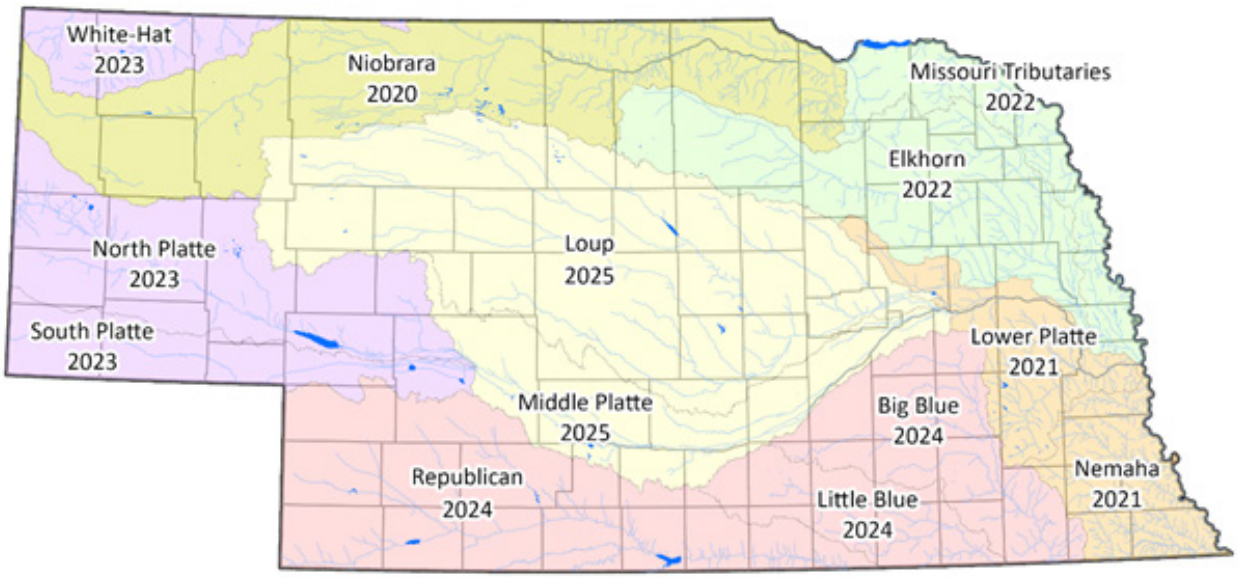
Why does NDEE conduct basin rotation monitoring?

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, NDEE 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 NDEE 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 NDEE 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, NDEE 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 conducted on a weekly basis from May 1 through September 30. In 2020, a total of 42 streams were sampled in the Niobrara basin with monitoring assistance provided by the Middle Niobrara NRD. In 2021, 42 streams were sampled in the Lower Platte and Nemaha River basins with monitoring assistance provided by the Nemaha NRD. This sampling resulted in 924 water quality samples being collected in 2020 and 2021, of which all samples were analyzed for 15 parameters. The map below shows the basins and their rotation schedule.

NDEE six-year basin rotation monitoring schedule



How are the monitoring sites chosen?

One of the primary objectives for the BRMP is the protection of public health. To meet this objective, NDEE 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.

Collecting water sample from Pine Creek, Sheridan County.

What is monitored?

NDEE 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 site and analyzed at a laboratory: ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus, chloride, total suspended solids, atrazine, and *E. coli* bacteria. Field measurements of water temperature, pH, conductivity, dissolved oxygen, turbidity, and stream discharge are also recorded.

Impairments and sources

Obtaining field measurements from Pine Creek, Sheridan County.

According to the 2020 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 surface 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://dee.ne.gov/NDEQProg.nsf/OnWeb/BRM

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

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 can contain 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.

Collecting fish at Deer Creek, Sheridan County

History of the Stream Biological Monitoring Program

NDEE 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 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 when 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 10).

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. NDEE'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.

Aquatic Macroinvertebrates

Aquatic macroinvertebrates are small creatures that live in streams attached to rocks, vegetation, and 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 differ-

ent 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.

(Left) Collecting aquatic macroinvertebrates from Deer Creek, Sheridan County. (Right) Caddisfly larvae and protective cases made from sand grains from the waters of Monroe Creek, Sioux County.

Fish

From small cold water 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. Most 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.

How are the data used?

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

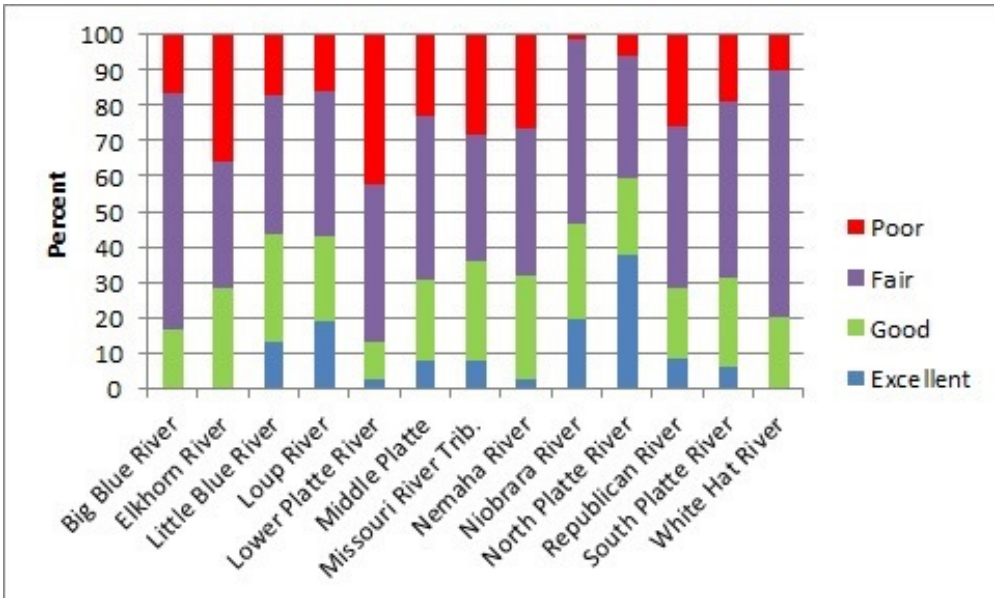
- Documenting current statewide biological conditions in Nebraska's streams to track water quality status and trends.
- Identifying streams that do not attain their assigned environmental goals and need restoration or remedial action. Where significant problems were found (i.e., streams were assessed 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) regarding aquatic life.
- Identifying exceptional stream segments (reference conditions).
- Providing accurate biological distribution information.
- Serves as a benchmark to measure best management practice success.

Young grass pickerel collected from Fairfield Creek, Cherry 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 on the next page). 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.

Condition of wadeable streams in Nebraska's major river basins

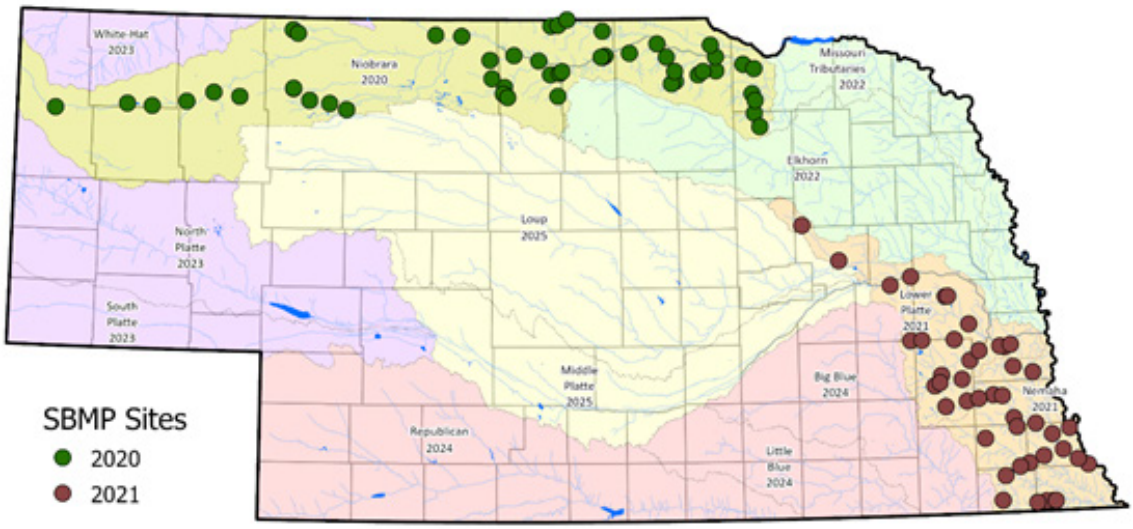


The Wadeable Streams Assessment done in 2004-2005 by EPA reported that increases in nutrients (e.g., nitrogen and phosphorus) and streambed sediments have the highest negative impact on biological condition. These contaminants are commonly introduced into the streams by non-point source pollution from agricultural practices such as crop production and livestock operations and by point source pollution such as discharge from sewage treatment facilities. Analyses within Nebraska have shown that the loss of quality habitat is a very strong stressor on aquatic communities, as is excess sedimentation that accompanies human activities in watersheds.

2020 & 2021 Update

The NDEE sampled 37 stream sites from the Niobrara River basin in 2020. For the benthic macroinvertebrates, 22 of the streams were rated as having excellent quality. These excellent streams attained diversity values similar to the very best streams in Nebraska. Of the remaining streams, five were of good quality, eight were of fair quality, and two were poor. Poor streams will be placed on the list of impaired streams and will receive attention for improvement.

Stream Biological Monitoring Program 2020 and 2021 Sites



Five of the streams from the Niobrara basin had excellent fish communities, 16 were good, 15 were fair, and one stream was poor. The poor site was a stretch of the Niobrara River immediately upstream of Box Butte Reservoir, which appeared to be experiencing depleted fish communities from predation by northern pike that migrated upstream from the reservoir. NDEE and other entities are monitoring this situation.

NDEE sampled 44 streams from the Lower Platte and Nemaha River basins in 2021, with the assistance of the Stream Team from the Nebraska Game and Parks Commission. The bug communities in these basins rated as zero excellent, three good, 19 fair, and 22 poor. The fish communities in these basins rated as one excellent, nine good, 21 fair, and 13 poor.

(Top) Brown trout collected from South Branch of Plum Creek, Brown County. (Left) Red shiner collected from Salt Creek, Lancaster County

More information

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Adult mayflies clinging to vegetation after an overnight emergence from Lake Maloney, Lincoln County.

Ambient Lake Monitoring Program

Why monitor lakes and reservoirs?

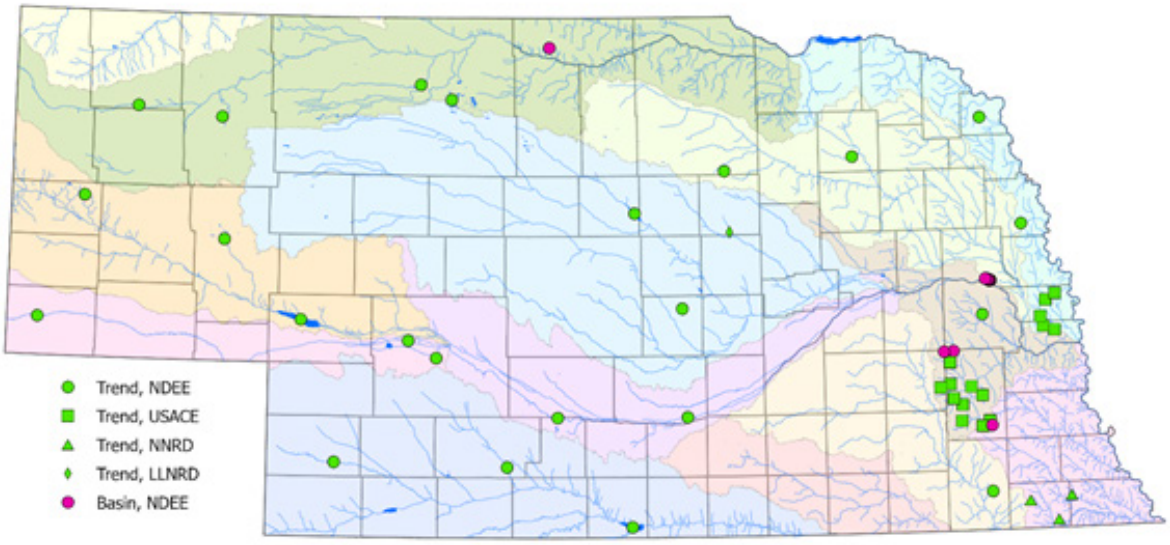
Nebraska's natural lakes and man-made reservoirs have different public usage throughout the year. NDEE monitors these resources to determine if water quality is sufficient for recreational activities such as swimming and water skiing. Lakes and reservoirs are also monitored to see if water conditions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

Filtering a water sample to be analyzed for orthophosphorus from Rockford Lake, Gage County.

Monitoring involves the collection of monthly water samples from May through September from publicly owned lakes and reservoirs across Nebraska. In some cases, the streams that flow into lakes and reservoirs are monitored. Since these water bodies reflect their watersheds, data on streams that flow into lakes and reservoirs can provide useful information in evaluating water quality problems.

In 2020 and 2021, 55 lakes were sampled for physical/chemical parameters by NDEE and its lake monitoring partners, which include the US Army Corp of Engineers (USACE), the Nemaha Natural Resources District (NRD), and the Lower Loup NRD. Sampling also began on nine lakes at Fremont State Recreation Area to monitor the success of a lakes renovation project that was conducted there in 2012. This sampling concluded in 2022.

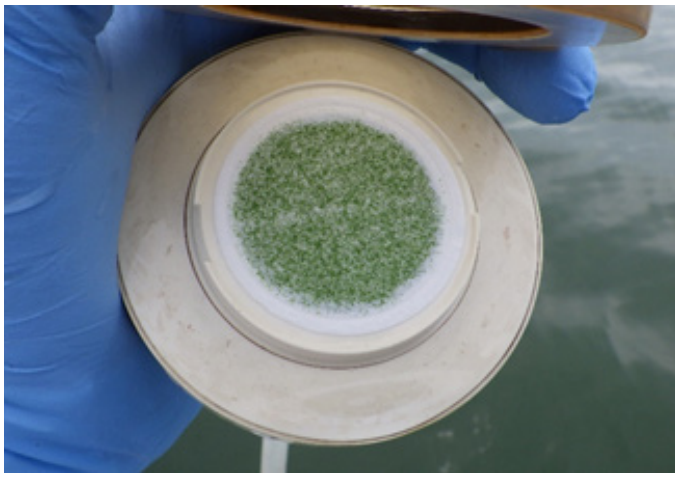
Lakes sampled for the Ambient Lake Monitoring Program in 2020-2021



What is monitored?

To determine if water quality is sufficient to meet its intended uses in these lakes and reservoirs, 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 phospho-

rus, alkalinity, and chlorophyll-*a*. 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. An additional profile is also collected at a lake or reservoir that is larger than 75 surface acres. This profile is recorded approximately in the middle of the lake or reservoir and is considered a mid-lake site.



Filter disc used for chlorophyll-a analysis.

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 impaired as not having sufficient quality. If a waterbody is 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 NRDs, 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 NDEE on even numbered years. The 2020 report is available online at http://dee.ne.gov/NDEQProg.nsf/OnWeb/TMDL.

Statewide concerns

Nutrient and algae related issues are the most common lake impairments. Excessive algal 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 these algae.

Sedimentation in Nebraska's reservoirs is one of the main causes of reduced water quality. Sediment carried from bare ground or from eroded stream channels is usually nutrient rich. This sediment not only reduces a reservoir's storage capacity, but the nutrients attached to it can be released and become available for algal growth.

NDEE staff sampling in the elements of Nebraska weather.

Lake Improvement Programs

When water quality programs were first initiated at NDEE, most efforts were aimed at reducing the impacts of point source discharges. From the early 1970s to present, lake and reservoir management has evolved to include non-point sources. Several programs administered by NDEE, as well as other local, state, and federal programs, work to protect impounded

waters. Some of the programs administered by NDEE that are protective of the quality of impounded waters include livestock waste, wastewater, storm water, and non-point 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

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Approaching storm near Crescent Lake, Garden County.

Fish Tissue Monitoring Program

Why monitor fish tissue?

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 tend 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.

NDEE monitors fish tissue in the state to notify Nebraskans and visitors where contaminant levels in fish are a concern so they can make informed decisions on fish they catch and consume.

History of the 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 include those that are most frequently sought by fisherman. They include, but are not limited to catfish, largemouth bass, walleye, white bass, bluegill, 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 2020 and 2021, a total of 187 fish tissue samples were collected from 15 streams and 71 lakes throughout the Niobrara, Lower Platte, and Nemaha River basins for analysis of contaminants.

Fish being collected at Offutt Base Lake, Sarpy County.

What is monitored?

Currently, the primary pollutant of concern in fish tissue is methyl mercury, but a few locations remain under advisory for polychlorinated biphenyl compounds (PCBs). Information for these pollutants and sites targeted for screening are as follows:

- Fish samples from all waterbodies are screened for methyl mercury (organic mercury) – it can occur naturally, but it is also released into the environment from mining operations, fossil fuel combustion, refuse incineration, and industrial waste discharges.
- Only waterbodies currently under advisory for polychlorinated biphenyl compounds (PCBs) are screened for this pollutant – prior to 1971, they were used in heat transfer fluids, hydraulic fluids, lubricants, and wax extenders, and later in electrical transformers and capacitors.

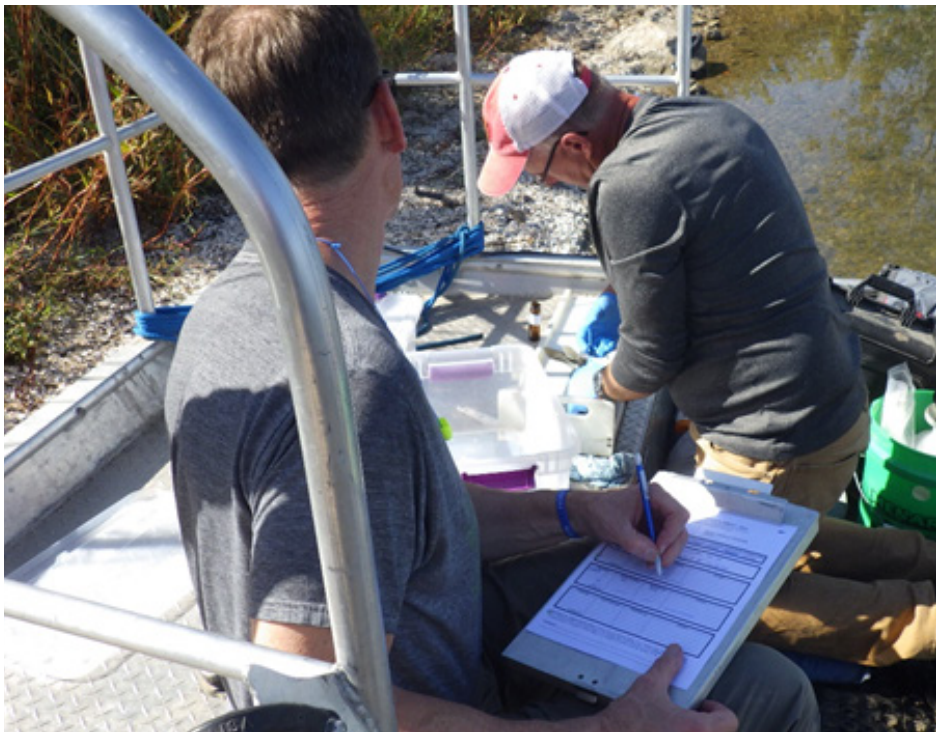
Like other states across the nation, mercury is responsible for many of our fish consumption advisories (>95%). Locations where other contaminants are of concern will be given special consideration for additional contaminant analysis.

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 considers 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 because 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 based on 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.



Fish tissue sample preparation at Offutt Base Lake, Sarpy County.

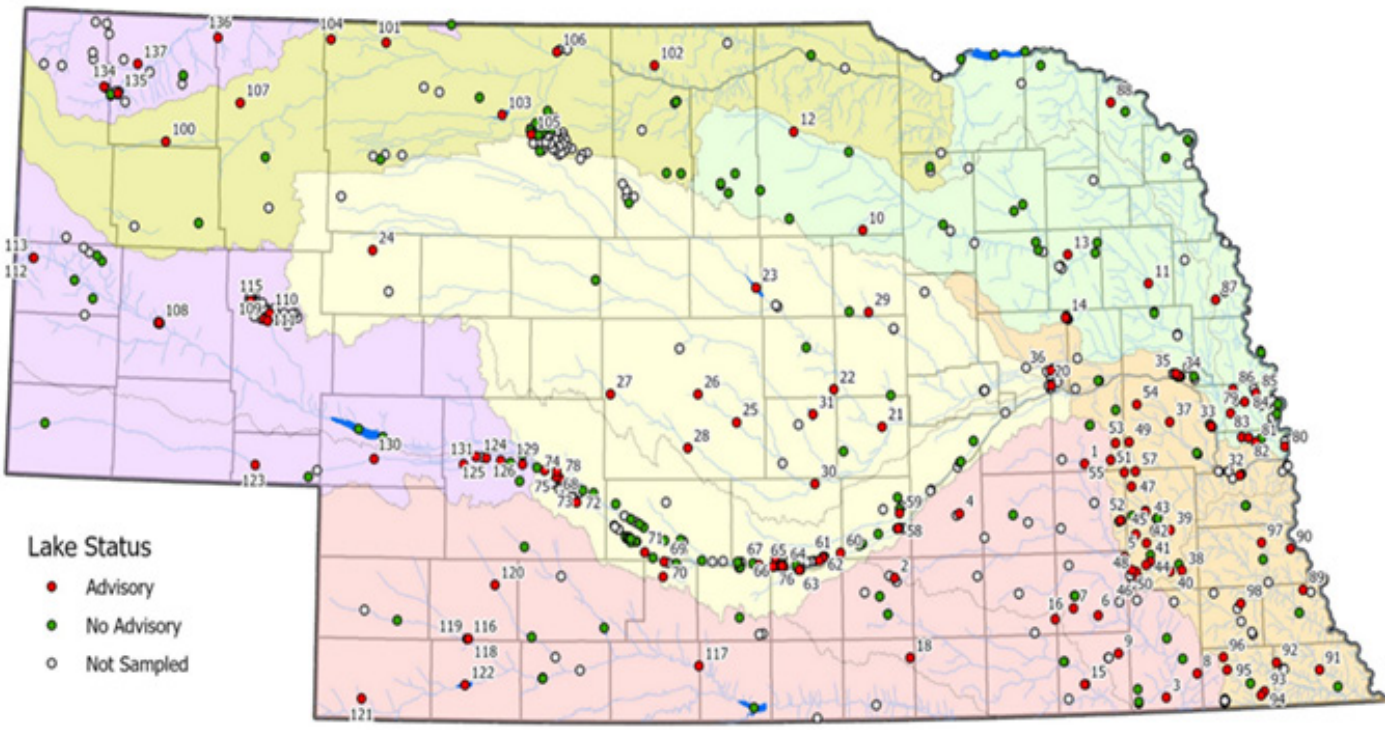
Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with NDEE, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate 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 data are also utilized to assess impairment of Nebraska's waterbodies. Where fish consumption advisories exist, NDEE places those waters on the State's Section 303(d) List of Impaired Waterbodies regarding 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

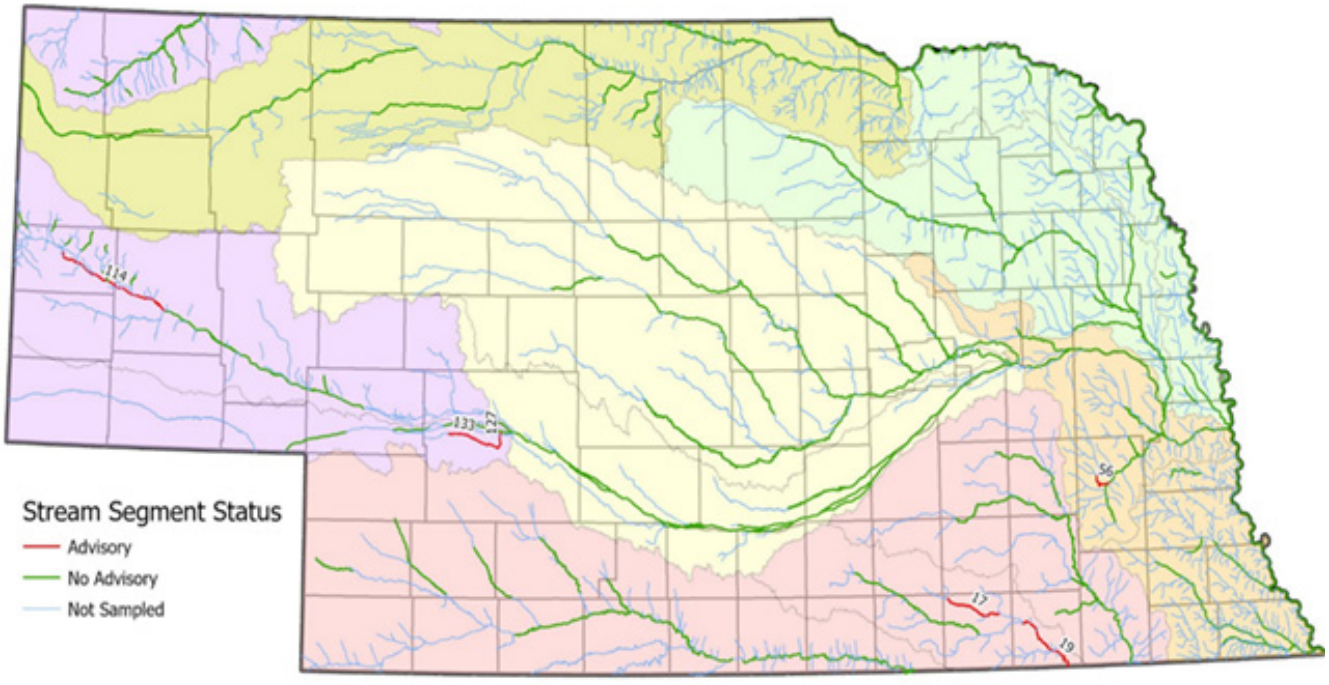
As of July 2021, NDHHS, in cooperation with NDEE, NGPC, and NDA, has issued fish consumption advisories for 137 waterbodies, which includes seven designated stream segments and 130 lakes/reservoirs. These advisories are not bans on eating fish, rather a warning to limit the consumption of specified fish. The map below and following table display advisory locations and information.

Lake status for fish advisories



The table on the following pages provides information associated with site identification numbers displayed.

Stream segment status for fish advisories



The table on the following pages provides information associated with site identification numbers displayed.

Site ID #	Waterbody	Fish Species	Pollutant of Concern
1	Oxbow Trails Reservoir	Largemouth Bass / Bluegill / Black Crappie	Mercury
2	Lake Hastings	Common Carp	PCBs, Mercury
3	Big Indian Reservoir	Largemouth Bass	Mercury
4	Pioneer Trail Lake	Largemouth Bass / Bluegill	Mercury
5	Walnut Creek #2	Largemouth Bass / Bluegill	Mercury
6	Swanton Lake (Swan Lake 67)	Largemouth Bass	Mercury
7	Willard L. Meyer (Swan Creek Lake 5A)	Largemouth Bass	Mercury
8	Wolf-Wildcat Lake	Largemouth Bass / Bluegill	Mercury
9	Cub Creek 9B (Leisure Lake)	Largemouth Bass	Mercury
10	Goose Lake	Largemouth Bass	Mercury
11	West Point City Lake	Largemouth Bass	Mercury
12	Atkinson Lake	Largemouth Bass	Mercury
13	Maskenthine Lake	Largemouth Bass / Bluegill	Mercury
14	Maple Creek Recreation Area Lake	Largemouth Bass	Mercury
15	Crystal Springs NW Lake	Largemouth Bass	Mercury
16	Lone Star Reservoir	Largemouth Bass / Bluegill	Mercury
17	Big Sandy Creek	Channel Catfish	Mercury
18	Liberty Cove	Largemouth Bass / Bluegill / Black Crappie	Mercury
19	Little Blue River	Channel Catfish	Mercury
20	Columbus City Park Pond	Largemouth Bass	Mercury
21	North Loup SRA Lake	Largemouth Bass	Mercury
22	Davis Creek Lake	Common Carp / White Bass	Mercury
23	Calamus Reservoir	Common Carp	Mercury
24	Frye Lake - WMA	Largemouth Bass	Mercury
25	Ansley City Lake	Largemouth Bass	Mercury
26	Melham Park Lake	Largemouth Bass	Mercury
27	Arnold Lake	Largemouth Bass	Mercury
28	Pressey Pond - WMA	Largemouth Bass	Mercury
29	Pibel Lake	Largemouth Bass	Mercury
30	Ravenna Lake	Largemouth Bass	Mercury
31	Sherman Reservoir	White Bass / Largemouth Bass / Walleye	Mercury
32	Louisville Lake No. 3 - SRA	Largemouth Bass / Bluegill	Mercury
33	Two Rivers Lake No. 1 - SRA	Largemouth Bass	Mercury
34	Fremont Lake No. 11 - SRA	Largemouth Bass	Mercury
35	Fremont Lake No. 1	Largemouth Bass	Mercury
36	Lake Babcock	Common Carp	Mercury
37	Lake Wanahoo	Largemouth Bass	Mercury
38	Hedgefield Lake - WMA	Largemouth Bass	Mercury

Site ID #	Waterbody	Fish Species	Pollutant of Concern
39	Holmes Lake	Largemouth Bass / Walleye / Bluegill	Mercury
40	Stagecoach Lake	Largemouth Bass	Mercury
41	Cottontail Lake	Largemouth Bass	Mercury
42	Yankee Hill Lake	Largemouth Bass / Bluegill	Mercury
43	Bowling Lake	Largemouth Bass	Mercury
44	Bluestem Lake	Largemouth Bass	Mercury
45	Conestoga Lake	Largemouth Bass	Mercury
46	Olive Creek Lake	Largemouth Bass	Mercury
47	Branched Oak Lake	Largemouth Bass	Mercury
48	Merganser Lake	Largemouth Bass	Mercury
49	Red Cedar Lake	Largemouth Bass	Mercury
50	Wild Plum Lake	Largemouth Bass / White Crappie	Mercury
51	Meadowlark Lake	Largemouth Bass / Bluegill	Mercury
52	East Twin Lake	Largemouth Bass	Mercury
53	Timber Point Lake	Largemouth Bass	Mercury
54	Czechland Lake	Largemouth Bass	Mercury
55	Redtail Lake	Largemouth Bass	Mercury
56	Oak Creek	Common Carp / Channel Catfish	Mercury
57	Wildwood Reservoir	Largemouth Bass	Mercury
58	Mormon Island Middle Lake - SRA	Largemouth Bass	Mercury
59	L.E. Ray Lake	Largemouth Bass	Mercury
60	Wax Axe Lake - SRA	Smallmouth Bass	Mercury
61	Windmill State Park Lake # 1	Largemouth Bass	Mercury
62	Bassway Strip Lake No. 5	Largemouth Bass	Mercury
63	Fort Kearny Lake # 5 (SRA)	Largemouth Bass	Mercury
64	Kea Lake - WMA	Largemouth Bass	Mercury
65	Kea West Lake - WMA	Largemouth Bass	Mercury
66	Cottonmill Lake	Largemouth Bass	Mercury
67	Union Pacific Lake - SRA	Largemouth Bass	Mercury
68	Pawnee Slough Lake	Largemouth Bass	Mercury
69	Johnson Lake	White Bass	Mercury
70	Elwood Reservoir	Largemouth Bass / Walleye	Mercury
71	Gallager Canyon Reservoir (SRA)	Largemouth Bass	Mercury
72	Jeffery Reservoir	Largemouth Bass	Mercury
73	West Brady Lake (WMA)	Largemouth Bass	Mercury
74	Maxwell Rest Stop NDOT Lake	Largemouth Bass	Mercury
75	Crystal Lake	Largemouth Bass	Mercury
76	East Odessa Lake (WMA)	Largemouth Bass	Mercury

Site ID #	Waterbody	Fish Species	Pollutant of Concern
77	Archway Pond #1	Largemouth Bass / Bluegill	Mercury
78	Fort McPherson Lake	Largemouth Bass	Mercury
79	Lawrence Youngman Lake	Largemouth Bass / Black Crappie	Mercury
80	Offutt Lake	Largemouth Bass / Smallmouth Bass	Mercury
81	Walnut Creek Lake	Largemouth Bass	Mercury
82	Prairie Queen Lake	Largemouth Bass	Mercury
83	Wehrspann Lake	Largemouth Bass	Mercury
84	Standing Bear Lake	Largemouth Bass / Black Crappie	Mercury
85	Glenn Cunningham Lake	Largemouth Bass	Mercury
86	Prairie View Lake	Largemouth Bass	Mercury
87	Summit Lake	Largemouth Bass	Mercury
88	Buckskin Hills Lake	Largemouth Bass	Mercury
89	Duck Lake	Largemouth Bass	Mercury
90	Steinart Park Lake	Largemouth Bass	Mercury
91	Verdon Lake	Largemouth Bass	Mercury
92	Kirkman's Cove Lake	Largemouth Bass	Mercury
93	Prairie Knoll Lake	Largemouth Bass	Mercury
94	Iron Horse Trail Lake	Largemouth Bass / Bluegill / Black Crappie	Mercury
95	Burchard Lake	Largemouth Bass	Mercury
96	Mayberry Lake -WMA	Largemouth Bass	Mercury
97	Wilson Creek 2X - WMA	Largemouth Bass / Black Crappie	Mercury
98	Wirth Brothers Lake	Largemouth Bass / Black Crappie / Bluegill	Mercury
99	Schoolhouse Lake	Largemouth Bass / Black Crappie	Mercury
100	Box Butte Reservoir	Largemouth Bass / Smallmouth Bass	Mercury
101	Cottonwood Lake	Largemouth Bass	Mercury
102	Cub Creek Lake	Largemouth Bass	Mercury
103	Merritt Reservoir	Walleye / Largemouth Bass	Mercury
104	Shell Lake	Largemouth Bass / Black Crappie	Mercury
105	West Long Lake	Largemouth Bass	Mercury
106	Valentine Mill Pond	Largemouth Bass / Bluegill	Mercury
107	Walgren Lake	Largemouth Bass / Black Crappie	Mercury
108	Bridgeport Middle Lake	Largemouth Bass	Mercury
109	Crescent Lake	Largemouth Bass	Mercury
110	Island Lake	Largemouth Bass	Mercury
111	Blue Lake	Largemouth Bass	Mercury
112	Morrill Sandpit - South	Largemouth Bass	Mercury
113	Morrill Sandpit - North	Largemouth Bass	Mercury
114	North Platte River	Common Carp	Mercury, Selenium

Site ID #	Waterbody	Fish Species	Pollutant of Concern
115	Smith Lake	Largemouth Bass	Mercury
116	Frenchman #1 WMA West Lake	Largemouth Bass / Bluegill	Mercury
117	Oxford City Lake	Largemouth Bass	Mercury
118	Frenchman #2 WMA Middle Lake	Largemouth Bass	Mercury
119	Frenchman #3 WMA East Lake	Largemouth Bass	Mercury
120	Hayes Center WMA Lake	Largemouth Bass	Mercury
121	Rock Creek Lake	Largemouth Bass	Mercury
122	Swanson Reservoir	Walleye	Mercury
123	Chappell Interstate Lake	Largemouth Bass	Mercury
124	East Hershey Lake	Largemouth Bass	Mercury
125	East Sutherland Lake	Largemouth Bass	Mercury
126	Hershey Lake	Largemouth Bass	Mercury
127	Maloney Res. Outlet Canal - above hydro	Common Carp / Smallmouth Bass	PCBs, Mercury / Mercury
128	Maloney Res. Outlet Canal - below hydro	Channel Catfish / Smallmouth Bass	PCBs, Mercury / Mercury
129	North Platte Interstate Lake	Largemouth Bass / Yellow Perch	Mercury
130	Ogallala City Park Lake (Humphrey Pond)	Largemouth Bass	PCBs, Mercury
131	Sutherland Reservoir	Common Carp	PCBs, Mercury
132	Sutherland Cooling Pond	Largemouth Bass / Flathead Catfish	Mercury
133	Sutherland Outlet Canal	Channel Catfish	PCBs, Mercury
134	Carter P. Johnson Lake	Largemouth Bass	Mercury
135	Grabel Pond #5	Largemouth Bass	Mercury
136	Isham Dam Lake	Largemouth Bass / Bluegill / Yellow Perch	Mercury
137	Whitney Reservoir	White Bass	Mercury

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Monitoring for Fish Kills and Surface Water Complaints

Why does NDEE sample after fish kills and complaints?

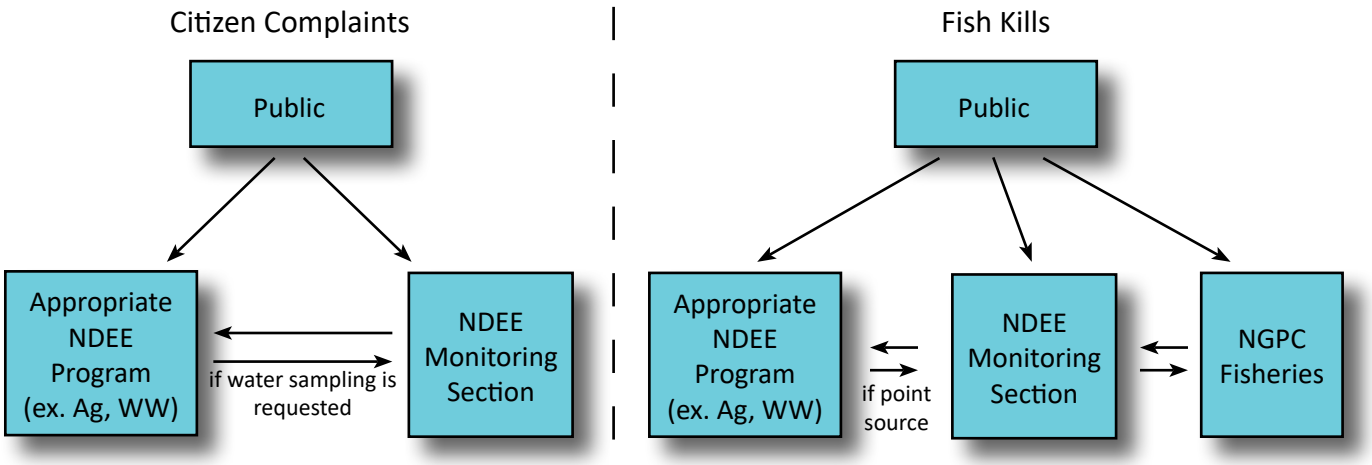
The agency responds to numerous fish kills and surface water complaints annually. In many cases, the investigations surrounding a fish kill may require sampling to document the cause of the water quality problem, the magnitude and extent of the water quality problem, the source of pollution, and/or a 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 member of the public calls NDEE's Monitoring Section to report a surface water complaint, the Monitoring Section notifies NDEE personnel within the program most closely related to the problem (ex. Agriculture, Wastewater). That program may ask for Monitoring Section assistance in the investigation if water samples are requested.

Contents of a storm drain entering Salt Creek, Lancaster 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 Monitoring Section, who will in turn notify the appropriate NDEE 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 Monitoring Section receives the call from the public, section staff will notify the NGPC of all fish kills and the appropriate NDEE program if the kill is related to a pollution event. Within the NDEE, the Monitoring Section is always notified of a fish kill regardless of cause or water body affected.



What types of data are collected?

The cause of fish kills is determined from information collected from the reporting party and/or the 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.

A fish kill at a private pond attributed to low dissolved oxygen concentrations.

Fish kills reported

From July 1, 2019, through June 30, 2020, a total of seven fish kills were reported to NDEE. Six of the reported fish kills were attributed to low dissolved oxygen levels within the waterbody and one resulted from an unknown cause. A total of 11 fish kills were reported between July 1, 2020, and June 30, 2021. Six of the reported fish kills were attributed to low dissolved oxygen levels, three from disease/parasite, one from a pollutant spill, and one resulted from an unknown cause.

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 large swings of dissolved oxygen concentrations throughout a 24-hour period. 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.

Trash thrown from a bridge into a stream, Dodge County.

Citizen complaints

Between July 1, 2019, and June 30, 2020, the Monitoring Section received 63 notifications of concern regarding surface water issues and from July 1, 2020, to June 30, 2021, the Monitoring Section received 90 such notifications. While many of these cases were referred to other agency programs that more closely relate to the problem, the Monitoring Section aided through investigations and/or sample collection to help document conditions.

More information

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Surface Water Sampling Summary

As discussed in the previous pages, the NDEE performs surface water monitoring throughout the state. This section summarizes the number of samples and parameters analyzed for each monitoring program in 2021. 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, sulfate
- **Atrazine:** monthly, May – June
- **Dissolved Organic Carbon (DOC):** four times per year (January, April, July, October)
- **Quarterly metals:** four times per year (January, April, July, October)
  - Bottom of basin sites: all metals, 17 sites (11 NDEE and 6 USACE) = Total-selenium, mercury and dissolved-sodium, magnesium, calcium, arsenic, selenium, aluminum, cadmium, chromium, copper, lead, nickel, silver, zinc
  - All other sites: "partial metals list" = Total-selenium; dissolved-sodium, magnesium, calcium, arsenic, selenium
- **Bacteria:** *E. coli*

Total number of individual field measurement readings and sample parameter analyses:

- **Field measurements:** 7,272
- **Traditional:** 8,484
- **Atrazine:** 202
- **Metals:** 3,036
- ***E. coli*:** 1,212

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

Collecting field measurements from a stream.

Measuring stream velocity and depth to calculate discharge.

Basin Rotation Monitoring Program

Network: 42 stream sites (including 12 shared Ambient Stream sites) in the Lower Platte and Nemaha River basins

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

Parameters (streams):

- **Field measurements:** water temperature, DO, pH, conductivity, turbidity, stream discharge
- **Traditional:** TSS, chloride, ammonia, nitrate-nitrite, kjeldahl nitrogen, total phosphorus
- **Atrazine:** weekly, May – June
- **Bacteria:** *E. coli*

Total number of individual field measurement readings and sample parameter analyses:

- **Field measurements:** 5,544
- **Traditional:** 5,544
- **Atrazine:** 378
- ***E. coli*:** 924

Assistance: NNRD.

(Bottom) Measuring gage height of a stream with a weighted tape measure from a reference point marked on a concrete culvert.

Public Beach Monitoring Program

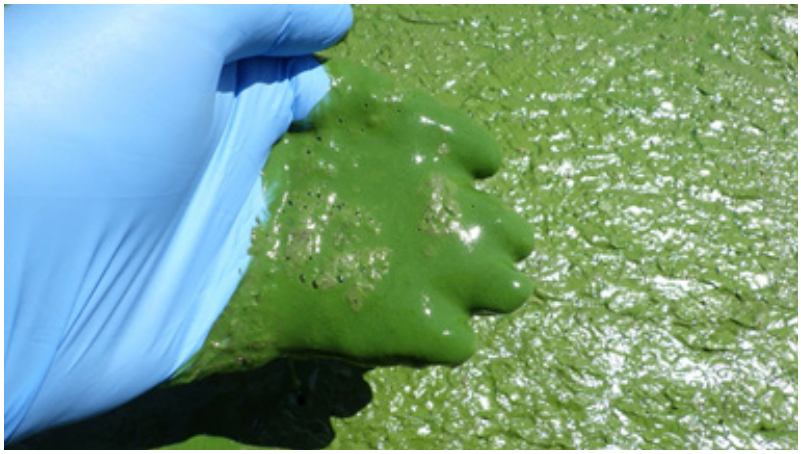
Network: 54 sites statewide from 51 lakes

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

Parameters: bacteria (*E. coli*) and toxic algae (microcystin)

Total number of routine individual sample parameter analyses:

- ***E. coli*:** 1,113
- **Microcystin:** 1,113



A Harmful Algal Bloom (HAB) at a Nebraska reservoir.

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

Ambient Lake Monitoring Program


Collecting field measurements on a Sandhills lake.

Network: 44 lakes statewide
NDEE: 37 lakes
USACE: 4 lakes
NNRD: 2 lakes
LLNRD: 1 lake

Frequency: Monthly from May through September

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

Total number of individual field measurement readings: (only the set of field measurements collected near the surface are included in the total number of readings from each deep-water and mid-lake location, however, an undetermined set of field measurements are also taken every 0.5 or 1.0 meters, depending upon depth at the location, from the surface to the lake bottom)
- **Deep-water:** 1,100
- **Mid-lake:** 1,100

Total number of individual sample parameter analyses:
- **Traditional:** 1,760
- **Chlorophyll-*a*:** 220

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

Fish Tissue Monitoring Program

Network: 114 fish samples collected from 56 sites (10 rivers/streams and 46 lakes/reservoirs) in the Lower Platte and Nemaha River basins

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


Collecting a fish community sample by electrofishing.

Stream Biological Monitoring Program

Network: 45 stream sites (10 completed in partnership with NGPC) were sampled in the Lower Platte and Nemaha River basins

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

Fish Kills and Surface Water Complaints

Time frame: July 1, 2020, to June 30, 2021

A total of 11 fish kills were reported between July 1, 2020, and June 30, 2021. During this same time frame, the Department received 90 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.

Assistance: NGPC and NRDs

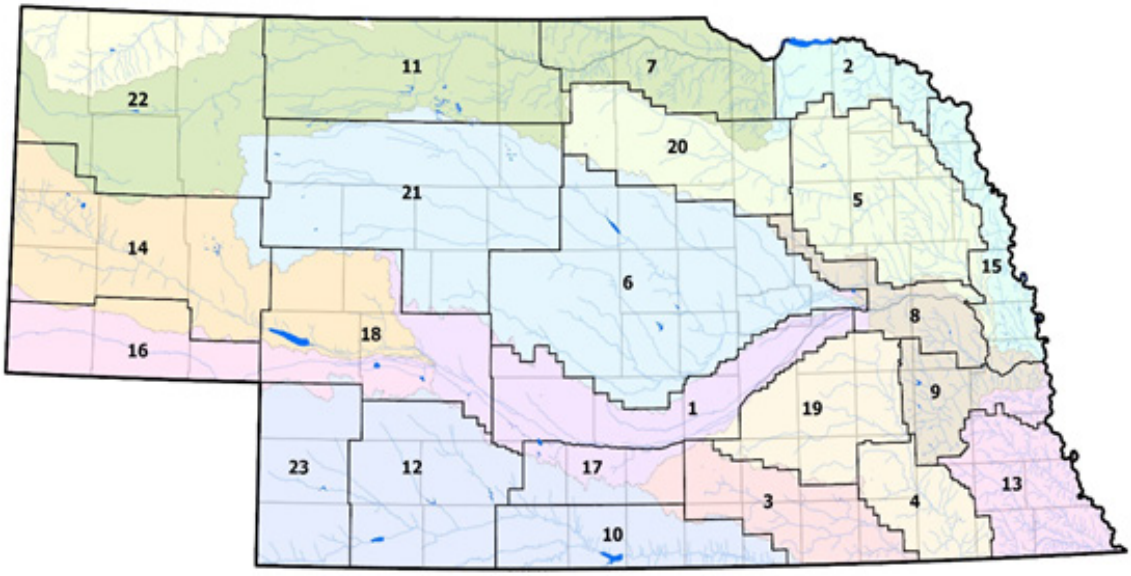
Collecting a fish tissue sample from a rainbow trout.

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.

A rainbow over the sandhills.

Nebraska's Natural Resources Districts (NRDs)



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 Loupe NRD	ULNRD	Thedford
22	Upper Niobrara-White NRD	UNWNRD	Chadron
23	Upper Republican NRD	URNRD	Imperial

Stream Nutrient Assessment Procedure (SNAP) Pilot Study

What is SNAP?

The purpose of SNAP is to determine how nutrient enrichment affects Nebraska's stream ecosystems. Locally, excess nutrients may not cause such obvious problems as dead zones in estuaries. However, the nitrogen and phosphorus that enter our waterways is expected to alter the amount and composition of algae, which are an important base resource for fishes and macroinvertebrates. Therefore, NDEE has been focusing on the composition of algal communities, and measures such as dissolved oxygen that are linked to stream algae.

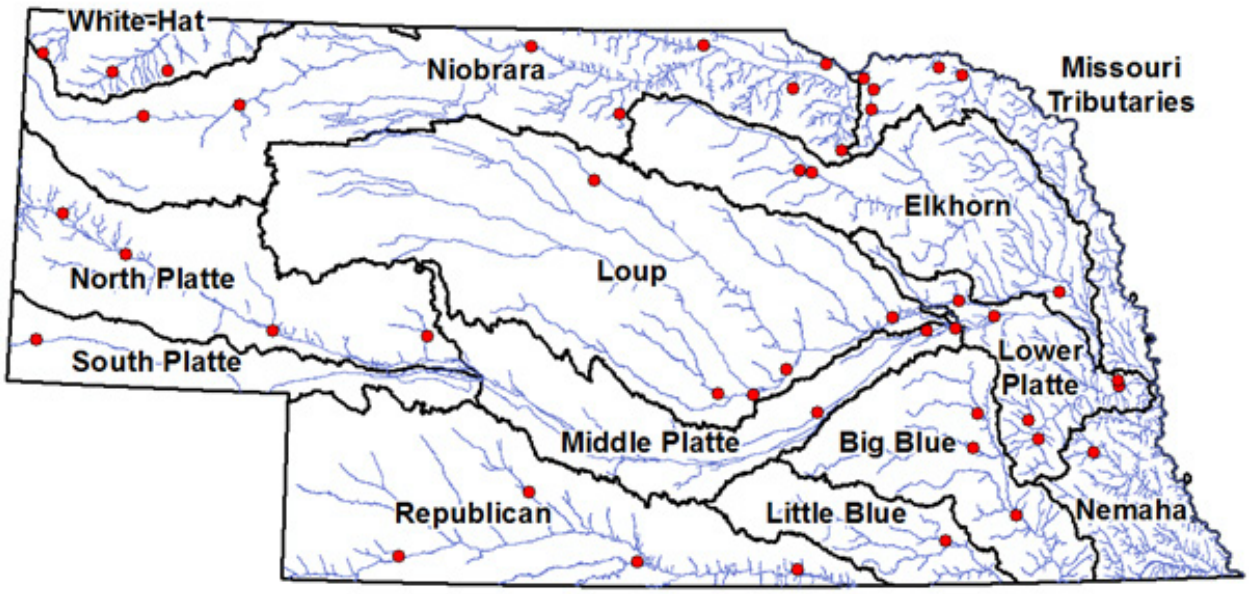
SNAP implementation

Each year, the SNAP program occurs concurrently with the Basin Rotation Monitoring Program (BRMP) to take advantage of the high frequency nutrient sampling. Eight sites from the BRMP are chosen per year, and each of the streams is sampled for algal communities that have been colonized on tiles, chlorophyll-*a* in the water column and accrued on tiles, diel (24 hour) changes to dissolved oxygen concentrations, as well as habitat, macroinvertebrate, and fish sampling in conjunction with the Stream Biological Monitoring Program.

Environmental DNA (eDNA) sampling was added to SNAP in 2016. This sampling is quite easy, being done with a filter attached to a syringe, and the return of data on the entire suite of algal species is unmatched in terms of rapidity and price. Environmental DNA also has

(Left) Multi-parameter meter and benthic algae tiles deployed in the water at Monroe Creek, Sioux County. (Top) Collecting samples by scraping algae colonized from benthic tiles to identify algal species and determine chlorophyll-a concentrations.

SNAP sites sampled 2015-2020

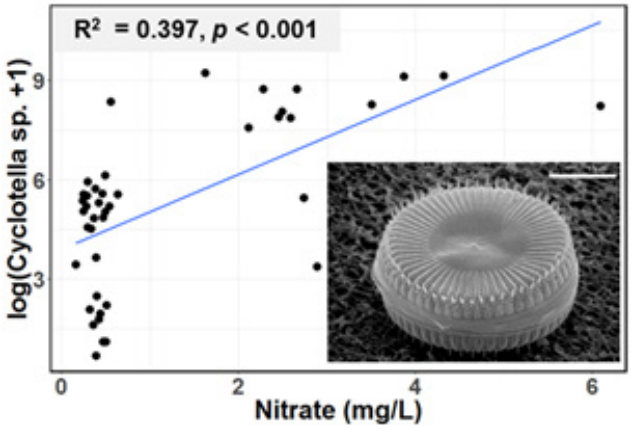


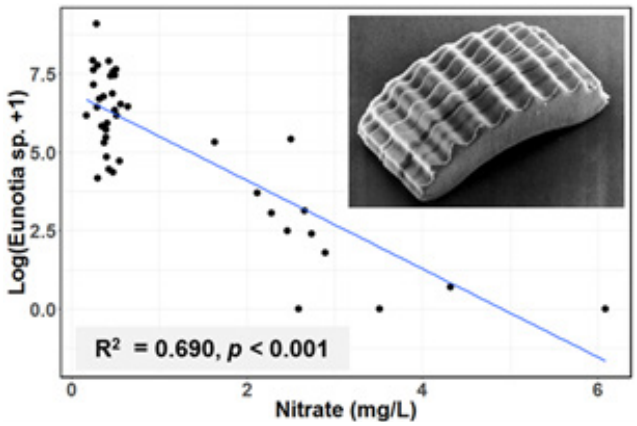
other advantages over algae grown on tiles: eDNA sampling includes both sestonic (water column) and benthic (stream bottom) algae; eDNA sampling is not subject to difficulties that may arise from colonizing tiles such as burial after storms and grazing by herbivorous macroinvertebrates; and eDNA is easily collected at the time of weekly Basin Rotation chemical sampling.

eDNA filter attached to a syringe used to determine the algal species inhabiting a stream.

Results and update

Sample collection occurred from 2015-2020, completing an entire basin rotation. The colonized algae 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. These results suggest that increased nitrogen in the streams is the most likely to alter the structure and function of these ecosystems. The included figures are examples of potential indicator diatoms: *Cyclotella* appeared to indicate higher nitrate waters and *Eunotia* seemed to be found in stream with lower nitrate.





In 2022, NDEE will begin collecting sestonic chlorophyll-*a* monthly from all 101 stream stations of the Ambient Streams Monitoring Program, May through September. Chlorophyll-*a* is a measure of the biomass of algae in the water column and serves as a measure of the overall productivity of a stream. NDEE will use this data, in conjunction with dissolved oxygen percent saturation, to demonstrate whether nutrients are affecting aquatic life. In turn, this will allow managers to incorporate these effects into watershed management plans that are protective of our streams.

More information

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

Regional Monitoring Network

What is the Regional Monitoring Network?

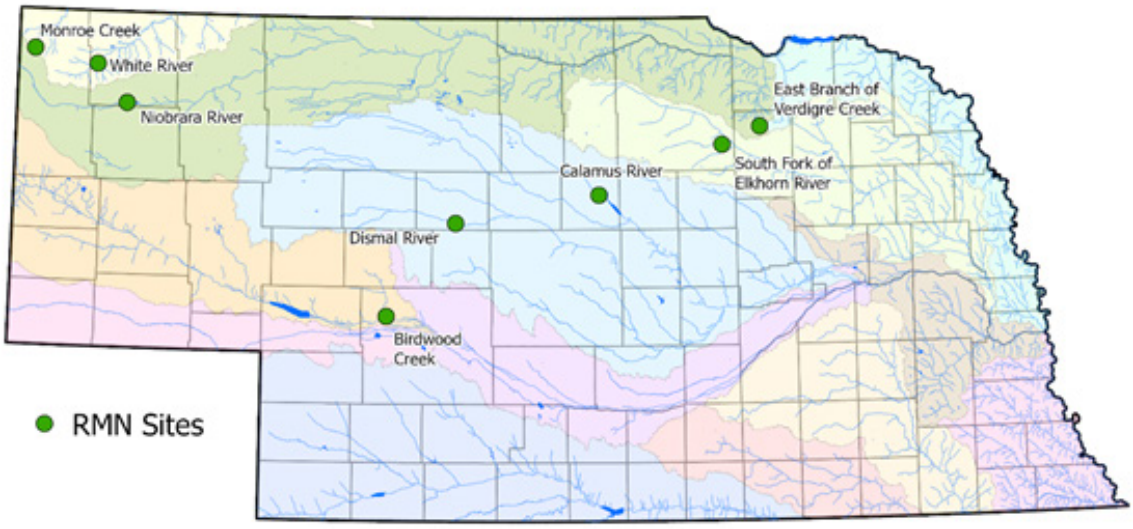
The Regional Monitoring Network (RMN) is a collaboration between the Environmental Protection Agency (EPA) and numerous states, tribes, and other organizations to collect continuous stream discharges,temperatures, and other chemical and biological data. The data will then be used as baselines for long term comparisons of stream condition. Having many sensors deployed nationwide that collect continuous data will allow NDEE, EPA, and other partners to detect significant yet subtle trends in stream condition.

East Branch of Verdigre Creek, Antelope County.

What is monitored and where is the monitoring conducted?

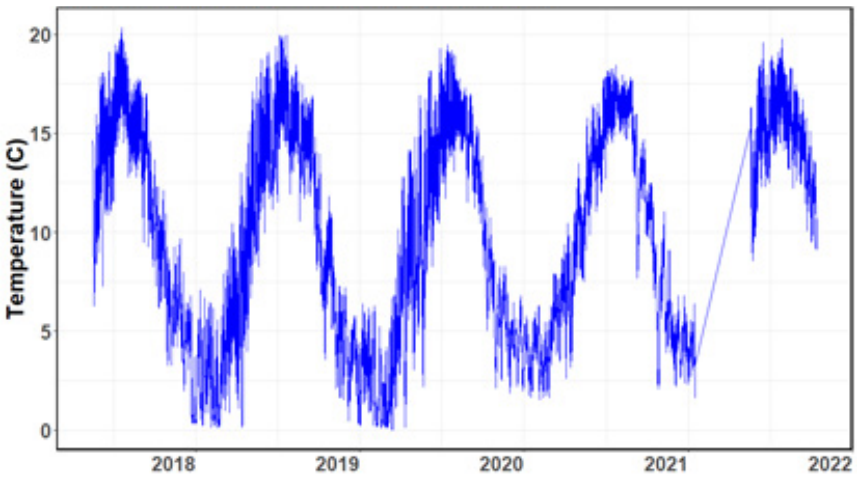
NDEE has been monitoring eight streams since May 2017. Each location has a sensor that collects water level and temperature every 30 minutes, typically bolted to a fence post driven into the stream bottom. NDEE staff download data from the sensors and perform maintenance once every autumn and spring. Each of the study locations is also sampled as part of the NDEE Ambient Stream Monitoring Program, with water chemistry and other parameters collected monthly year-round. These sites are also regularly sampled for the Basin Rotation and Stream Biological Monitoring Programs.

Regional Monitoring Network Sites in Nebraska



(Above) Temperature sensor deployed in the waters of East Branch Verdigre Creek, Antelope County. (Top right) Downloading temperature data from a sensor.

Monroe Creek Water Temperature 2017-2021



More information

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Public Drinking Water Stream Study

Why does NDEE conduct this monitoring?

Title 117 – *Nebraska Surface Water Quality Standards* (NSWQS) defines the Public Drinking Water (PDW) designation as "...waters which serve as a public drinking water supply. These waters must be treated (e.g., coagulation, sedimentation, filtration, chlorination) before the water is suitable for human consumption. After treatment, these waters are suitable for drinking water, food processing, and similar uses."

In 2019, the surface water quality standard for arsenic in PDW designated streams was lowered from 10 µg/L to .018 µg/L for the protection of human health at the recommendation of EPA. This has led to the impairment of PDW streams in Nebraska. While arsenic additions to waterbodies may be anthropogenic in nature, it is a naturally occurring metalloid and may be found in geologic formations, groundwater, and surface water.

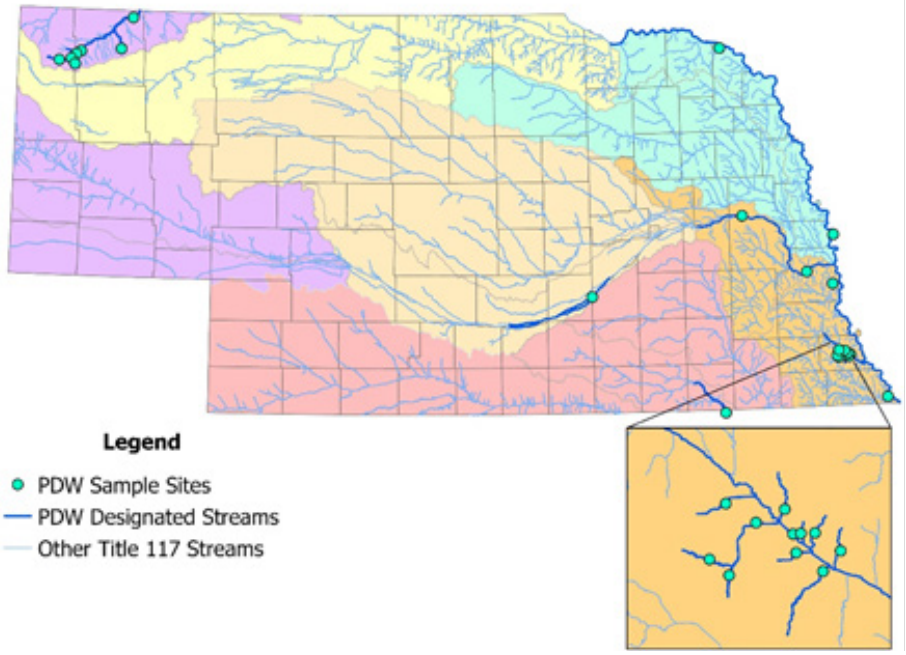
Drilling a hole through the ice to sample the water at Hughes Creek, Nemaha County.

PDW study implementation

In June 2021, NDEE started a two-year special study to develop a dataset that will allow the Department to assess whether the 26 stream and river segments designated as PDW are meeting that beneficial use. In consultation with the Drinking Water Section, six parameters were chosen to sample monthly throughout the year: arsenic, atrazine, manganese, nitrate/nitrite, selenium, and uranium. The study will conclude in April 2023.

Collecting water samples through the ice at Scotch Branch Creek, Nemaha County.

Public Drinking Water Stream Study sample sites



More information

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Daniel Ross, daniel.ross@nebraska.gov or (402) 471-4227.
David Schumacher, david.schumacher@nebraska.gov or (402) 471-4709.

Integrated Report for Nebraska's Waters

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 standards. Nebraska's water quality standards are defined in *Title 117- Nebraska Surface Water Quality Standards* (NDEE, 2019). 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:

- Recreation (swimming, wading)
- Aquatic life (health of water insects, fish, and wildlife)
- Public drinking water supply (water for public consumption)
- Agricultural water supply (water for crops and livestock)
- Aesthetics (appearance, odor)

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 of a specific waterbody, NDEE assesses monitoring data against the pollutant criteria defined in Title 117 for each assigned beneficial use.

Lake under health alert and impaired for microcystin in the Integrated Report.

Reporting water quality conditions

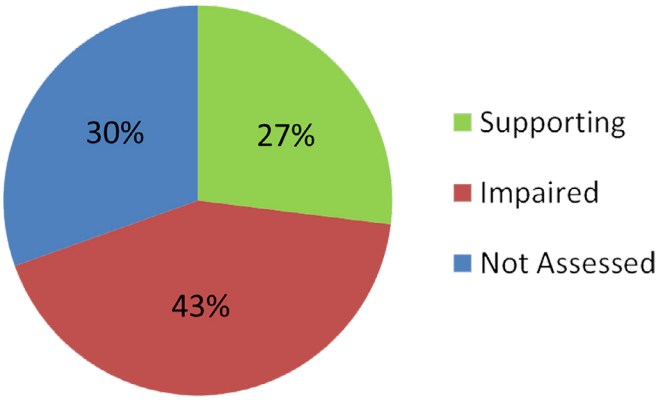
Every two years the CWA requires that states develop an "Integrated Report" that summarizes the water quality condition of all surface waters in the state. For this report, states evaluate all readily available water quality data and determine which waterbodies are or are not supporting their designated beneficial uses. Waters that do not support one or more of their assigned beneficial uses are categorized as "impaired," while waters that support their assigned uses are categorized as "supporting" and considered to be in good condition.

Summary of Nebraska's 2020 Integrated Report

Nebraska has 1,558 stream segments flowing over 16,670 miles and 553 lakes and reservoirs that cover more than 134,980 acres. As of the 2020 Integrated Report, NDEE staff has assessed the water quality of 665 stream segments (11,595 miles) and 340 lakes (125,248 acres). While numerous waterbodies still need assessment, NDEE has tried 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 on the next page).

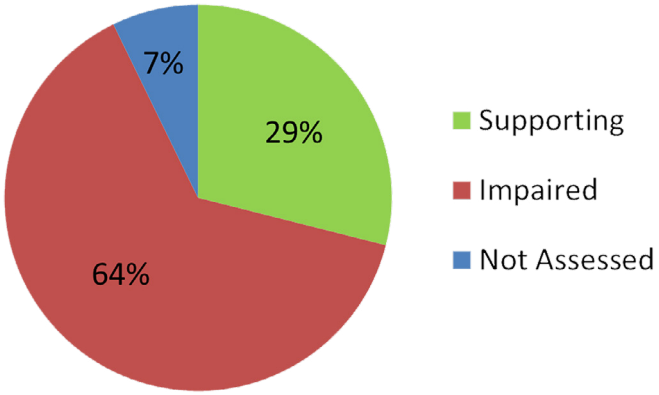
Of the 665 stream segments assessed, 356 were supporting their assigned uses, while 309 were impaired. Similarly, of the 340 lakes assessed, 126 were supporting while 214 were impaired (see the following figures).

Stream status



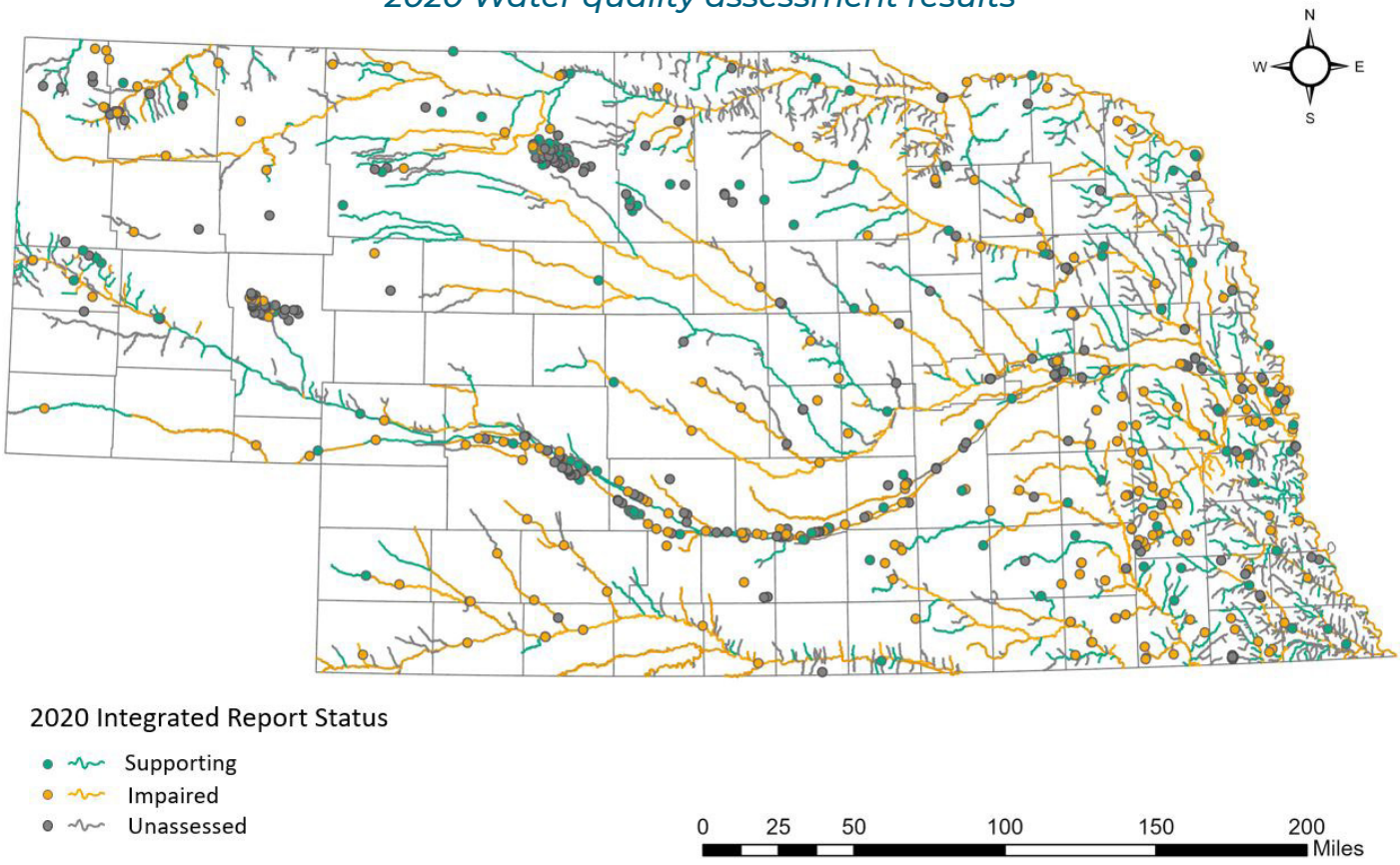
Status of Nebraska streams in miles as reported in the 2020 Integrated Report.

Lake status



Status of Nebraska lakes in acres as reported in the 2020 Integrated Report.

2020 Water quality assessment results



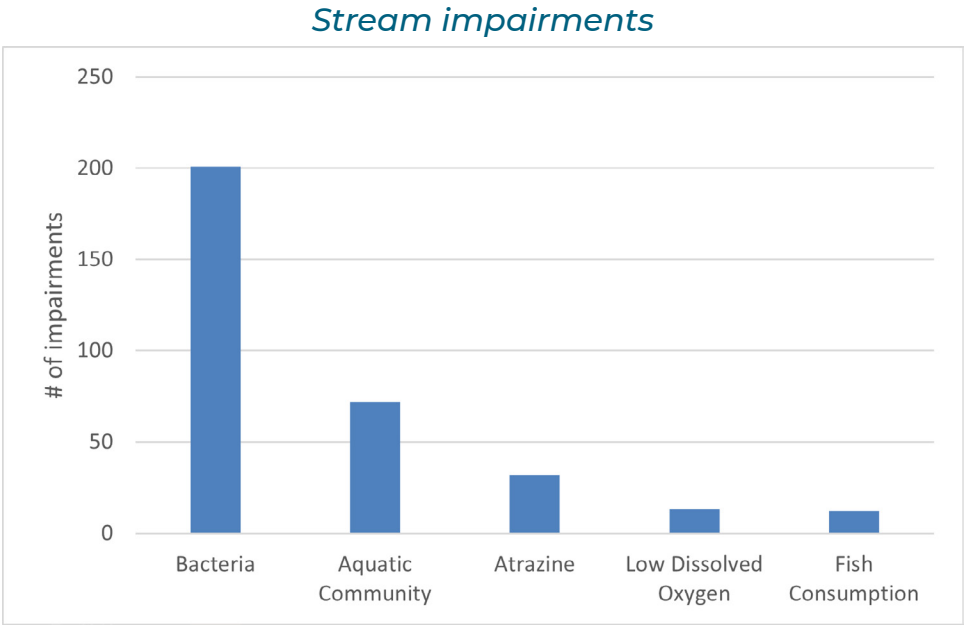
Water quality assessment results as reported in the 2020 Integrated Report.

Common stream and lake impairments

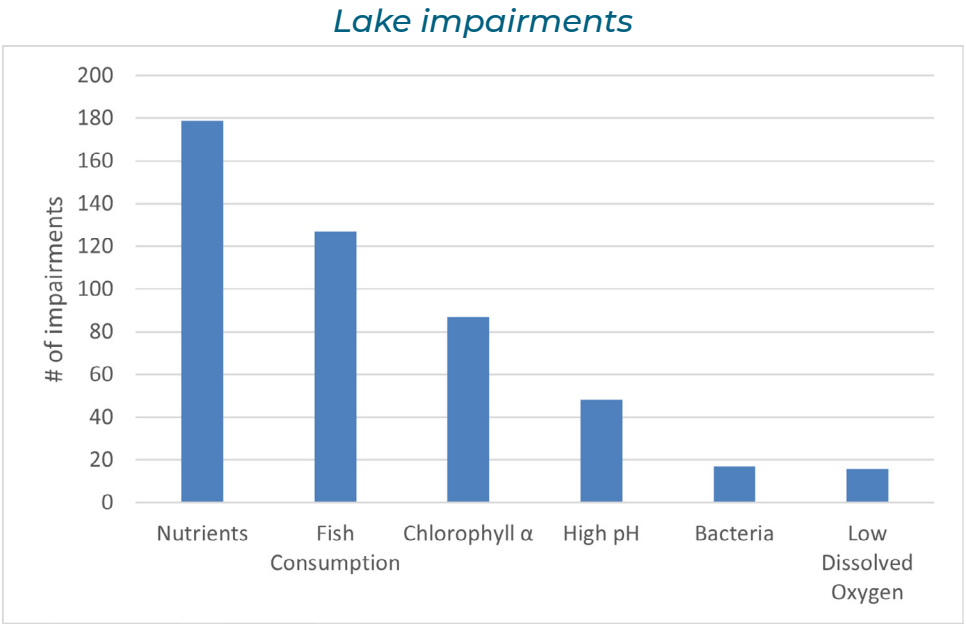
The most common impairments for Nebraska's streams and lakes can be seen in the following figures. *E. coli* bacteria impaired nearly three times as many streams as the next leading cause, impaired aquatic community (fish and insects). Atrazine, fish consumption advisories, and low dissolved oxygen were also common stream impairments. The most common lake impairment was elevated nutrients followed by fish consumption advisories, Chlorophyll α 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.



Common stream impairments from the 2020 integrated report.



Common lake impairments from the 2020 integrated report.

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 the waterbody can support its designated uses. Point source pollution is managed by the National Pollutant Discharge and Elimination System (NPDES) permitting program, and nonpoint source pollution is typically addressed by 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 necessary data to determine if the plan is working or if modifications are required.

More information

Brian Barnes, brian.barnes@nebraska.gov or (402) 471-6988.

Groundwater Quality Monitoring Report to the Legislature

Why NDEE does this report

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

History of this report

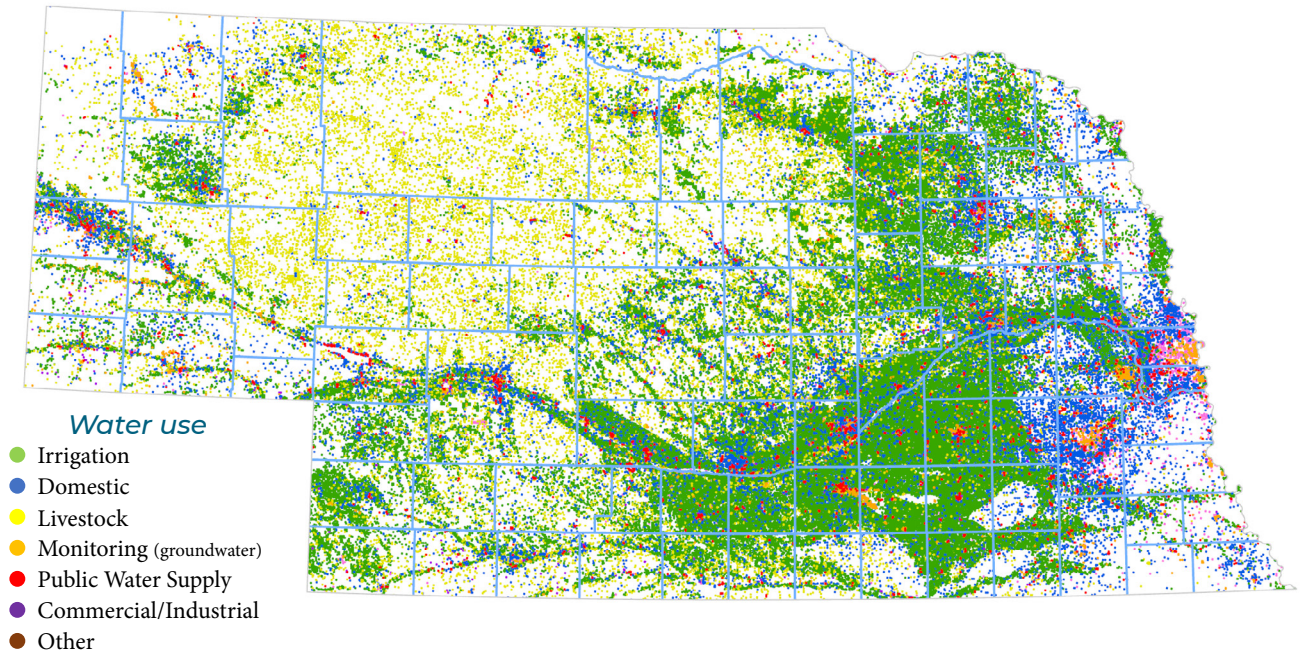
Beginning in December 2001, the Department has prepared a report outlining the extent of groundwater quality monitoring conducted by Natural Resources Districts (NRDs) during the preceding calendar year. The Department uses the data submitted by the districts in conjunction with all other readily available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

Groundwater sample, Grant County ***(Lexi Hingtgen, Upper Loup NRD)***.

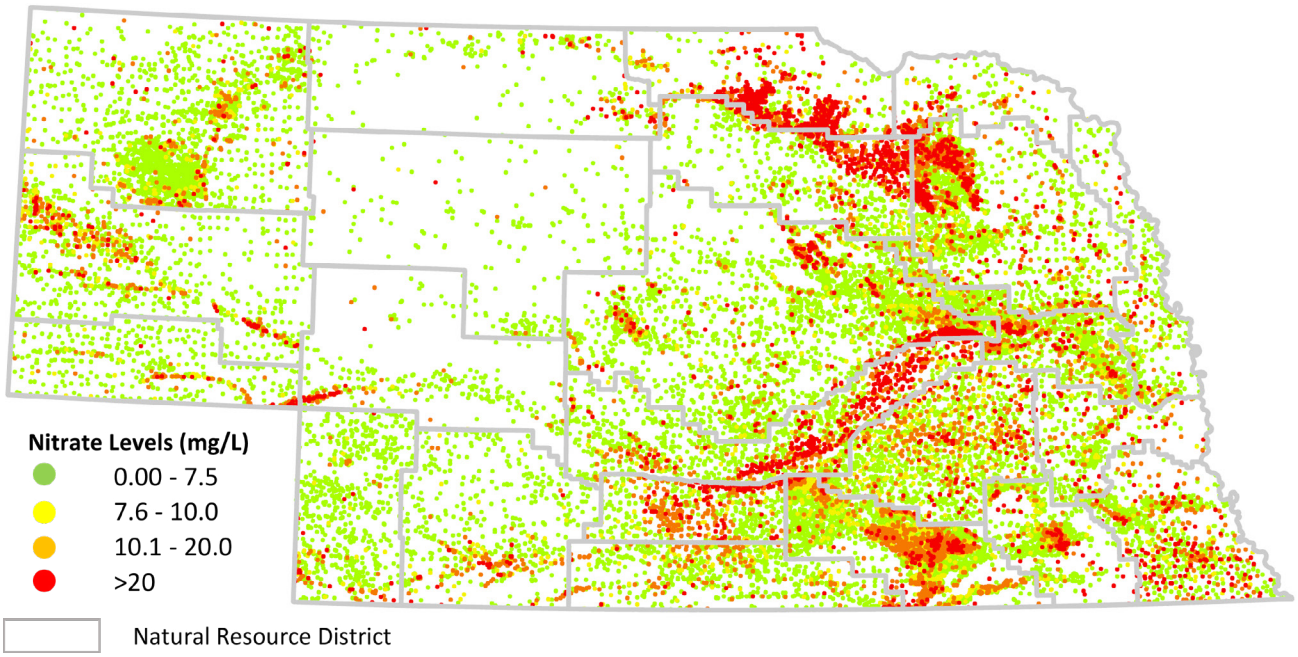
Where is the monitoring conducted?

The State of Nebraska is a large geographic area, over 77,000 square miles. There are over 189,000 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2019, 5,442 wells were sampled. Since 1974, over 34,000 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.

Active registered wells and their water use as of Nov. 2022



Nitrate-N concentrations

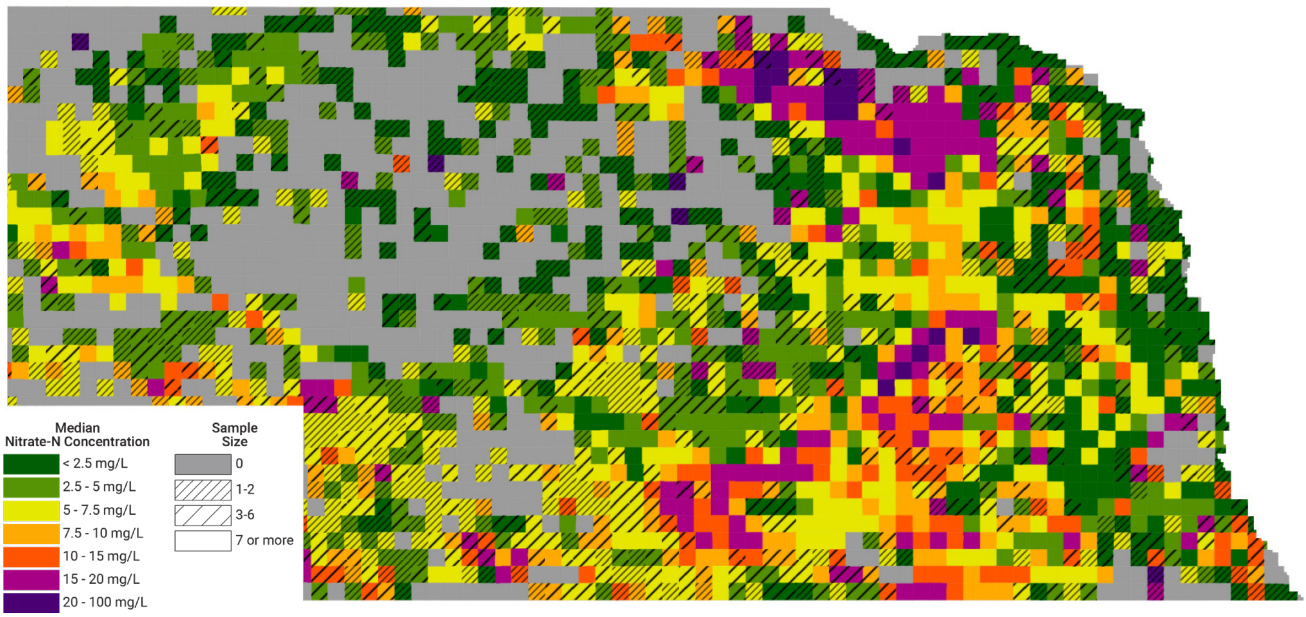


Map of Nitrate-N concentration of 142,259 samples from an average of 5,786 water wells per year (all types) during 2000-2019. (Source: Nebraska Groundwater Quality Clearinghouse, 2022). Empty areas indicate no data reported, not the absence of nitrate in groundwater.

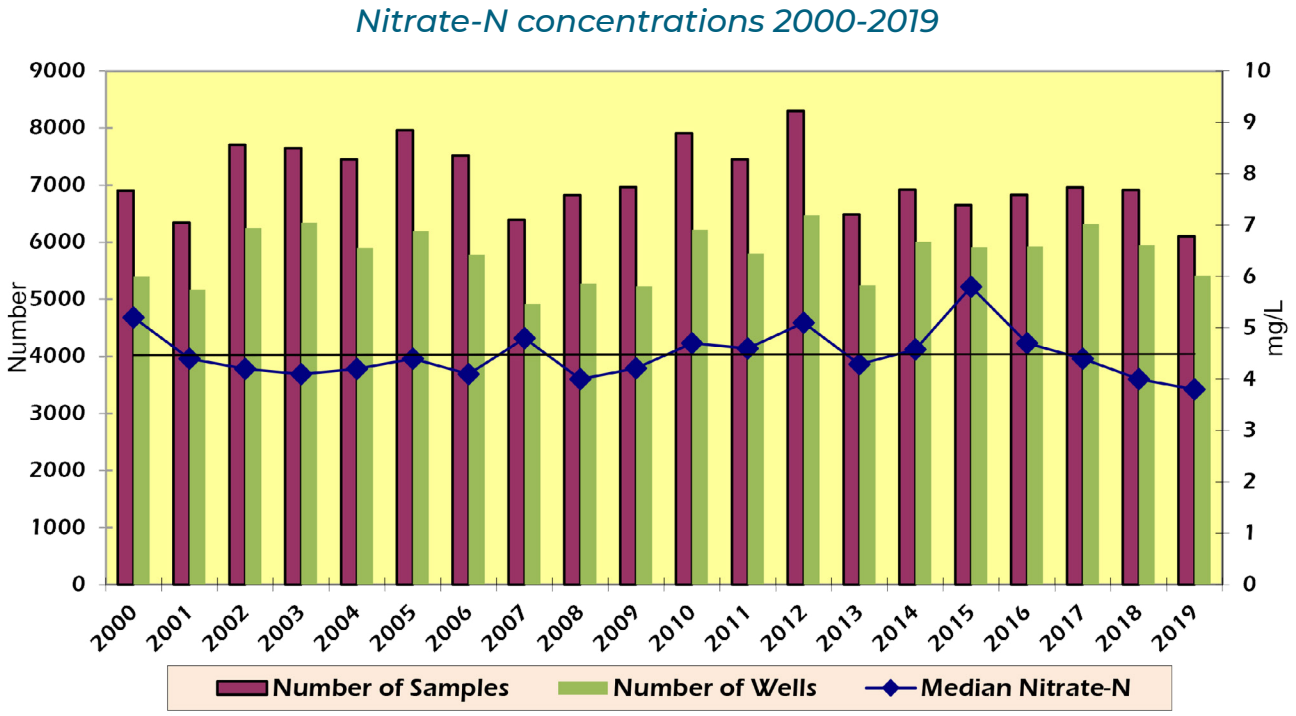
What is monitored?

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.

Median Nitrate-N concentrations



Median of the most recent Nitrate-N concentration by township of 34,007 unique water wells (all types) during 2000-2019. (Source: Nebraska Groundwater Quality Clearinghouse, 2022). Empty areas indicate no data reported, not the absence of nitrate in groundwater.



Graph of Nitrate-N concentration of 142,259 samples from an average of 5,786 water wells per year (all types) during 2000-2019. (Source: Nebraska Groundwater Quality Clearinghouse, 2022).

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. All NRDs have designated Groundwater Management Areas over part or all of their districts to address groundwater quality problems.

Irrigation pivot, Logan County ***(Lexi Hingtgen, Upper Loup NRD).***

Results as of 2022

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).

Reverse Osmosis treatment plant to remove nitrate, Seward County.

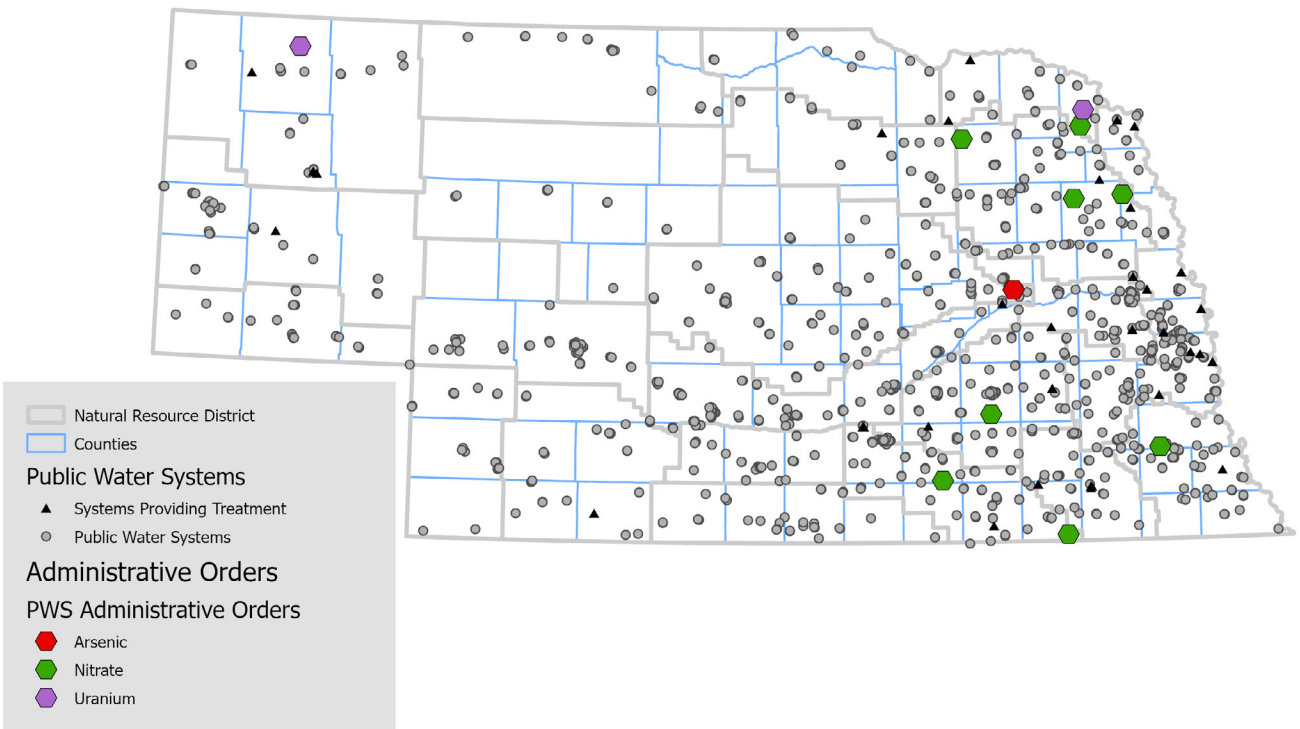
The most representative picture of the statewide nitrate concentration is from the time period from 2000 to 2019 due to the number and spatial relationship of the samples collected. The overall trend indicates only a slight increase in nitrate median concentrations statewide (see chart above).

All of the results for agricultural chemicals (including nitrate) can be found at clearinghouse.nebraska.gov. The entire database can be accessed at this 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://dee.ne.gov/Publica.nsf/Pages/WAT248
David Miesbach, david.miesbach@nebraska.gov or (402) 471-4982.

Community public water supply systems with requirements for arsenic, nitrate, and uranium



Groundwater Monitoring at Permitted Livestock Facilities

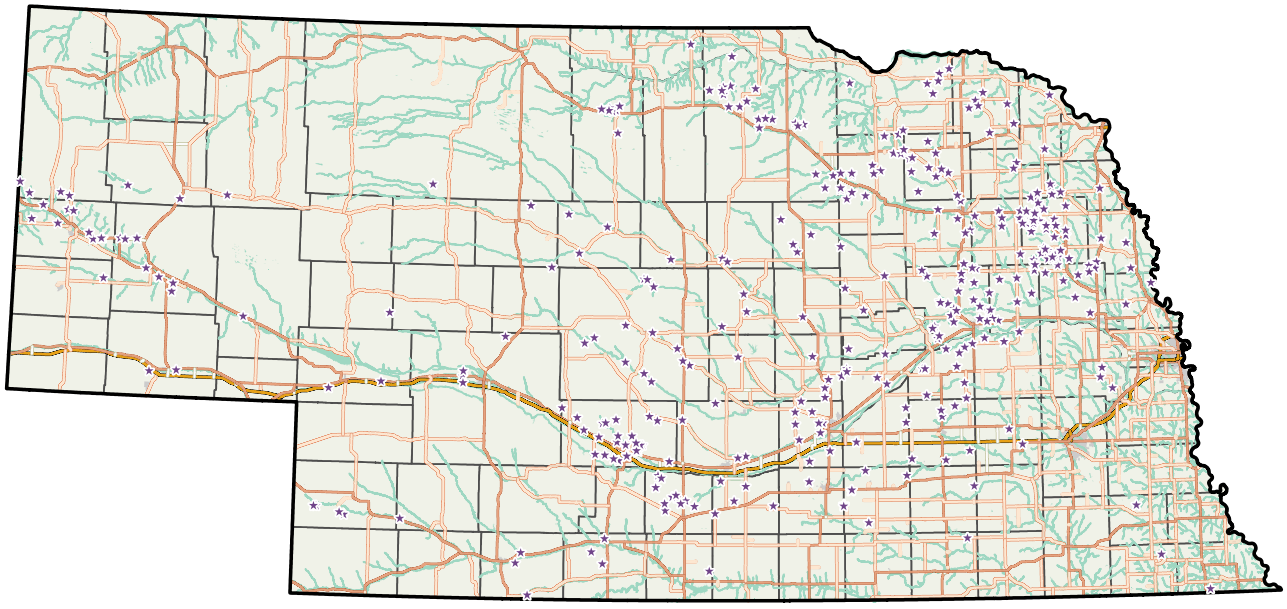
Why require monitoring at livestock facilities?

Nebraska's groundwater may be negatively impacted by seepage from holding ponds or lagoons at livestock waste control facilities (LWCFs). The liquid waste in the holding ponds has elevated levels of nutrients and chloride ions. NDEE requires monitoring at facilities with an elevated risk of groundwater contamination for nitrate, ammonia, and chloride to document any impact to groundwater from the holding ponds or lagoons. The contaminated groundwater may negatively impact public water supplies and domestic wells. NDEE oversees the investigation and remedial measures conducted by the owners of the facilities if groundwater has been impacted.

History of the monitoring program

NDEE's Groundwater Section 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 Section has reviewed 1,584 LWCFs (as of November 2022) and recommended monitoring at 538 of them. Currently, there are 421 approved groundwater monitoring plans with 378 operations where semi-annual monitoring is conducted. Thirty-five of those 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.

Livestock facilities with groundwater monitoring



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.

Additional data collected from each monitoring well includes:

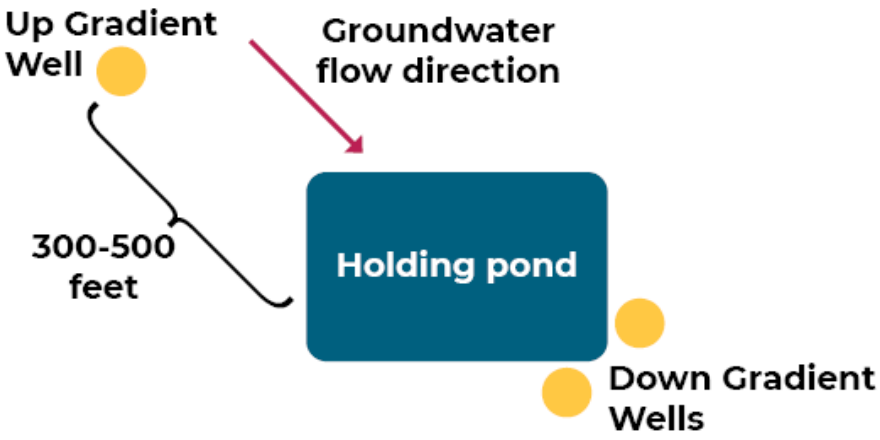
- depth to water,
- pH,
- temperature, and
- specific conductivity

The groundwater quality and the flow direction are monitored in the spring (before irrigation season) and the fall (after irrigation season).

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 diagram below 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 NDEE twice a year. Monitoring is conducted either by a hired consulting firm or by the owner of the livestock operation. Groundwater Section 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 10 LWCFs with more comprehensive groundwater investigations underway. To date, NDEE does not know of any private or public drinking water wells that have been contaminated from a livestock waste control facility.

More information

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Crow Butte Resources, Inc. Groundwater Monitoring

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 Environment and Energy (NDEE) 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.

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

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.

Permit modifications

CBR most recently requested a minor permit modification in 2018. This modification request had two purposes; to allow all mine units to be officially placed in the restoration phase during non-active mining operational phases, and to eliminate required daily pressure readings in well houses that have been isolated and no longer have the potential for flow of mining solutions to or from the well house. Because this was a minor permit modification, no official public notice period was required.

Permit renewals

CBR most recently requested a permit renewal for Deep Disposal Well #2 in 2020. This renewal request included no significant changes. Because this was a permit renewal, an official public notice period was required. No comments were received regarding the renewal of this permit.

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 NDEE in a quarterly report, and each quarter NDEE randomly checks laboratory analyses by splitting samples from the monitoring wells with the facility. The samples are collected by NDEE 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. NDEE 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 2022

Groundwater monitoring well samples are collected and analyzed by the laboratory at CBR. In 2022, the NDEE split 112 of those groundwater samples (seven from deep monitor wells and seven from shallow wells each quarter, and an additional 56 during restoration and stabilization split sampling) with CBR. Samples collected by NDEE for regular quarterly split sampling are sent to the State Health Lab for analysis, samples collected by NDEE for restoration and stabilization split sampling are sent to a third-party lab for analysis. Comparisons between CBR laboratory's analyses and NDEE's analyses for the samples were within a statistically reasonable margin of error.

Future expansion

There are currently 11 mine units constructed at the facility. Mine Unit 1 has reached restoration and stabilization goals as determined by NDEE. Mine Units 2, 3, 4, and 5 are being monitored for stabilization. Mine units 6, 7, and 8 are currently undergoing restoration activities. To date, CBR has no plan to extend mining at their current facility beyond Mine Unit 11.

Future expansion would occur 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. At this time, it has been requested by CBR that these expansion applications be tabled until further notice.

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

More information

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