2010

2010 Nebraska Water Monitoring Programs Report

Marty Link

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Nebraska Department of Environmental Quality
Water Quality Division
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Acknowledgements:

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Photos on the cover (left to right): Stream Sampling, Bloody Run Creek on the south side of Rockford Reservoir in Gage County (photo by Will Myers, NDEQ); In-house irrigation water sample analysis, Twin Platte NRD (photo by Ann Dimmitt, TPNRD); Center Pivot Irrigation, Little Blue NRD (photo by Marlene Faimon, LBNRD).

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

Please direct any general questions related to this report to Marty Link at NDEQ at 402/471-4270 or marty.link@nebraska.gov, who edited this report.

NDEQ staff sampling the Little Blue River in Kansas, near Steele City, NE (Washington County, KS).

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Introduction

The Nebraska Department of Environmental Quality (NDEQ) is charged with monitoring, assessing, and to the extent possible, managing the state's water resources. The purpose of this work is to protect and maintain good quality water and encourage or execute activities to improve poor water quality. Monitoring is done on the over 18,000 miles of flowing rivers and streams, our greater than 280,000 acres of surface water in lakes and reservoirs, and the vast storage of groundwater in Nebraska's aquifers.

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

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

Partners

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

NDEQ staff sampling Horseshoe Creek near Marysville, KS, for the Tuttle Creek Watershed Project.

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Fish Tissue Monitoring

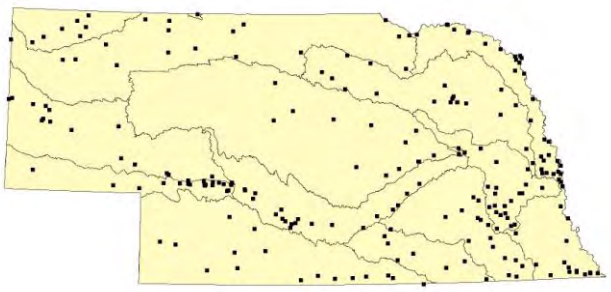
Why NDEQ Does this Monitoring

Each year fish samples are collected from numerous streams and lakes across Nebraska to determine their suitability for human consumption. This is important because certain contaminants have a tendency to bio-accumulate 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 in saturated fat, and high omega-3 fatty acid food source, so anglers should not be discouraged from consuming fish in moderation.

History of Fish Tissue Program

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

Where is the Monitoring Conducted?



Historic fish tissue monitoring locations.

Monitoring is generally conducted at locations where most fishing occurs, therefore the risk to human health is greatest. Fish species targeted for collection included those that are most frequently sought by fisherman, such as: catfish, largemouth bass, walleye, crappie, and even 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 two or three of Nebraska's 13 major river basins (see the map above for basin divisions and historic sampling locations). Fish tissue sampling activities are rotated through all 13 basins on a six-year cycle. In addition, fish samples are collected every two years at five locations termed "trend sites." These five trend sites have been monitored for more than 16 years in an effort to identify long-term changes in fish contaminant levels, if present.

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What is Monitored?

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

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

How are the Data Used?

Fish tissue data collected are used to assess human health risks utilizing a risk-based assessment procedure. For non-cancer (noncarcinogenic) effects, the assessment procedure results in a *Hazard Quotient* (HQ) value for each contaminant and takes into account an average 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 noncarcinogencic effects are not anticipated. If the HI equals or exceeds 1.0 then an advisory is issued.

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

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

Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks Commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where high concentrations of contaminants may indicate a health risk for consumers. Waterbodies where sampling has revealed exceedances of health risk criteria and subsequent consumption advisories have been issued will be re-sampled following the 6-year rotating basin monitoring approach. Re-sampled sites will be

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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, the NDEQ places those waters on the State's Section 303(d) List of Impaired Waterbodies with regard to aquatic life. Nebraska does not have an assigned beneficial use of "fish consumption" in Title 117 Surface Water Quality Standards, therefore the assumption is made that if contaminant loads to fish can affect human health, it is probable that these contaminants can impact aquatic life health.

Current Advisories

As of May 2010, the NDHHS, in cooperation with the NDEQ, the NGPC, and the NDA, has issued fish consumption advisories for 71 waterbodies: 21 stream segments and 50 lakes/reservoirs. These advisories are not bans on eating fish, rather a warning to limit the consumption of specified fish. Please refer to the table and figure below for advisory and location information.

Nebraska Fish Consumption Advisories Through 2008.

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
1	Lake Hastings	Adams	Carp	PCBs
2	Ravenna Lake	Buffalo	Largemouth Bass	Mercury
3	Bassway Strip Lake No. 5	Buffalo	Largemouth Bass	Mercury
4	Kea Lake	Buffalo	Largemouth Bass	Mercury
5	Cottonmill Lake	Buffalo	Largemouth Bass	Mercury
6	Logan Creek	Burt	Channel Catfish	PCBs, Dieldrin
7	Summit Lake	Burt	Largemouth Bass	Mercury
8	Salt Creek	Cass	Carp	PCBs
9	Chalkrock Reservoir	Cedar	Largemouth Bass	Mercury, Selenium
10	Enders Reservoir	Chase	White Bass	Mercury
11	Valentine Mill Pond	Cherry	Largemouth Bass	Mercury
12	Merritt Reservoir	Cherry	Walleye	Mercury
13	Cottonwood Lake	Cherry	Largemouth Bass	Mercury
14	Shell Lake	Cherry	Northern Pike	Mercury
15	Omaha Creek	Dakota	Channel Catfish	PCBs, Dieldrin, Chlordane
16	Crystal Cove Lake	Dakota	Largemouth Bass	Mercury
17	Box Butte Reservoir	Dawes	Northern Pike	Mercury
18	Chappell Interstate Lake	Deuel	Largemouth Bass	Mercury, Selenium
19	Dead Timber Lake	Dodge	Largemouth Bass	Mercury
20	Platte River	Dodge	Carp	PCBs
21	Fremont Lake No. 1	Dodge	Largemouth Bass	Mercury
22	Elkhorn River	Douglas	Carp	PCBs, Dieldrin
23	Zorinsky Lake	Douglas	Largemouth Bass	Mercury
24	Carter Lake	Douglas	Largemouth Bass	PCBs

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

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Table Continued

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
25	Standing Bear Lake	Douglas	Largemouth Bass	Mercury
26	Rock Creek Lake	Dundy	Largemouth Bass	Mercury
27	Hugh Butler Lake	Frontier	Northern Pike	Mercury
28	Muddy Creek	Furnas	Channel Catfish	Mercury
29	Big Blue River	Gage	Carp	PCBs, Dieldrin
30	Wolf-Wildcat Lake	Gage	Largemouth Bass	Mercury
31	Rockford Lake	Gage	Largemouth Bass	Mercury
32	Phillips Lake	Gosper	Carp	Mercury
33	Frenchman WMA Lake	Hayes	Largemouth Bass	Mercury
34	Elkhorn River	Holt	Carp	Mercury
35	North Loup SRA Lake	Howard	Largemouth Bass	Mercury, Selenium
36	Farwell South Reservoir	Howard	Largemouth Bass	Mercury
37	Cub Creek Lake	Keya Paha	Largemouth Bass	Mercury
38	Niobrara River	Knox	Carp	Mercury, Selenium
39	Salt Creek	Lancaster	Carp	PCBs, Mercury
40	Wagon Train Lake	Lancaster	Largemouth Bass	Mercury
41	North Platte River	Lincoln	Largemouth Bass	Mercury
42	Maloney Res. Outlet Canal	Lincoln	Carp	Mercury
43	Sutherland Outlet Canal	Lincoln	Channel Catfish	PCBs, Mercury
44	North Platte Interstate Lake	Lincoln	Largemouth Bass	Mercury
45	East Hershey Lake	Lincoln	Largemouth Bass	Mercury
46	Hershey Lake	Lincoln	Largemouth Bass	Mercury
47	Skyview Lake	Madison	Largemouth Bass	Mercury, Selenium
48	North Platte River	Morrill	Carp	Mercury, Selenium
49	Little Nemaha River	Nemaha	Channel Catfish	PCBs, Dieldrin
50	Prairie Knoll Lake	Pawnee	Largemouth Bass	Mercury
51	Iron Horse Trial Lake	Pawnee	Largemouth Bass	Mercury
52	Willow Creek Lake	Pierce	Carp	Mercury
53	Columbus City Park Pond	Platte	Largemouth Bass	Mercury
54	Loup River Power Canal	Platte	Carp	PCBs
55	Missouri River	Richardson	Channel Catfish	PCBs, Dieldrin, Chlordane
56	Verdon Lake	Richardson	Largemouth Bass	Mercury
57	Swan Creek 5A	Saline	Largemouth Bass	Mercury
58	Missouri River	Sarpy	Channel Catfish	PCBs, Dieldrin
59	Papillion Creek	Sarpy	Carp	PCBs, Dieldrin
60	West Papillion Creek	Sarpy	Carp	PCBs, Dieldrin
61	Walnut Creek Lake	Sarpy	Largemouth Bass	Mercury
62	Wehrspann Lake	Sarpy	Largemouth Bass	Mercury
63	Czechland Lake	Saunders	Largemouth Bass	Mercury
64	Walgren Lake	Sheridan	Largemouth Bass	Mercury
65	Sherman Reservoir	Sherman	Walleye	Mercury
66	Carter P. Johnson Lake	Sioux	Largemouth Bass	Mercury

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

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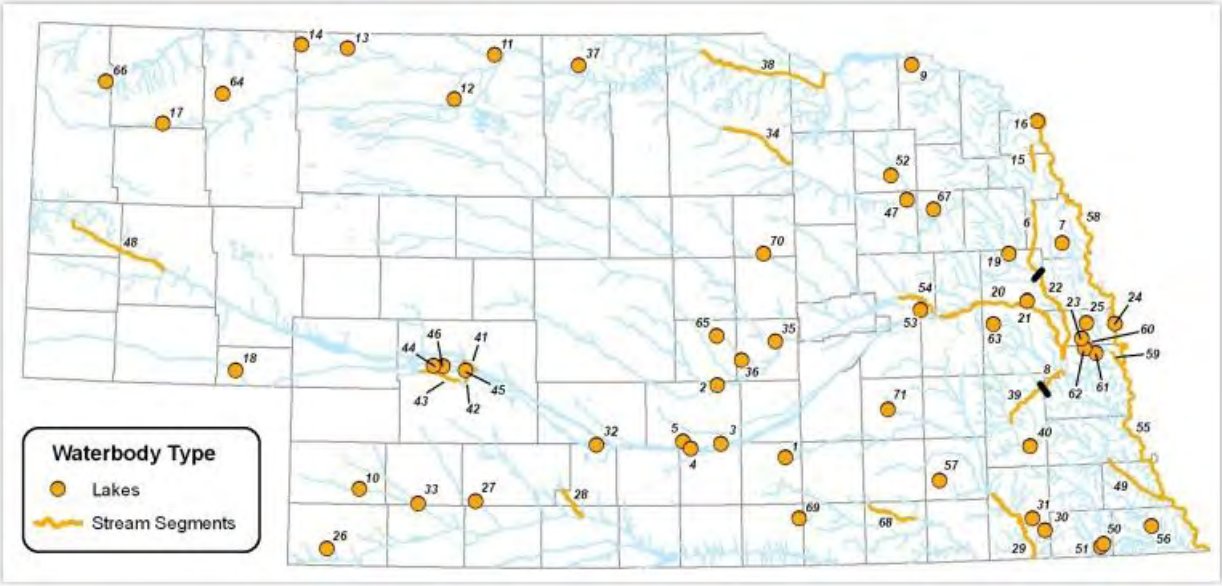
Table Continued

MAP I.D. #	WATERBODY	COUNTY	FISH SPECIES	PRIMARY POLLUTANT(S) OF CONCERN
67	Maskenthine Lake	Stanton	Largemouth Bass	Mercury
68	Big Sandy Creek	Thayer	Channel Catfish	Mercury
69	Liberty Cove	Webster	Largemouth Bass	Mercury
70	Pibel Lake	Wheeler	Largemouth Bass	Mercury
71	Recharge Lake	York	Largemouth Bass	Mercury

NOTE: The NDEQ's *Policy for Issuing Fish Consumption Advisories* uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 70 years for calculating health risks (NDEQ, 2007).

Location of Nebraska Fish Consumption Advisories Through 2008



For More Information Contact:

Nebraska Department of Environmental Quality: (402) 471-4264 or greg.michl@nebraska.gov
Nebraska Game and Parks Commission: (402) 471-5553
Nebraska Health and Human Services System: (402) 471-8880

For Reports and Other Information Online go to: www. ndeq.state.ne.us
The direct URL link to "Findings of the 2006 to 2008 Regional Ambient Fish Tissue Program in Nebraska":

http://deq.ne.gov/Publica.nsf/Pages/WAT155 . To find it on our web site, click on the Publications tab, select Water Quality, find it under "Reports."

The direct URL to our "Fish Consumption Advisories" page is:

http://deq.ne.gov/SurfaceW.nsf/Pages/FCA To find it on our web site, click on the NDEQ News/Topics of Interest tab, then select "Fish Consumption Advisories."

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Crow Butte Resources, Inc.
Groundwater Monitoring

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

Crow Butte Resources, Inc. uranium mine has been operating in western Nebraska for over two decades. The site consists of several thousand Class III injection wells used for In-Situ Recovery (ISR) uranium mining, and it has been regulated and monitored by the Nebraska Department of Environmental Quality (NDEQ) since 1984. Part of this regulation included a local ban on drilling of any water wells in the permitted area other than those associated with the mining process.

The Class III production/injection wells are used in the ISR method of uranium mining. The U.S. Nuclear Regulatory Commission (NRC) defines ISR uranium mining as a process using a leaching solution to extract uranium from underground ore bodies in place (in other words, in-situ). The leaching agent, called lixiviant, contains an oxidant such as oxygen with sodium carbonate. 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

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aquifer to oxidize the reduced environment and liberate the uranium. This solution is then pumped via other wells, called production wells, to the surface for processing.

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

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 (as $CaCO_3$), 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.

Monitoring well at CBR

Currently, 324 monitoring wells are actively sampled on a biweekly basis; 147 of these are deep monitoring wells and 177 are shallow monitoring wells. If chloride, conductivity, or alkalinity concentrations increase in any of these wells, the well is re-sampled within 24 hours. If the parameters do not exceed the permitted limits, the well is sampled again within 48 hours of the time the first sample was taken. If the second or third samples indicate parameters exceeding the permitted limits, the well in question is placed on "parameter exceedance status", which means that a well surrounding the mine unit, laterally or vertically, has exceeded one or more of the parameter control limits. This means that the lixiviant is migrating toward the outside of the mine unit, but it is still within the permit boundary. Corrective action is initiated and the well on parameter exceedance status is

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then monitored on a weekly basis. This corrective action typically consists of an increase in the pumping rate of the production wells to pull the mining fluids back into the mining area. When three consecutive one-week samples are below the permitted limit, the exceedance status is removed from the well; however, weekly sampling continues for an additional three weeks. If the parameters remain below the permitted limit for those three weeks, biweekly sampling resumes.

Reporting Requirements

The NDEQ is notified within 24 hours of the time the "confirmation" sample was taken for parameter exceedance. CBR sends laboratory data from all the samples and a plan of corrective action to the NDEQ within five days of the confirmation. Typically, corrective action consists of turning off the injection wells in the area the exceedance occurred and increasing the production/pumping rate to bring those fluids back into the mining area. If a shallow well exhibits elevated levels of any of the monitored constituents, corrective action includes testing production and injection wells in the area for mechanical integrity to ensure they are not leaking fluids into the shallow aquifer.

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

Quality Assurance/Quality Control in 2009

In 2009, approximately 8,359 groundwater monitoring well samples were collected and analyzed by the laboratory at CBR. The NDEQ randomly split 46 of those groundwater samples with CBR. The table below outlines the number of samples split during each quarter of the 2009 calendar year for both the deep and the shallow groundwater monitoring wells.

First Quarter		Second Quarter		Third Quarter		Fourth Quarter	
Deep Wells	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells	Shallow Wells
8	2	8	2	8	4	5	9

Samples collected by NDEQ are sent to the Nebraska Public Health Environmental Laboratory for analysis. Comparisons between CBR laboratory's analyses and NDEQ's analyses for all of these samples were within a statistically reasonable margin of error.

During the 2009 calendar year, CBR reported two parameter exceedances. As of the end of October 2010, seven shallow monitoring wells and one deep monitoring well had parameter exceedances reported by CBR in 2010. The parameter exceedances identified in the shallow monitoring wells were caused by increased groundwater levels from higher than normal precipitation at the facility during the spring. These wells were

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removed from excursion status in August, 2010. CBR reported all parameter exceedances to the NDEQ and the Nuclear Regulatory Commission (NRC). In all cases, corrective action was taken immediately, and the wells were returned to routine biweekly sampling within weeks.

Future expansion is planned at three satellite facilities: North Trend, Three Crow, and Marsland. Applications have already been received for North Trend and Three Crow, and a pumping test plan has been received for Marsland. These satellite facilities are expected to have similar groundwater monitoring plans and requirements as the current CBR mining operation.

To get more information on groundwater monitoring at this facility, visit our website at http://deq.ne.gov/, or contact Jenny Coughlin, Nebraska Department of Environmental Quality, Underground Injection Control (UIC) Program Coordinator at (402) 471-4290 or by email at jenny.coughlin@nebraska.gov.

Mechanical Integrity Test at CBR

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Groundwater Monitoring for MTBE

What is monitored and why is it done?

MTBE (methyl tert-butyl ether) is a gasoline additive that was used in the United States since the late 1970s and is now mostly out of use. (In 2000, Nebraska banned the sale of any petroleum product containing more than a trace of MTBE.) Many states around the country have reported finding MTBE in the environment. In Nebraska, it has been found in the soil and groundwater and in a handful of public water supply wells, mostly as a result of leaks from above ground and underground storage tanks. Although there is not a drinking water standard for MTBE, EPA established a Drinking Water Advisory which states that people start to smell or taste MTBE in water at 20-40 parts per billion (approximately 1 or 2 drops of MTBE in 500 gallons of water).

NDEQ contractor installing monitoring well in Lincoln at site of old fuel tanks

MTBE is listed as a chemical of concern in NDEQ's Title 118 – Ground Water Quality Standards and Use Classification. NDEQ uses 20 parts per billion to develop protective levels, which are used in its groundwater cleanup program. The major contaminant of concern for petroleum spills is benzene, a carcinogen with a drinking water standard of 5 parts per billion. In Nebraska, benzene contamination is the reason for most cleanups of petroleum in groundwater.

Where is it monitored?

Over the years, thousands of sites where petroleum has spilled or leaked have been reported in Nebraska. Whenever NDEQ determines that a site is significant enough to require investigation, monitoring wells are installed and sampling performed to characterize the groundwater contamination. NDEQ has been looking for the presence of MTBE since 1999.

What is done with the information?

NDEQ compares the concentration of MTBE found in the groundwater to safe levels to determine if there is a risk in the event of human exposure. If a risk exists, NDEQ may require cleanup to protect the public. At most sites, MTBE concentrations are so low that cleanup is not necessary.

What are the results of the monitoring?

MTBE has been found in groundwater at 287 (or 16%) of all petroleum-contaminated sites in Nebraska. The map below shows that it has been detected in many areas of the state. The maximum concentration found in groundwater has been 62,000 parts per billion.

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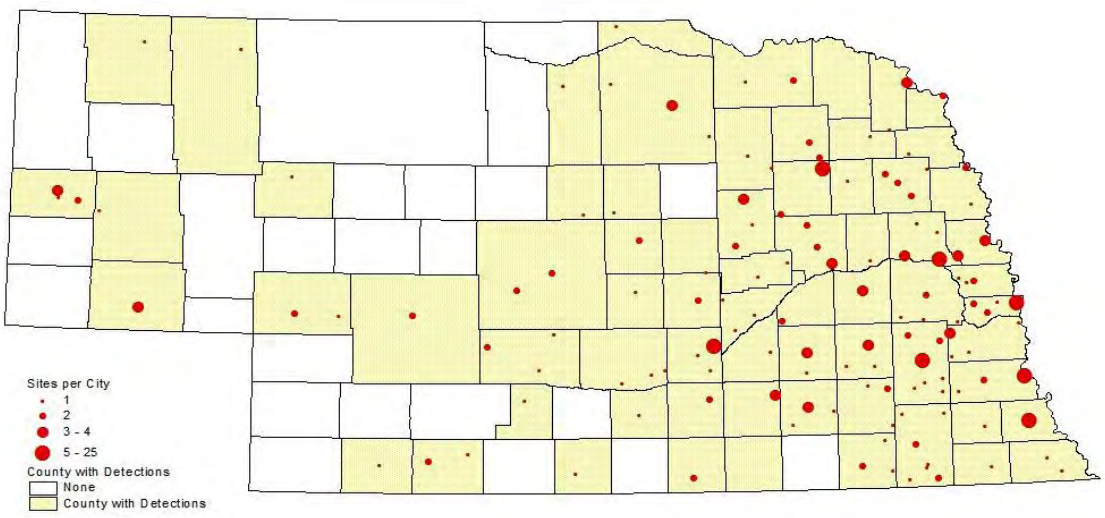
More Information
For more information on this topic, contact David Chambers at 402/471-4258, or david.chambers@nebraska.gov.



Cities and counties in Nebraska where MTBE has been detected.

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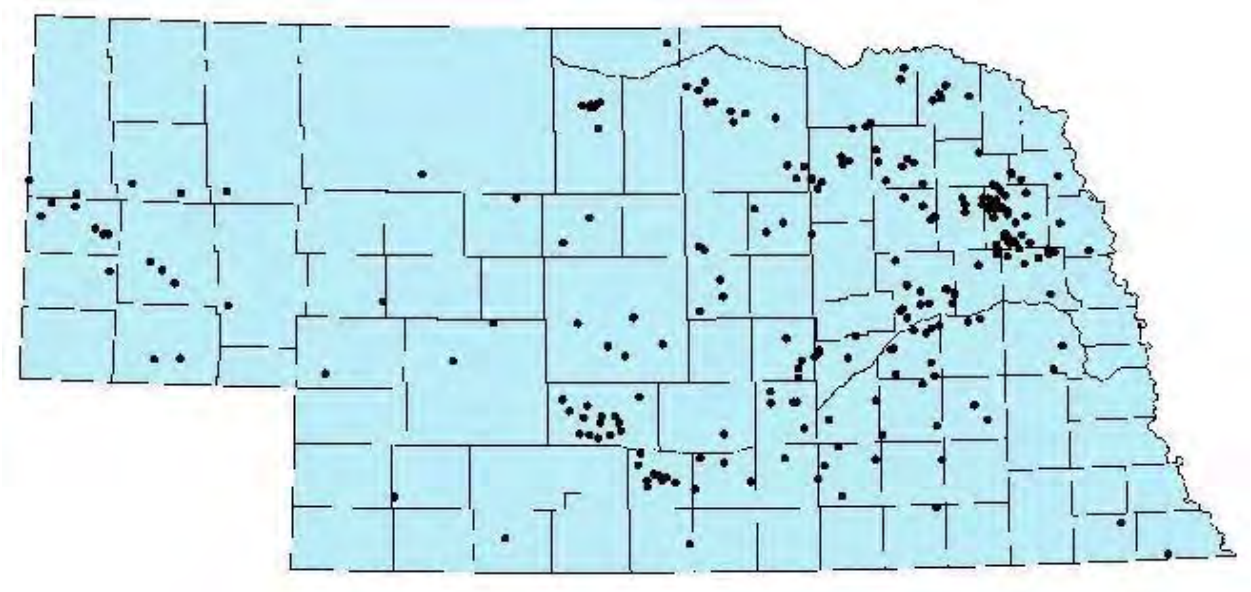
Groundwater Monitoring at Permitted Livestock Facilities

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

History of the monitoring program
The NDEQ's Groundwater Unit began reviewing permitting plans for LWCFs in October 1997. The site-specific hydrogeology, soils, depth to water and use of the groundwater are reviewed to determine the vulnerability of the groundwater. The Groundwater Unit has reviewed 1,045 LWCFs (as of the end of October 2010), recommending monitoring at 361. There are 306 approved groundwater monitoring plans and currently there are 237 operations where semi-annual monitoring is conducted. Six operations conduct only annual sampling due to specific site conditions and no or little change in the groundwater quality. The map below shows the locations of the facilities where groundwater monitoring is being conducted.

Livestock Operations with Ongoing Groundwater Monitoring



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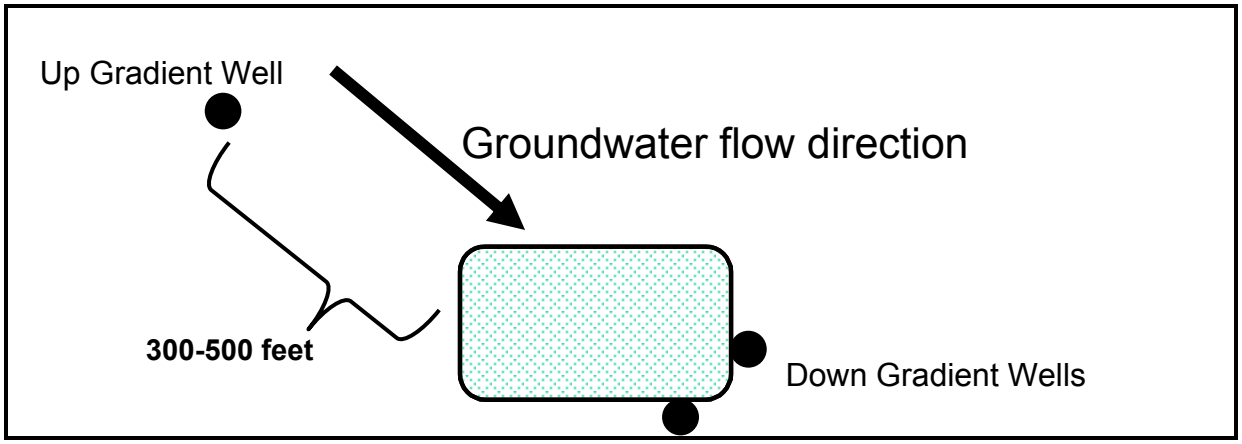
What is monitored?
Groundwater samples are collected from monitoring wells installed around the lagoons or holding ponds and analyzed at a laboratory for

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

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



Recommended Locations for Groundwater Monitoring Wells

Additionally,

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

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

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. The down gradient wells are placed adjacent to the holding pond to more quickly identify possible impacts to groundwater. The diagram above shows a generic map of recommended locations for groundwater monitoring wells.

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Groundwater Monitoring in Central Nebraska (livestock waste holding pond in distance).

How are the data used?

The LWCF is responsible for conducting the semi-annual monitoring and submitting a report to NDEQ twice a year. Monitoring is conducted either by a hired consulting firm or by the owner of the livestock operation. Groundwater Unit staff review the results from the groundwater sampling. A facility that has had at least three sampling events is evaluated to determine if groundwater has been negatively impacted. In the event a facility has impacted groundwater, the facility is required to address the issues. Currently there are less than 22 LWCFs with more comprehensive groundwater investigations underway. To date, NDEQ does not know of any private or public drinking water wells that have been contaminated from a livestock waste control facility.

More Information:

For more information about groundwater monitoring at livestock waste control facilities, contact Dan Inman at (402) 471-0294, dan.inman@nebraska.gov or Dave Miesbach at (402) 471-4982, david.miesbach@nebraska.gov .

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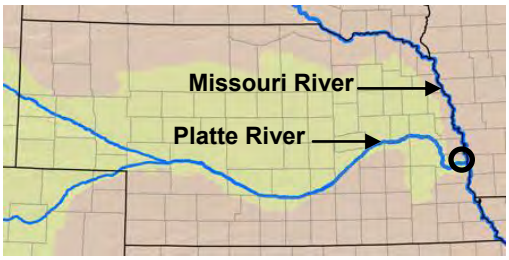
PCS Nitrogen Facility Groundwater Monitoring

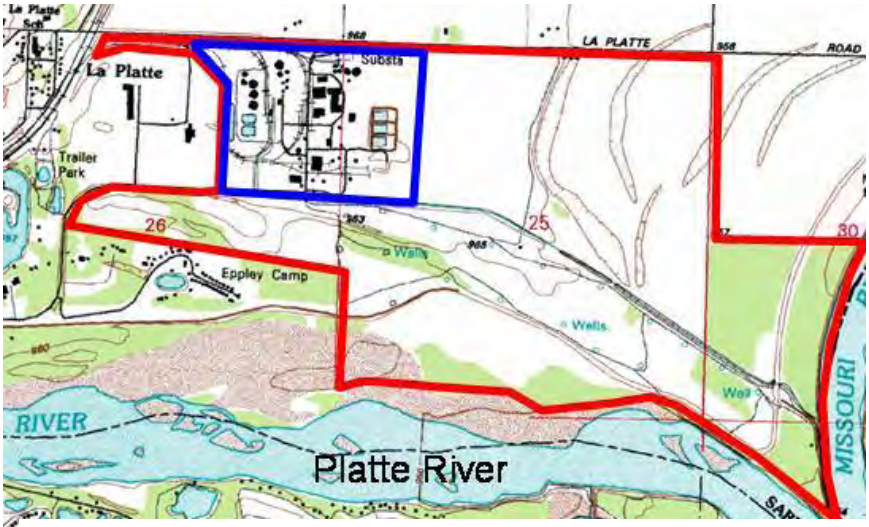
History and Location

The PCS nitrogen facility began operations in 1954 as a nitrogen fertilizer facility and operated until 1999. The nitrogen fertilizer facility was owned and/or operated by several companies that manufactured the following products: ammonia, anhydrous ammonia, urea, solid urea, nitric acid, ammonium nitrate, ammonium nitrate with micronutrients, urea, zinc nitrate, magnesium nitrate, carbon dioxide, and various fertilizer solutions at different times throughout their history.



The PCS nitrogen property is bordered to the east by the Missouri River, to the south by the Platte River, and is north of Plattsmouth, NE. The site encompasses approximately 955 acres of land east of La Platte, Nebraska (area bounded by the red line below).

The former nitrogen production facility at the site covers approximately 147 acres of land at the northwest corner of the property (area bounded by the blue line).



Site Map

Several spills occurred during the facilities operation. An environmental site assessment was conducted in 2000 by Thiele Geotech, which indicated groundwater at the site was impacted by nitrates and ammonia. One of the off-site drinking water wells sampled was impacted for nitrates above the drinking water limit of 10 mg/l and the well was replaced. Ongoing groundwater monitoring for nitrates and ammonia have been required by NDEQ since 2001.

Drinking Water Wells

In addition to the regular groundwater monitoring, NDEQ contracted to have area private and public drinking water wells resampled in 2010 and to assess any potential impact from the facility.

According to the analytical results, none of the private or public water supply wells sampled exceeded the federal and state drinking water maximum contaminant level

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(MCL) of 10 mg/l for nitrates. However, several of the well samples had concentrations of nitrates just under 10 mg/l.

Current Groundwater Monitoring

The current monitoring program includes 31 shallow and 31 deep onsite monitoring wells. Monitoring occurs quarterly and results submitted to NDEQ annually by the facility.

Based on the groundwater elevation data provided by PCS Nitrogen, the Missouri River dominates the groundwater flow direction and velocity. As measured in both the deep and shallow wells at the PCS facility, groundwater flows east or east-southeast toward the Missouri River, with a very minor component of flow south to the Platte River.

Based on the data provided and the resultant groundwater flow direction indicated, it is unlikely that the groundwater contamination at the former PCS Nitrogen facility would impact the residents living west of the former PCS Nitrogen facility, the MUD wellfield further west, or City of Plattsmouth wells located south of the Platte River.

The overall nitrate concentrations have decreased and the plume greater than 10 mg/l (the drinking water MCL) has also decreased in size since the operation ceased more than ten years ago. The overall ammonia concentrations have also decreased, but the ammonia plume greater than 10 mg/l appears slightly larger over time and has migrated eastward.

The data reviewed suggests that nitrate contaminated groundwater is likely migrating east and discharging into the Missouri River at concentrations below the Nebraska Title 117 standard of 10 mg/l nitrate for surface waters that serve as a public drinking water supply and the agricultural use standard of 100 mg/l nitrate.

The data reviewed indicates nitrates may have traveled offsite at concentrations exceeding the drinking water MCL in an area adjacent to LaPlatte Road to the north, and possibly to the south. Groundwater samples were collected from one well to the south and one well to the north of the site along LaPlatte Road. Samples from both wells were below 10mg/l for nitrates.

Review of the chemistry at the site indicates while nitrate and ammonia levels are reduced, they are still significantly above the preliminary cleanup levels set in 2001. Based on the concentrations to date, NDEQ has requested continued monitoring of this site.

For More Information

For more information about nitrate and ammonia monitoring at this site, contact Michael Myers at 402/ 471-4254, or by e-mail michael.myers@nebraska.gov.

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Groundwater Quality Monitoring Report

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

History of this Report:
Beginning in December 2001 the Department has prepared a report outlining the extent of ground water quality monitoring conducted by Natural Resources Districts (NRDs) during the preceding calendar year. All of the results for monitored agricultural chemicals (including nitrate) can be found in the Ag Chemical Clearinghouse (database) on the Nebraska Department of Natural Resources (NDNR) website (http://www.dnr.ne.gov/ or http://dnrdata.dnr.ne.gov/clearinghouse/). The Department uses the data submitted by the districts in conjunction with all other readily available and compatible data for the purpose of the annual ground water quality trend analysis.

Where is the Monitoring Conducted?
The State of Nebraska is a large geographic area, over 77,000 square miles. There are approximately 160,900 active registered wells in Nebraska including irrigation, industrial, municipal, and domestic wells. In 2009, 3,879 wells were sampled. Since 1974, nearly 22,500 wells across the state have been sampled by state agencies, University of Nebraska, federal agencies, and local NRDs. Monitoring is typically conducted in areas of Nebraska with groundwater problems.

What is Monitored?
There are over 170 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 (91,184 analyses in database) and atrazine (18,354 analyses in database). Nitrate is a form of nitrogen common in human and animal waste, plant residue, and commercial fertilizers. Atrazine is an herbicide used for weed control in a variety of crops such as corn and soy beans.

How are the Data Used?
The Department analyzes the data collected for the purpose of determining whether or not ground water quality is degrading or improving and presents the results to the Natural Resources Committee of the Legislature in a report each year. The State's 23

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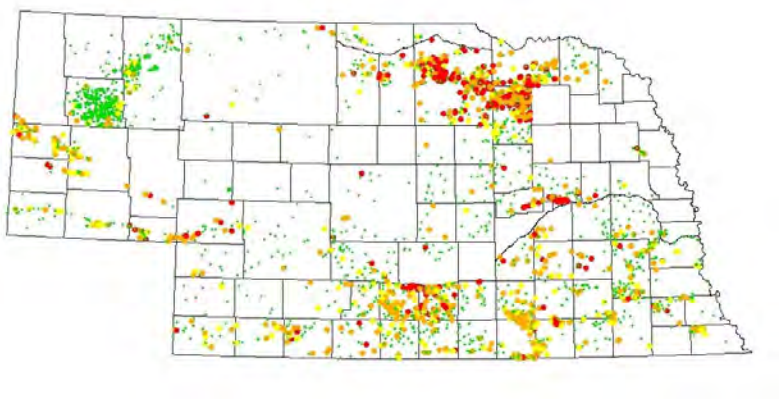
NRDs use the data to make decisions on the management of groundwater. To date, 21 NRDs have formed Groundwater Management Areas over part or all of their districts to address groundwater quality problems.

Results as of 2009:

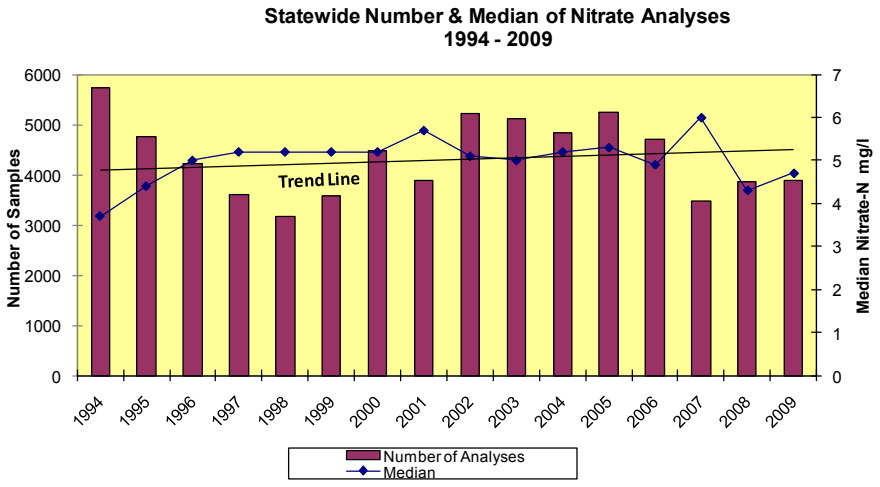
The majority of Nebraska's residents rely on groundwater for drinking water, agriculture, and industry. Most public water supplies that utilize groundwater do not require any form of treatment for drinking water before serving it to the public. Nitrate is Nebraska's most prevalent groundwater contaminant.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

Nitrate Levels of Wells Sampled in 2009

- **< 7.5 mg/l**
- **7.5 – 10 mg/l**
- **10 – 20 mg/l**
- **> 20 mg/l**



The most representative picture of the statewide nitrate concentration is from the time period from 1994 to 2009 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 figure below).



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As mentioned previously, all of the results for agricultural chemicals (including nitrate) can be found on the NDNR's website (http://www.dnr.ne.gov/ or http://dnrdata.dnr.ne.gov/clearinghouse/). The entire database can be accessed at NDNR's website, where the database may be searched or 'queried' for numerous subsets of data, such as results by county, type of well, Natural Resources District, etc.

More Information:
For more information on the Groundwater Quality Monitoring Report, contact Dave Miesbach at (402) 471-4982 or david.miesbach@nebraska.gov. The current and past Reports can be found at NDEQ's web site, http://deq.ne.gov/ (click Publications & Forms, click Water Quality, click Annual Reports).

Center pivot sprinkler head (photo by Marlene Faimon, LBNRD)

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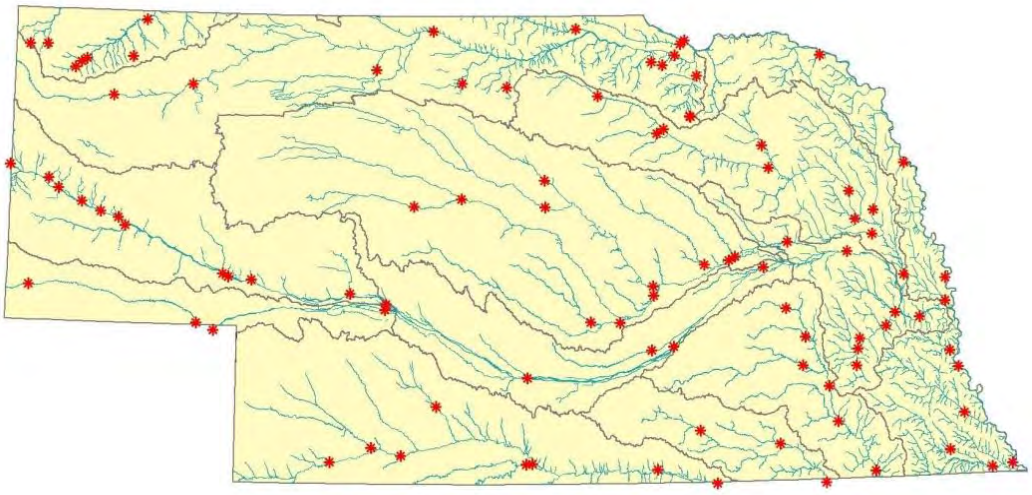
Ambient Stream Monitoring

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

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

Where and When is the Monitoring Done?
The ambient stream monitoring program consists of 97 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. The map below shows the locations of the 97 monitoring sites.



Locations of NDEQ ambient stream monitoring sites

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How were the Monitoring Sites Selected?
Nebraska's ambient stream monitoring program 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 predominate regions 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 integrator site. Basin integrator sites are located at the bottom of each major basin and provide insight into the water quality of the entire river basin.

What is Monitored?
NDEQ monitors numerous water quality parameters to establish general water quality trends and to ensure each stream is able to support its designated uses. The following physical and chemical parameters are collected at each site every month:

- water temperature
- dissolved oxygen
- pH
- conductivity
- total suspended solids
- ammonia
- total nitrogen
- total phosphorus
- total chlorides

Pesticide samples are collected at all sites from April though September. Arsenic and selenium are collected at all sites quarterly, as are a complete suite of metals at each basin integrator site.

NDEQ Staff sampling Turkey Creek near Dewitt, Gage County.

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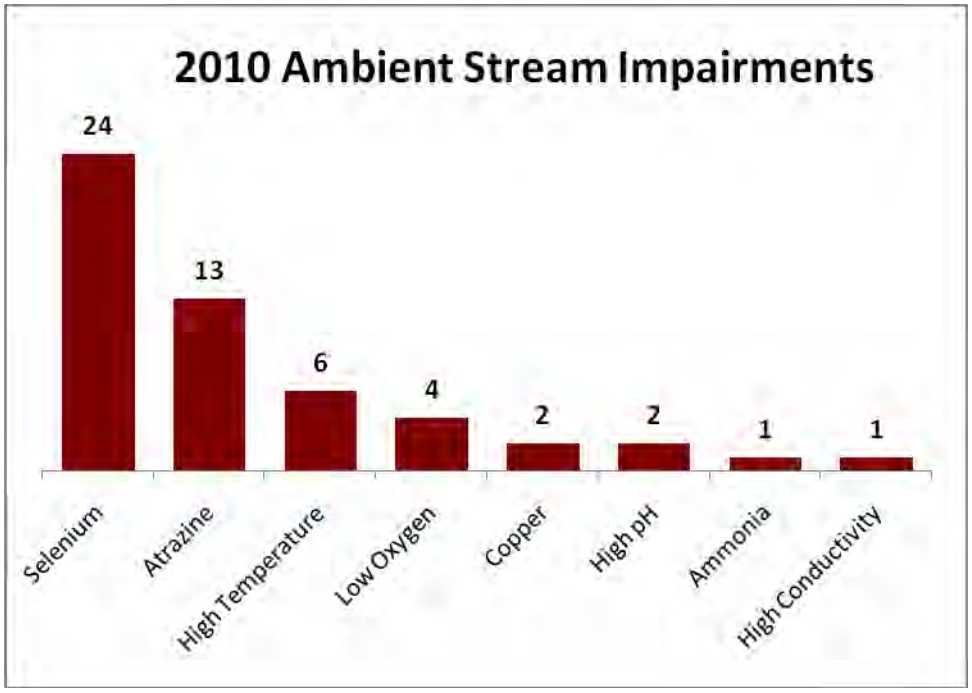
History of the Ambient Stream Monitoring Program
NDEQ has maintained a network of stream monitoring sites since the inception of the agency in 1971. In the early 1970s, 365 sites were monitored on a quarterly basis to gather baseline data on streams where there was limited information. In 1978, the program was reorganized to consist of 90 sites that were monitored monthly. The program was again restructured in 2001 to its current configuration and sampling has been conducted monthly at each of the 97 sites ever since, resulting in ~1164 water quality samples being collected annually.

Impairments and Sources
The most recent assessment of the ambient stream monitoring network found that 40 of the 97 monitored stream segments were impaired (some segments had multiple impairments). An impairment means the stream water quality does not meet state requirements for at least one of its designated uses (either recreation, drinking water, irrigation water, or the support of aquatic life).

The most common water quality impairments from the 2010 assessments were concentrations of selenium and atrazine that exceeded Nebraska's water quality standards and violated the aquatic life designated use. The source of selenium in Nebraska's streams can be both natural and man-made. Naturally high concentrations of selenium occur in groundwater throughout the state and several of the selenium impaired streams are fed by groundwater with naturally high selenium concentrations. However, excess selenium can also be a result of agricultural and industrial practices, and it is important that anthropogenic sources of this pollutant are managed.



The water quality impairments detected by the ambient monitoring program for the 2010 Water Quality Integrated Report.

The second most common impairment, elevated atrazine concentrations, is due to agricultural runoff. Atrazine is a widely used herbicide that is commonly applied in the

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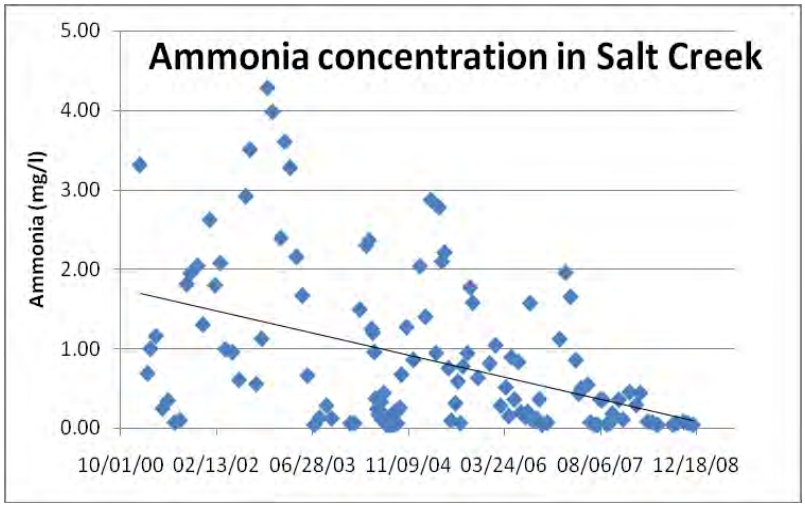
spring to target emerging weeds. Intense spring rain events can cause atrazine to run off fields and into nearby streams and rivers resulting in violations of the atrazine water quality standard. Adopting agricultural practices that slow field runoff can also reduce delivery of atrazine to Nebraska's streams.

Trends

The design of the ambient monitoring program also allows the NDEQ to recognize trends in stream water quality and determine the efficacy of current pollution control strategies.

For example, Salt Creek downstream of Lincoln, was in violation of the state's ammonia water quality standard. An investigation determined that Lincoln's wastewater treatment facilities were causing the elevated ammonia concentrations and the City of Lincoln worked with NDEQ to develop an ammonia pollution control strategy. Within a few years of implementing the strategy, the ammonia concentrations in Salt Creek decreased significantly and Salt Creek now meets Nebraska's ammonia water quality standard.



More Information

For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Integrated Report* and the *Annual Report to the Legislature* are available on the Department's website at http://deq.ne.gov/. Or contact Chris Pracheil at (402) 471-4249 / chris.pracheil@nebraska.gov or Luke Zakrzewski at (402) 471-3382 / luke.zakrzewski@nebraska.gov.

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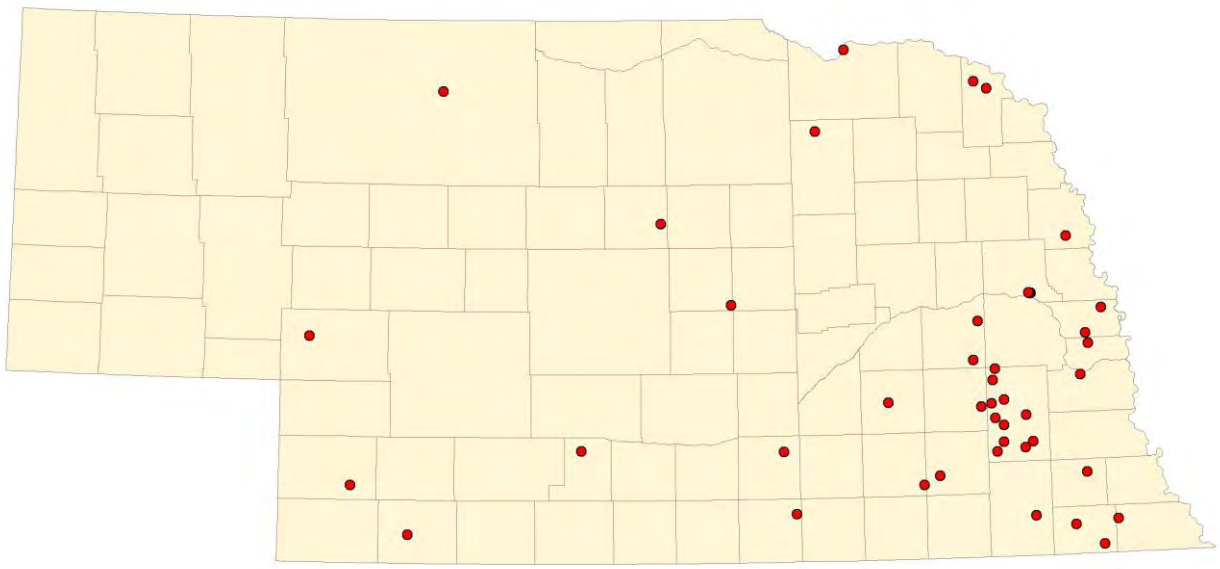
Nebraska Lake Monitoring

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

From May 1 to September 30, the Department and its partners obtain monthly samples from publicly owned lakes and reservoirs across the state. Sample collections focus on numerous parameters including bacteria, nutrients, heavy metals, and pesticides. In some cases, the streams that flow into reservoirs are also monitored. Since reservoirs are a reflection of their watersheds, data on streams that flow into reservoirs can provide useful information in evaluating water quality problems. In 2010, 50 lakes were monitored for chemical and biological parameters while fish tissue monitoring was conducted at 25 lakes. Stream monitoring was conducted above six reservoirs.



Lakes and reservoirs monitored in 2010.

Statewide Concerns
Nebraska Surface Water Quality Standards identifies 528 public lakes totaling 148,920 surface acres (NDEQ, 2009). Since 1991, the NDEQ and its partners have monitored 229 public lakes totaling 138,837 surface acres. This represents 43 percent of the total lakes and 93 percent of the total lake surface acres in the state. Of the 229 lakes assessed, 113 were considered to be impaired.

Nutrients and algae related issues are the most common lake impairments (see figure below). Approximately 86 percent of the lakes assessed were impaired by excessive

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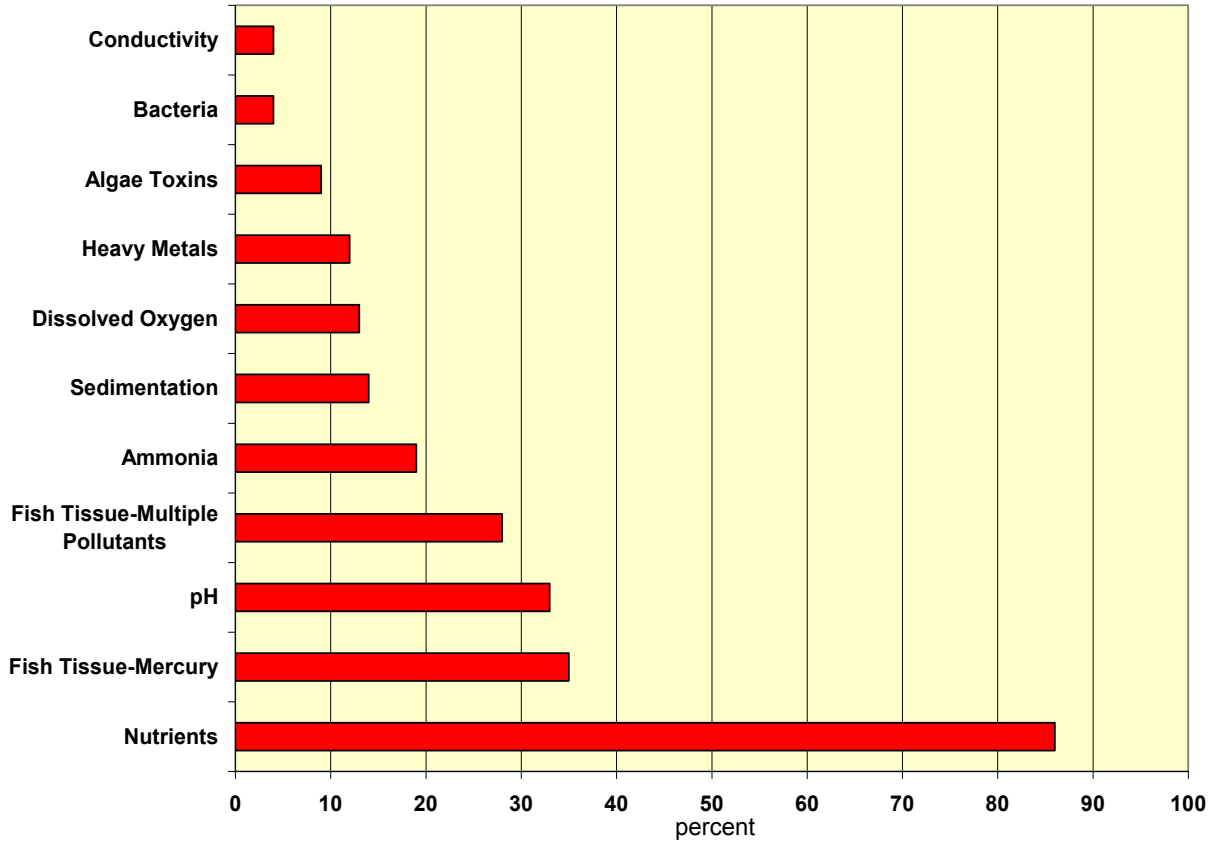
amounts of phosphorus or nitrogen (known as nutrients) or exhibited excessive algae productivity. Excessive algae growth can increase the pH of the water which can make some things, like ammonia, more toxic to aquatic organisms. Impairments for pH were observed for 33 percent of the lakes monitored. Excessive nutrients can also lead to blooms of blue green algae and high concentrations of microcystin, which is a toxin produced by this algae.

The accumulation of contaminants in the tissue of fish is a growing concern across the country. Approximately 35 percent of the lakes assessed had unacceptable concentrations of contaminants in fish tissue (see "Fish Tissue Monitoring", Section 1 of this Report). In most cases, the impairments were due to mercury which is believed to be entering lakes through atmospheric deposition. Mercury is the sole cause of impairment on 44 of the 50 lakes listed as being impaired for fish tissue contaminants (NDEQ, 2010(c)).

Although pesticides were monitored on 133 lakes, there were no lakes impaired from these pollutants.



Percent of Lake and Reservoir Impairments by Cause

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Nutrient Trends in Lakes and Reservoirs
Nutrient concentrations in lakes can undergo large fluctuations throughout the year. In many cases, concentrations are driven by extended wet or dry periods. Trend assessments for phosphorus were performed on 13 lakes across the state. Assessments indicated a significant increasing trend in phosphorus on three lakes, no significant trend on eight lakes, and a significant decreasing trend on one lake. While this small dataset may or may not be representative of statewide conditions, assessments indicate most lakes are neither improving nor getting worse.

Blue Green Algae (Algae Toxins) Trends in Lakes and Reservoirs
Nebraska first started monitoring for blue green algae toxins in 2004 (see "Public Beach Monitoring – Bacteria and Microcystin", Section 13 of this Report). During 2004 and 2005 numerous lakes were identified as having high toxin concentrations. Included in those lakes were Pawnee (Lancaster County), Conestoga (Lancaster County), Swan 5A (Saline County), and Kirkmans Cove (Richardson County). Trend assessments conducted on those reservoirs indicate a significant decreasing trend for algal toxins at all sites from 2004 through 2010. Precipitation records from that time period suggest that unusually dry conditions in 2004 and 2005 may have been a factor in the conditions observed during these years.

Pesticide Trends in Lakes and Reservoirs
Along with storm intensity and duration, the amounts of pesticides that are applied to crop land vary each year and can greatly influence pesticide concentrations in surface waters. Most of the herbicides that are applied in Nebraska are used in the process of corn production to control weeds. Over 8 million acres of corn are planted each year in Nebraska and some years the total acres planted approaches 9 million acres. One of the primary pesticides utilized on crops in Nebraska is atrazine. Decreases in atrazine concentrations have been documented at several reservoirs. A sufficient amount of data was available to assess atrazine trends on 16 reservoirs across the state. Of the 16 reservoirs assessed, ten exhibited a significant decreasing trend and only one exhibited a significant increasing trend. The remaining five reservoirs exhibited a stable or non-existent trend. From 1993 to 2000, statewide concentrations of atrazine in impounded surface waters dropped by 73 percent (NDEQ, 2010(b)).

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

Numerous agencies, including local, state, and federal, are involved in different aspects of lake and reservoir management whether it be the collection and/or assessment of

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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.

References

NDEQ, 2009. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

NDEQ, 2010(a). 2010 Water Quality Integrated Report. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

NDEQ, 2010(b). Occurrence and Trends of Pesticides in Nebraska Lakes and Reservoirs DRAFT. Nebraska Department of Environmental Quality, Water Quality Assessment Section. Lincoln, NE

NDEQ, 2010(c). Findings of the 2006 to 2008 Regional Ambient Fish Tissue Program in Nebraska. Nebraska Department of Environmental Quality, Water Quality Assessment Section. Lincoln, NE

More Information

The Department's Lake and Reservoir Monitoring Program is managed and conducted out of the main office in Lincoln. **For more information, contact**: Paul Brakhage at 402/471-4224 or paul.brakhage@nebraska.gov.

NDEQ staff collecting water samples at Elwood Reservoir in Gosper County.

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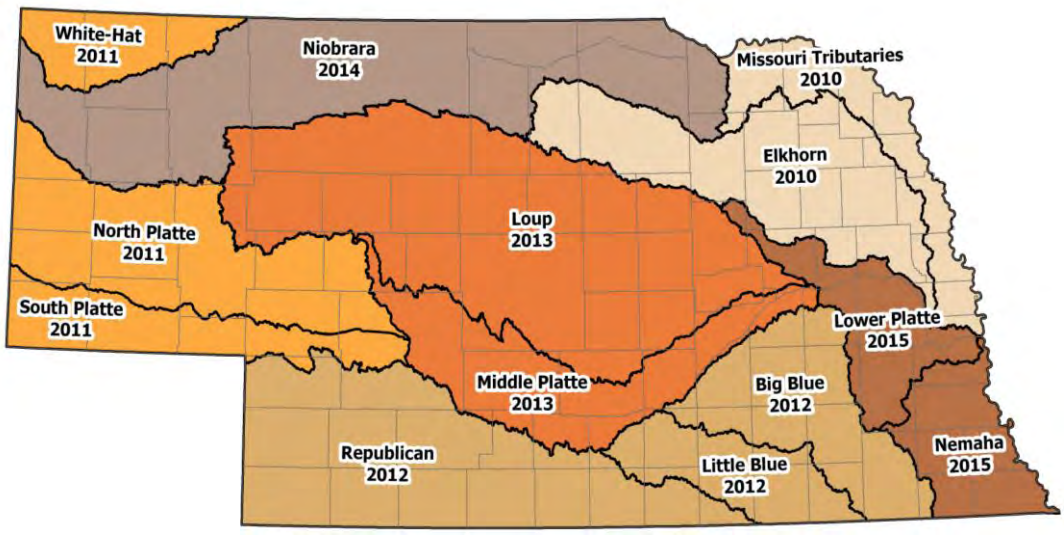
Basin Rotation Monitoring

Why Does NDEQ Conduct Basin Rotation Monitoring?
A goal of the Federal Clean Water Act is that each state assess the water quality of "all navigable waters of the State". In Nebraska, this means assessing nearly 20,000 miles of streams and rivers, and almost 300,000 acres of lakes and reservoirs. These water quality assessments are used to determine if the sampled waterbodies are safe for recreation and if they can support aquatic life and industrial or agricultural uses. If the data shows that a waterbody cannot support all of its designated uses due to pollution, NDEQ begins a process to determine the source of the pollution and develop a pollution control strategy. This process can be both time consuming and costly, so it is imperative that NDEQ has sufficient data on a waterbody before it makes a determination on the water quality. The basin rotation program was developed so that NDEQ can work towards the goal of assessing all waterbodies within the state, while at the same time, insuring sufficient data is collected to determine if a waterbody is impaired by pollution. By focusing sampling efforts to a few adjacent river basins each year, NDEQ can collect enough water quality samples to perform accurate assessments, while at the same time, collect data from many waterbodies because of the reduced size of the sampling area.

Where and When is the Monitoring Done?
Monitoring is done on a six-year rotation in the 13 major river basins in the state. Monitoring in each basin, during its rotation year, is done on a weekly basis from May 1st through September 30th. In 2010, a total of 32 streams and 17 lakes were sampled from the Elkhorn and Missouri tributaries river basins, resulting in ~1078 water quality samples being collected. The map below shows the basins and their rotation schedule.



NDEQ six-year basin rotation monitoring schedule.

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

What is Monitored?
NDEQ monitors a suite of water quality parameters to establish general water quality trends and to ensure each stream is able to support its designated uses. The following physical and chemical parameters are collected at each site: ammonia, nitrate-nitrite, total nitrogen, total phosphorus, total chlorides, total suspended solids, turbidity, pH, temperature, conductivity, dissolved oxygen, *E. coli* bacteria, and pesticides.

South Platte River at North Platte (Hwy 83) July 30, 2010 (photo by Ann Dimmitt, TPNRD).

Impairments and Sources
The most common impairment detected by NDEQ's basin rotation monitoring program is the bacteria *E. coli*. Potential sources of bacterial pollution are improperly functioning waste water treatment facilities, septic tanks, and lagoons, as well as, urban and agricultural runoff.

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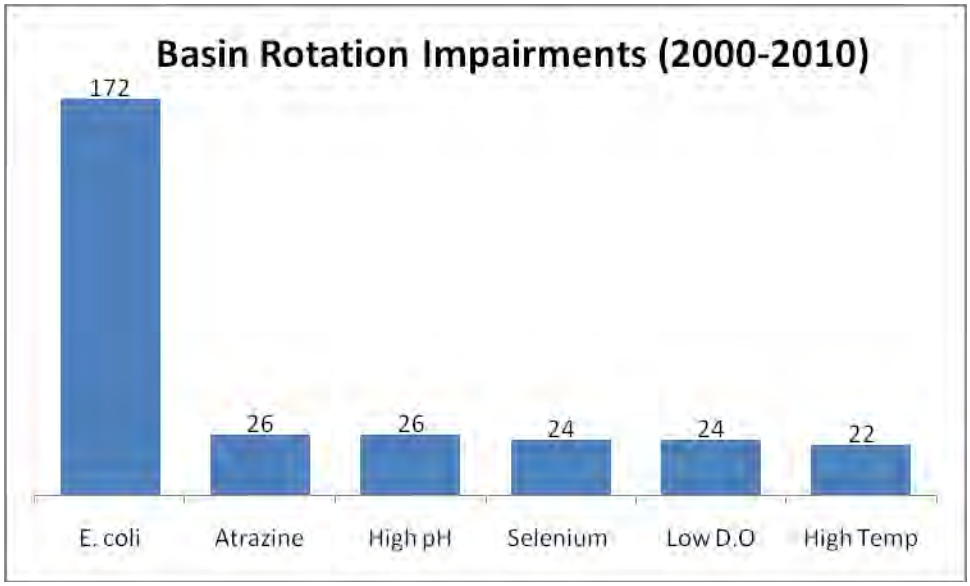
The herbicide atrazine is the second most common impairment detected. Atrazine is a widely used herbicide that is commonly applied in the spring when rain events can cause cropland runoff to enter nearby streams and rivers.



Water quality impairments detected by the basin rotation program from 2000-2010.

More Information

For more information on the quality of Nebraska's streams, the most recent *Surface Water Quality Report* and the *Annual Report to the Legislature* are available on the Department's website at http://deq.ne.gov/. Or contact Chris Pracheil by email at chris.pracheil@nebraska.gov or by phone at (402) 471-4249.

E. coli bacteria

Atrazine chemical make up

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Water Monitoring and the NPDES Program

City of Lincoln's Teresa Street Wastewater Treatment Facility.

What is the NPDES program?
The goal of the Clean Water Act (CWA) can be stated: "To provide for the protection and propagation of fish, shellfish and wildlife and provide for recreation in and on the water whenever attainable." In more simple terms, the CWA seeks to provide "fishable/swimmable" waters.

Two programs administered by the Nebraska Department of Environmental Quality (NDEQ) are aimed at the attainment of these goals: 1) Surface Water Quality Standards (Standards) that assigns beneficial uses to waterbodies and also contains the criteria needed to protect those uses and 2) the National Pollutant Discharge Elimination System program (NPDES) that issues permits to point source discharges to regulate the quantity and quality of pollutants being discharged. The goal of NDEQ permit writers is to determine what effluent composition will protect aquatic organisms and human health.

How are NPDES permits developed?
The permit development process involves identifying the pollutants of concern and then developing permit limits based upon the more stringent of either technology-based standards or water quality based standards. Technology-based standards reflect effluent quality that can be achieved using treatment technology that is available to the permittee. NDEQ's *Title 119 - Rules and Regulations Pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination System* (NDEQ, 2005) sets forth technology-based standards for municipal facilities and many types of industrial

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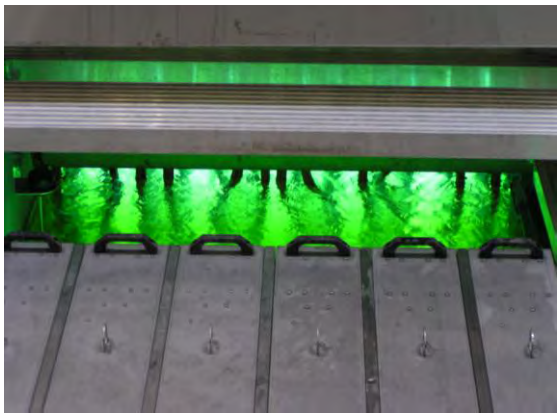
facilities. Technology-based standards can also be developed on a case-by-case basis when necessary.

Water quality based limits are the limits necessary to meet the in-stream water quality standards and protect beneficial uses established in NDEQ *Title 117 - Nebraska Surface Water Quality Standards* (NDEQ, 2009). In some instances, where a surface water/groundwater interconnection may be of concern, NPDES permit limits may be based upon NDEQ *Title 118 - Groundwater Quality Standards and Use* (NDEQ, 2006).

There are four major categories of information needed to develop a water quality based permit limit: 1) receiving stream volume, 2) receiving water quality, 3) effluent volume and 4) effluent quality. Surface water data collected by NDEQ provide the basis for the receiving stream water quality.

Why are the water data important?
The NPDES Program in Nebraska permits almost 700 permittees with site specific permits. Water monitoring data from monitoring sites in Nebraska provide information on existing stream background levels of ammonia, chloride, nitrate-nitrite, total nitrogen, total phosphorus, total suspended solids, turbidity, pH, temperature, conductivity, dissolved oxygen, bacteria, toxic algae, and pesticides.



Disinfection system at a treatment facility used to eliminate bacteria from effluent.

When developing water quality based permit limits, it is important that this site-specific data and information be utilized in an attempt to address variability and other concerns that may be associated with the receiving water. As with most decisions, the larger the database the greater the confidence level that will accompany the decisions. In Nebraska, the availability of water quality data ranges from numerous data points collected year round to the little or no data at all. Although not preferred, in situations where water quality data is lacking, the Department must continue to issue permits using default or extrapolated values.

References:

NDEQ, 2005. Title 119 - Rules and Regulations Pertaining to the Issuance of Permits under the National Pollutant Discharge Elimination System.

NDEQ, 2009. Title 117 – Nebraska Surface Water Quality Standards.

NDEQ, 2006. Title 118 - Groundwater Quality Standards and Use.

More Information
For more information on the use of water monitoring data for NPDES permits, contact Donna Garden at (402) 471-1367 or donna.garden@nebraska.gov.

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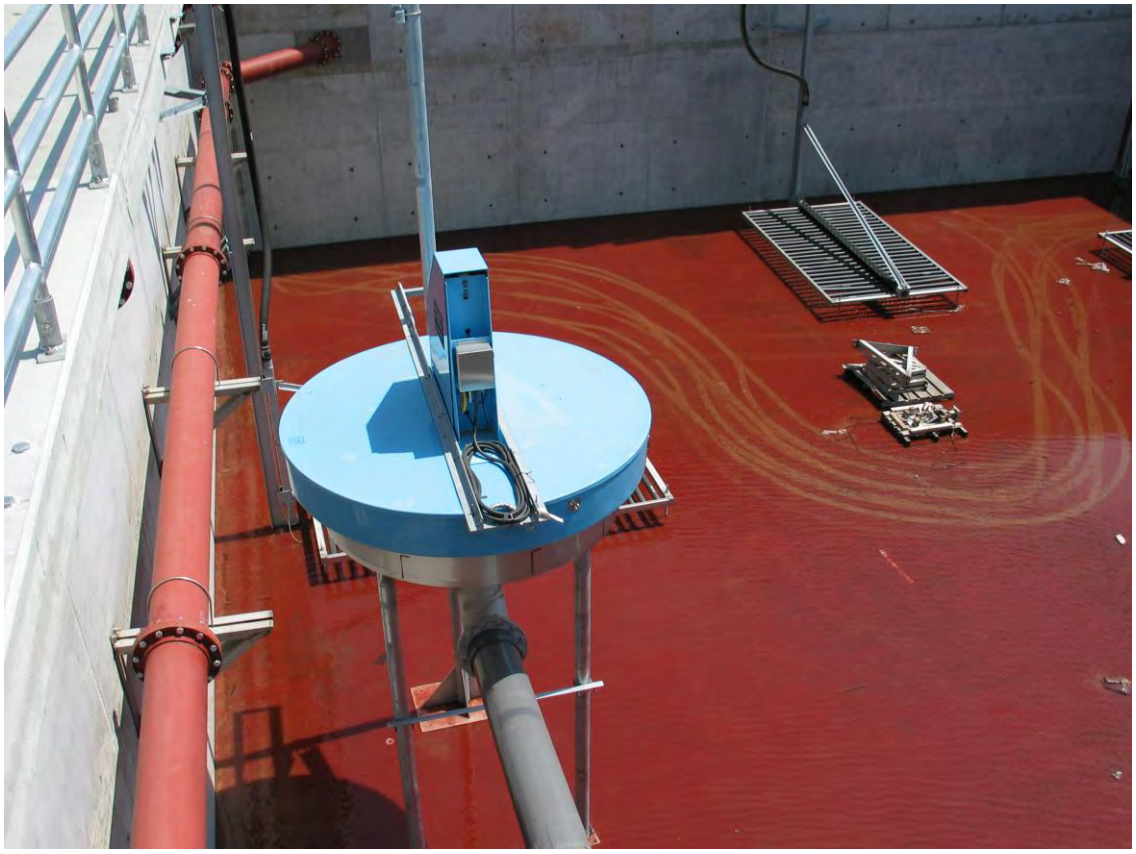
NPDES Compliance Monitoring



West Point's Wastewater Treatment Facility.

Why does NDEQ Monitor Wastewater Treatment Plant Discharges?
The federal Clean Water Act established the National Pollution Discharge Elimination System (NPDES). Under this program any person, business, or municipality must have a NPDES permit to discharge to waters of the State. The NPDES permit establishes limits on the amount of pollutants that can be discharged. In order to comply with the pollutant limits, the discharger often has to construct a wastewater treatment plant to treat their contaminants.

The NPDES program is primarily a self monitoring program. The NPDES permit, along with limiting the amount of pollutants that can be discharged, also requires the discharger to sample on a routine basis and to report the results of sampling to the department quarterly.

NDEQ manages around 687 discharging NPDES permits for municipalities and industries. The permits allow for inspection by NDEQ or EPA. The NDEQ compliance monitoring program samples the wastewater treatment plant discharges to verify the

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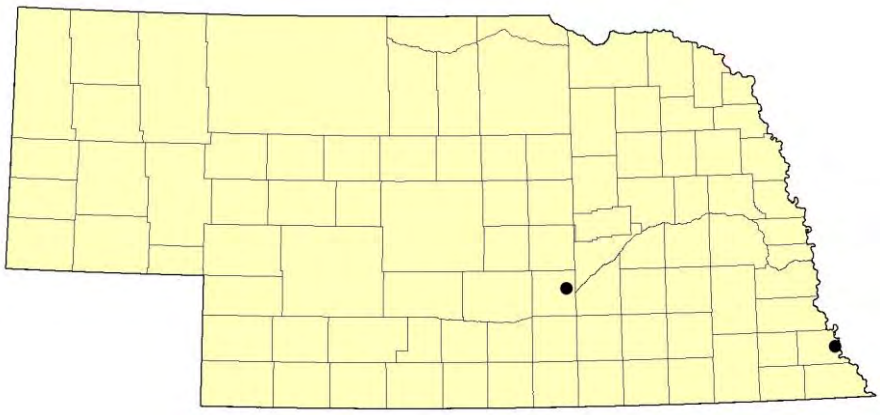
accuracy of the self monitoring activities, to monitor the performance of the wastewater treatment plant, and check the accuracy of the testing laboratories.

Where is monitoring conducted?
Compliance monitoring is conducted at selected wastewater treatment plants. Wastewater treatment plants are chosen based on several criteria. EPA requires an annual inspection of all major dischargers (plants with flows greater than one million gallons per day). Some of the major facilities were selected for compliance sampling at the same time as the annual inspection or facilities with recent compliance issues may be selected for sampling**.** Facilities located on river and streams not meeting water quality standards may be selected.

In 2010, compliance monitoring was conducted at Grand Island and Brownville.



Locations monitored for NPDES compliance.

What was monitored and how are the data used?
Parameters are selected based on the pollutants of concern included in the facility's NPDES permit. These parameters may include carbonaceous Biochemical Oxygen Demand (cBOD), total suspended solids, pH, bacterial contaminants such as fecal coliform or E. coli, ammonia, and heavy metals. Pollutants not on the facility's NPDES permit may also be analyzed if the department suspects other pollutants may be discharged.

The influent into the wastewater treatment plant and treated effluent discharged from the wastewater treatment plants were sampled. Sampling locations on the influent and effluent were selected based on the sampling locations included in the NPDES permit. Sampling included grab and composite sample collection.

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Sampling data collected from the facilities was compared to their NPDES permit limits to verify compliance with the permit. If the data exceeded the permit, enforcement action is a possible action that can be taken by the department. Data was also compared to the most recent four to eight quarters of self monitoring data submitted to the department. This provides verification of the data being submitted to the department. Data from samples that were split with the facility were used to compare the facility's lab results with the laboratory results of the Health and Human Services laboratory as a verification of the facility's lab accuracy.

More Information

For more information on compliance monitoring at NPDES facilities, contact Curt Christiansen at (402) 471-4260 or curt.christiansen@nebraska.gov.

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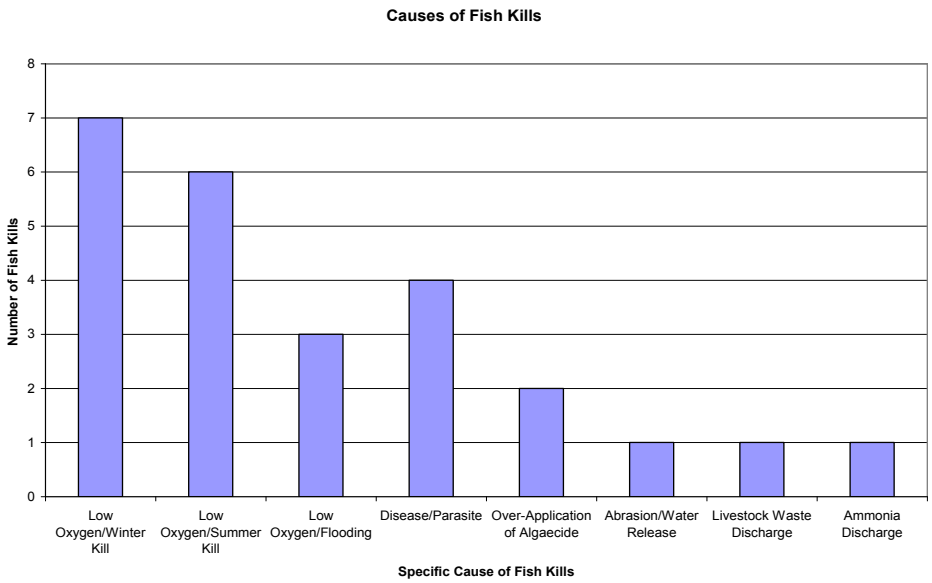
Monitoring for Fish Kills and Citizen Complaints

Why does NDEQ 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, a source of pollution, and/or a responsible party. Because a fish kill could result in legal action, sampling requires a relatively high level of quality data.

What types of data are collected?
The types of data collected are determined on a case-by-case basis. Initially, the types of data to be collected will be 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 can define the cause of the kill, but further sampling and investigation may be needed to determine the source or reason for poor water quality conditions.

Fish Kills Reported in FY2010
From July 1, 2009 through June 30, 2010 (FY2010), a total of 25 fish kills were reported to NDEQ. Of these, 15 occurred in a lake or reservoir, four were in rivers or streams and 6 were in private ponds. The cause of the fish kills is determined from information collected from the reporting party and/or follow-up investigation and sampling. Twenty (80%) of the reported fish kills were due to natural causes. These included 16 due to low oxygen, specifically seven from winter kill, six from summer kill and three from decomposition of organic matter washed in with flooding. Four more natural kills were attributed to disease or parasites. Five kills were believed to be man induced or due to pollution (20%). These included two from toxicity from over applications of algaecide to control



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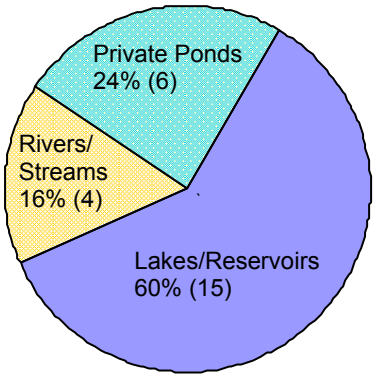
algae in ponds and one from abrasion from water released from a reservoir. One fish kill was due to low oxygen and ammonia toxicity from a discharge of livestock waste to a pond and one was due to an ammonia discharge from a fertilizer plant to a stream.

The extreme weather events that occurred over the past year can be attributed as the cause of almost 64% of the total fish kills reported to NDEQ. The most common reported kills in 2010 were determined to be seasonal winter kill events due to low dissolved oxygen. The low dissolved oxygen concentrations were caused by the prolonged ice and snow cover on many 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.

Likewise, about 24% percent of the fish kills were summer kills, caused by low dissolved oxygen concentrations stemming from eutrophic conditions. Eutrophication is a term that describes water quality conditions as a lake or reservoir ages. Lakes or reservoirs that are "eutrophic" tend to be shallow with high nutrient concentrations and exhibit frequent algae blooms, warmer water temperatures, and lower dissolved oxygen concentrations.

Along with the record snowfall amounts and cold temperatures over the past winter, this summer also brought record precipitation and flooding events. The flooding events this summer caused around 12% of the fish kills due to the low dissolved oxygen caused by decomposition of organic material. Flood waters re-suspended organic matter that had settled in bottom sediments and also brought in increased loads of organic matter. The suspended organic materials then rapidly decomposed, a process that uses oxygen, and dropped dissolved oxygen levels to a critical l
It is very likely that there were many more fish kills occurred due to flooding events but most were like unseen due to the water body conditions at the tim

Additional "natural fish kills" included four that wer determined to be the result of a disease or parasit infestation. One of these kills was a highly publici one involving thousands of carp infected with the *herpes* virus at the Calamus Reservoir.



Location of FY2010 Fish Kills

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Citizen Complaints Reported in FY2010

Between July 1, 2009 and June 30, 2010 the surface water unit received 21 notifications of complaints concerning surface water issues. The agency has incorporated a new electronic complaint notification tracking system so these numbers are non-comparable to past years. While many of these complaints were handled by other agency programs that more closely related to the problem, the surface water unit assisted by providing observations or samples with five on-site investigations. Of these cases, two investigated potential livestock waste discharged to a stream, one was to investigate a report of a black oily substance in a stream, one was of concern of potential toxic algae in a private lake, and another concerned hundreds of dead snow geese observed in a wetland.

For More Information:
Contact Dave Bubb at 402/471-2810 or David Schumacher at 402/471-4232, or contact them via e-mail at dave.bubb@nebraska.gov and david.schumacher@nebraska.gov, respectively.

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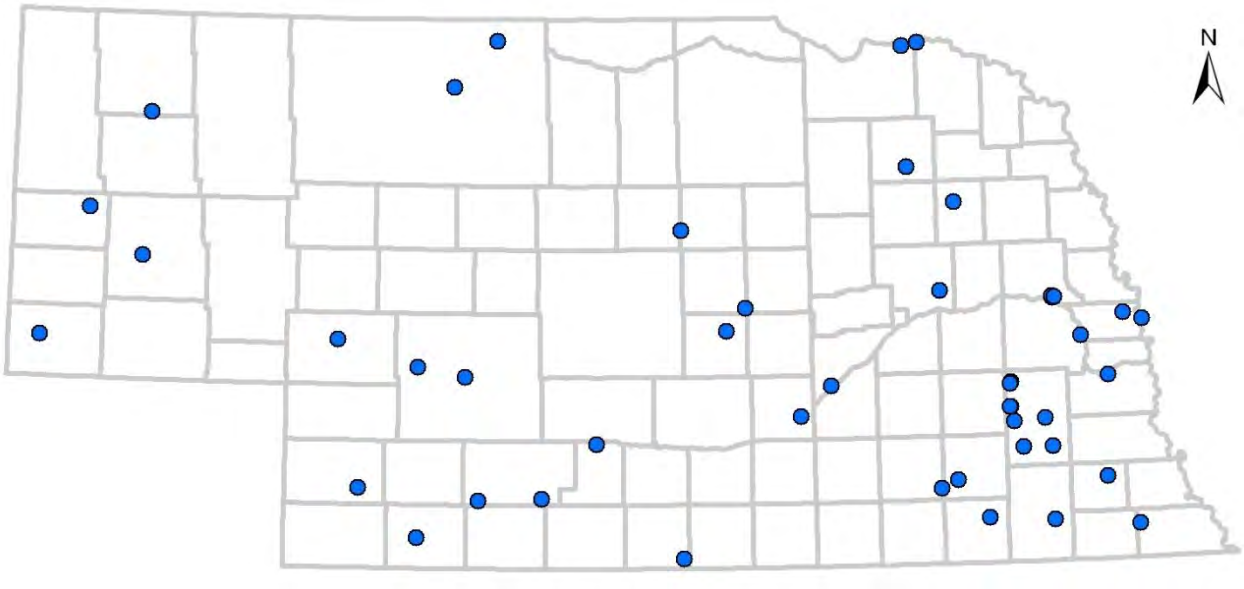
Public Beach Monitoring Program – Bacteria and Microcystin

Why Does NDEQ Monitor Public Beaches?
Water based recreation is a popular activity with the residents of and visitors to Nebraska and includes swimming, power boating, water skiing, tubing, and sailing. The Nebraska Game and Parks Commission, Natural Resources Districts and other entities support water recreation by providing camping, shower, and day use facilities. While each user expects the water to be clean and safe, unfortunately, this is not always the case. It is important that individuals participating in water related recreation activities have the opportunity to learn about current water quality and the risks that may be associated with spending a day at the lake.

When and Where is the Monitoring Conducted?
From May 1 to September 30, NDEQ and its partners obtain weekly samples from publicly owned and operated swimming beaches and waterbodies that allow power boating. In 2010, 48 swimming beaches at 45 lakes were included in the network. The map below shows the statewide distribution of the beaches monitored in 2010. Because of lake renovation work at Big Indian Lake in southern Gage County, no data was collected there.



Waterbodies Monitored under the Public Beach Monitoring Program in 2010

What is Monitored at the Beaches?
E. coli bacteria and blue-green algae toxins, primarily microcystin, are monitored to give an indication of the quality of water at Nebraska swimming beaches. Bacteria often present a problem early in the recreation season as a result of increased spring-time rain and run-off events from land, whereas blue-green algae (microcystin) impacts are

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observed later in the summer, after lake water has warmed up and algae have had time to grow.

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. When people swim or drink water with higher levels of *E. coli* bacteria, flu-like symptoms or diarrhea may occur. However, these symptoms may not be a result of *E. coli* bacteria itself; rather high counts of *E. coli* bacteria indicate the likelihood of Pathogens present in water. *E. coli* is monitored because Pathogens are more costly and rather difficult to analyze.

Blue-green algae bloom at Wolf Wildcat Reservoir in Gage County.

Spring-time rains also transport nitrogen and phosphorus to lakes from agricultural and urban run-off. These nutrients can accumulate in Nebraska lakes during the summer months. This accumulation coupled with warmer temperatures and longer summertime days (i.e. more sunlight) provide ideal growing conditions for blue-green algae. When blue-green algae die and break down microcystin toxin is produced. Blue-green algae look like thick green paint or oil floating on the surface of a lake. Microcystin in the water can cause skin rashes, lesions, and blisters on people who have been swimming or wading in it. If swallowed, microcystin can cause headaches, nausea, muscle or stomach pain, diarrhea, or vomiting. Though rare, severe cases can include seizures, liver or respiratory failure, or even death.

How are the Data Used?

In situations where *E. coli* bacteria exceed counts of 235/100ml of water for a single sample or counts of 126/100ml of water for a long-term average (5 sample average/30 days) NDEQ does not issue alerts. Rather, information is provided that allows the public to decide whether or not to use the lake. Lakes that are in violation are listed on NDEQ's website as having high levels of *E. coli* bacteria. Guidance provided that assists the public in the decision making process includes:

- Avoid situations which could cause you to swallow lake water
- When levels are high, shower after coming in contact with the water
- If you have been in contact with lake water, wash hands before eating

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When levels of microcystin exceed 20 micrograms per liter (µg/l, or parts per billion, ppb), the Departments of Environmental Quality and Health & Human Services jointly issue a Health Alert. During a Health Alert at a public lake, signs are posted advising the public to use caution. Affected swimming beaches will be closed until levels of microcystin are below 20µg/l for two consecutive weeks. Boating and other recreational activities will be allowed, but the public will be advised to use caution and avoid prolonged exposure to the water, and to particularly avoid drinking the water.

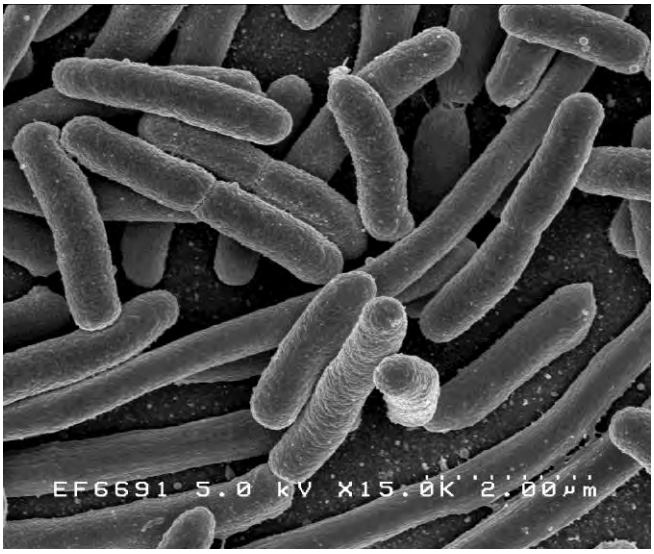
Lakes that repeatedly exceed the *E. coli* and microcystin water quality standard may further end up on Nebraska's 303d list. This list comprises the states impaired waters list, where a Total Maximum Daily Load (TMDL) or other pollution control measures become required to ensure that waterbodies are compliant with Nebraska's Water Quality Standards (collectively referred to as Title 117).

2010 Results

In 2010, the Beach Monitoring program collected and analyzed a total of 1,000 samples for *E. coli* and 1,022 microcystin samples. NDEQ and its partner's staff (typically local NRDs) sampled lake water at beaches early in each week (typically Monday or Tuesday) with the results being posted on the Department's internet site (http://deq.ne.gov/) by Thursday or Friday of the same week. This schedule provides information to the public prior to the weekend, when they are more likely to boat and swim at lakes in Nebraska.

E. coli bacteria

Of the 1,000 bacteria samples taken and analyzed, 61 samples (6%) exceeded 235 counts/100ml of water. Of the 61 samples exceeding 235/100ml standard, the months of May and June accounted for 41 of those samples. The remaining 20 samples exceeding 235/100ml of water occurred during the remaining months of the recreation season (July thru September).



E. coli under the microscope.

The graph below shows the number of samples that exceeded 235/100ml of water for 2008 (green), 2009 (blue) and 2010 (red). Trend lines were added to show the decline of samples that exceed 235/100ml as the summer wears on. 2008 was an extremely wet year for many parts of Nebraska compared to 2009, which saw average precipitation. This may be one reason for higher numbers of samples that exceeded 235 colonies/100ml in 2008 compared to 2009. Also during 2010, week 8 sampling corresponds to record rainfall across much of the state.

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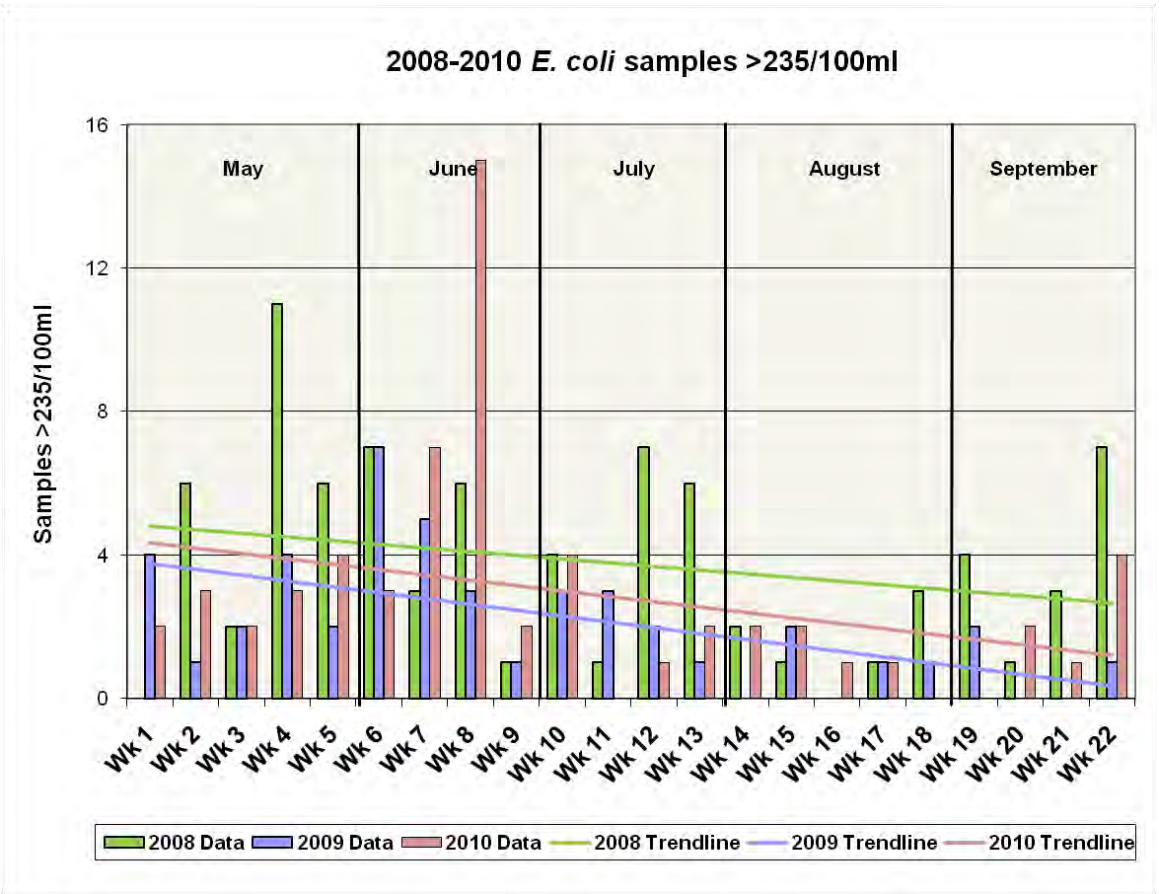

Microcystin (from blue-green algae)

Of the 1,022 samples taken for microcystin and analyzed, 20 samples exceeded the 20µg/l threshold for closing a beach. This accounts for only two percent of the total samples taken. In 2010, six lakes were placed on alert for a total of 28 weeks for high levels of microcystin. This compares to eight lakes in 2008 for a total of 32 weeks, and five lakes in 2009 for a total of 16 weeks on health alerts. Red Willow Reservoir in Frontier County and Willow Creek Reservoir in Pierce County each had six samples exceed 20µg/l. This accounts for 60% of samples that exceeded the 20µg/l threshold.

The figure below shows the number of microcystin samples that exceeded 20µg/l over the past four years. The first thing to note is the absence of samples in violation during the early part of the recreational season compared to later in the season when blue-green algae have had time to grow. Another interesting observation is the difference between 2008 and 2009 in total exceedances. Summer temperatures for much of the state were relatively normal in 2008. 2009 however saw below average temperatures during the summer throughout much of the state. Lower temperatures in 2009 may have prevented lakes from completely warming thus limiting blue-green algae growth which ultimately limits the amount of microcystin present. In May and June of 2010, much of Nebraska experienced historic flooding. This flooding may have provided for an increased amount of nutrients to accumulate within Nebraska's lakes and reservoirs. Statewide in 2010, overall temperatures were above average throughout the summer

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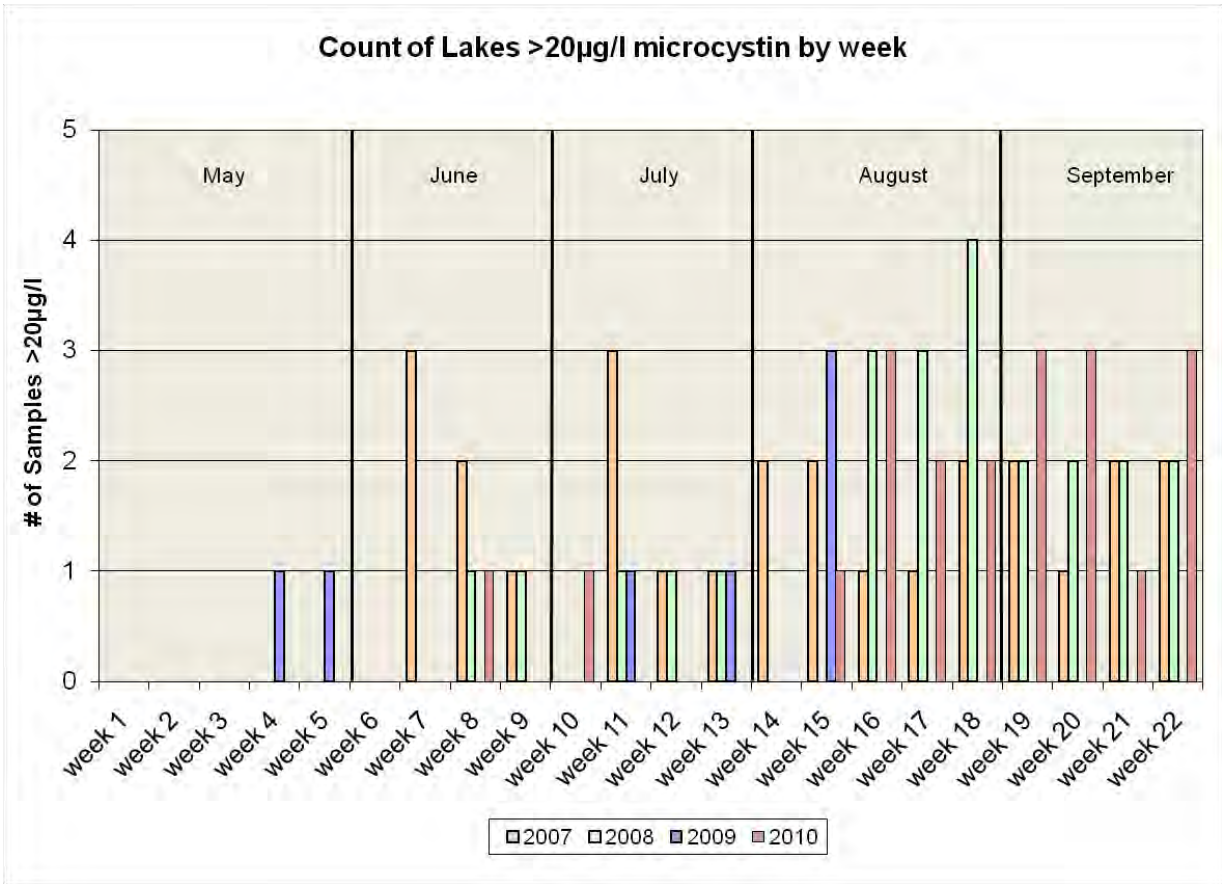
(July-Sept), with August being the warmest month experiencing 1-5 degrees above average throughout a majority of the state. The increase in nutrients from flooding and above average summer temperatures may explain why 2010 experienced an increase in the number of microcystin samples exceeding the 20µg/l threshold compared to recent years.



From 2005 through 2010, NDEQ has collected more than 5,000 toxic blue-green algae (microcystin) samples on 58 lakes across the state. The number of samples collected each year has generally increased as more public swimming areas become available to the public (see table below).

	2005	2006	2007	2008	2009	2010
Total Samples collected	414	719	898	1022	1042	1022
Number of Samples in Violation	57	33	43	23	7	20

For More Information:
For more information on NDEQ's Beach Monitoring Program and recreation season weekly sampling results visit http://deq.ne.gov/ and click on "Environmental Alerts" under the "News & Announcements" section. You can also contact Luke Zakrzewski (luke.zakrzewski@nebraska.gov) at 402/471-3382 or John Lund (john.lund@nebraska.gov) or at 402/471-4709.

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Stream Biological Monitoring Program

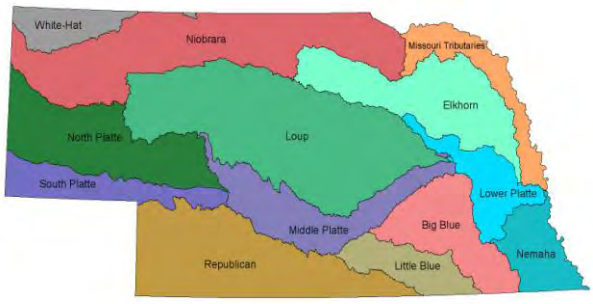
Why Biological Monitoring?

Nebraska has over 81,000 miles of streams of which approximately 18,000 miles flow continuously. Streams in Nebraska are capable of containing a rich diversity of aquatic life including aquatic macroinvertebrates (i.e. small animals living in water that can be seen with a naked eye), fish, amphibians, and mammals. Nitrogen, phosphorus, pesticides, sediment, and other pollutants are stressors that can degrade stream conditions for aquatic life, and can be potentially harmful to us. 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 or revised.

Elkhorn River near Atkinson

History of the Stream Biological Monitoring Program:

The Department began biological monitoring in 1983 with a targeted approach for classifying stream segments for Title 117 (Nebraska Surface Water Quality Standards). These sites were typically located at bridges. 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 it's SBMP in order to address statewide and regional questions about water quality. Data to answer such questions as "How good is the water quality in Nebraska?" is best obtained from sample locations chosen so that all streams have an equal chance of being sampled. These monitoring sites are generated by a computer program that randomly chooses sites on streams throughout Nebraska. From 1997-2009, the biological communities of 444 randomly selected stream sites were sampled.



Where is the Monitoring Conducted?

Each year 34-40 randomly selected wadeable stream sites (i.e. streams that are shallow enough to sample without boats) are chosen for study in two or three river basins throughout Nebraska. During a six-year cycle, all 13 major river basins in the state are intensively monitored (see map above for basin divisions).

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What is Monitored?
Routine chemical analyses of water samples provide water quality information for a snapshot in time and short-term pollution events may never be detected. Chemical analyses also provide no indication of the stream's physical nature or habitat. The "health" of a stream depends on not only the contaminants present or absent, but the quality of the habitat and the creatures living there. NDEQ's SBMP assesses the health of streams by evaluating the composition and numbers of resident aquatic macroinvertebrate and fish communities. Assessments are made by comparing the macroinvertebrate and fish communities at "reference condition" streams where there are no significant disturbances, to the communities collected from the randomly selected stream sites.

Aquatic Macroinvertebrates


Dragonfly nymph

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

Fish


Pearl dace (top) and Creek chub (bottom)

From small coldwater trout streams to large warm rivers, Nebraska streams support about 50 species of fish. As with macroinvertebrates, fish display varying habitat requirements and water quality tolerances making them excellent indicators of stream health. The majority of Nebraska's species are small, with adults generally less than 5 inches long. The Department's fish surveys have also provided information on changing abundances and ranges of fish in the state. Some species have been found to 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.

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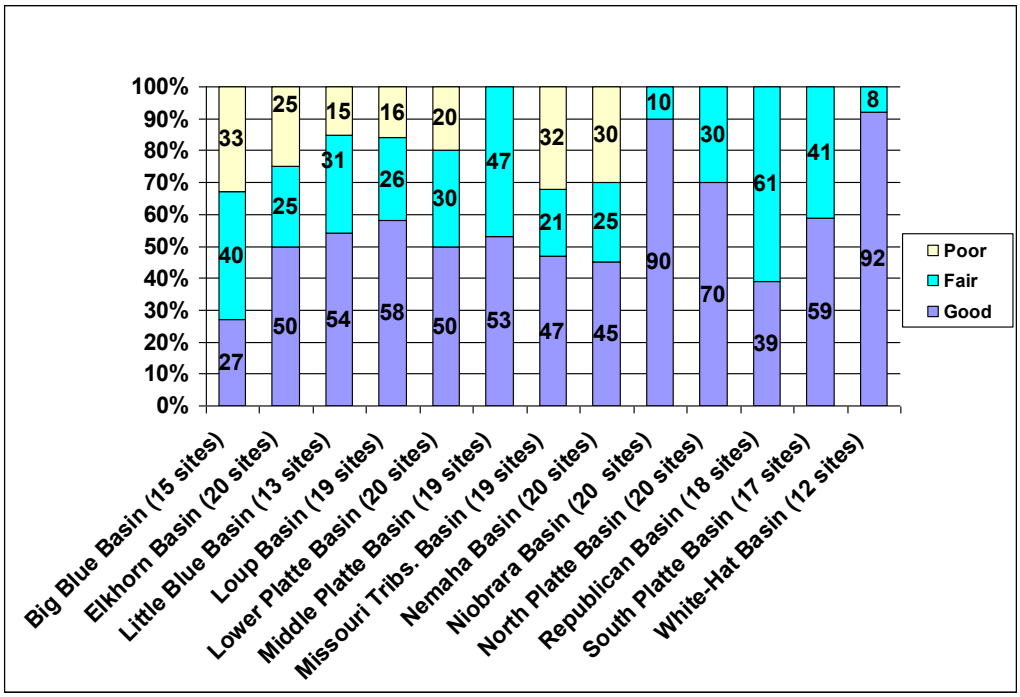
- Identifying streams that do not attain their assigned environmental goals and are in need of restoration or remedial action. Where significant problems were found (i.e. streams were assessed as having poor biological conditions), these stream segments are placed on the 303(d) List of Impaired Water Bodies (as required by the federal Clean Water Act) with regard to aquatic life.
- Identifying exceptional stream segments (reference conditions).
- Providing accurate biological distribution information.

Under the federal Clean Water Act, states are required to develop programs to evaluate the physical, chemical, and biological integrity of the Nation's waters and to adopt water quality standards to restore and maintain that integrity. States must report to Congress on the condition of all waters within their boundaries every two years. The information collected by the Department's SBMP satisfies these requirements for assessing the biological integrity of Nebraska's streams.

Results

For the purposes of this report, biological data from 232 random sites were used to characterize the condition of wadeable streams in the 13 major river basins in Nebraska (see bar graph below). Data from the latest completed round of surveys (2004-2008) were used to assess the water quality of streams in the Big Blue, Elkhorn, Little Blue, Loup, Lower Platte, Missouri Tributary, Nemaha, Niobrara, North Platte, and Republican Basins.



Results of Biological Monitoring, 2004 – 2008

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The Middle Platte, South Platte, and White-Hat Basins were assessed using two seasons of data because fewer random sites were selected in these basins. Additional findings from the next round of sampling that began in 2009 will be forth coming over the next several years and will be used to continue the assessment of the biological condition of wadeable streams in Nebraska.

The results of the survey show the White-Hat and Niobrara Basins are in the best condition of the basins evaluated with 92% and 90% of the streams in good condition, respectively. The streams in the remaining basins are considerably lower in quality. The Big Blue Basin presents the most concerns with only 27% of the streams in good condition and 33% of streams in poor condition.

The recent Wadeable Streams Assessment done 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 such as run-off from crop production (see photo below) and livestock operations and by point source pollution such as discharge from sewage treatment facilities. In order to protect and improve the condition of the streams in Nebraska, it is important that proper management measures are implemented to reduce the impacts of these pollutants.

Agricultural run-off

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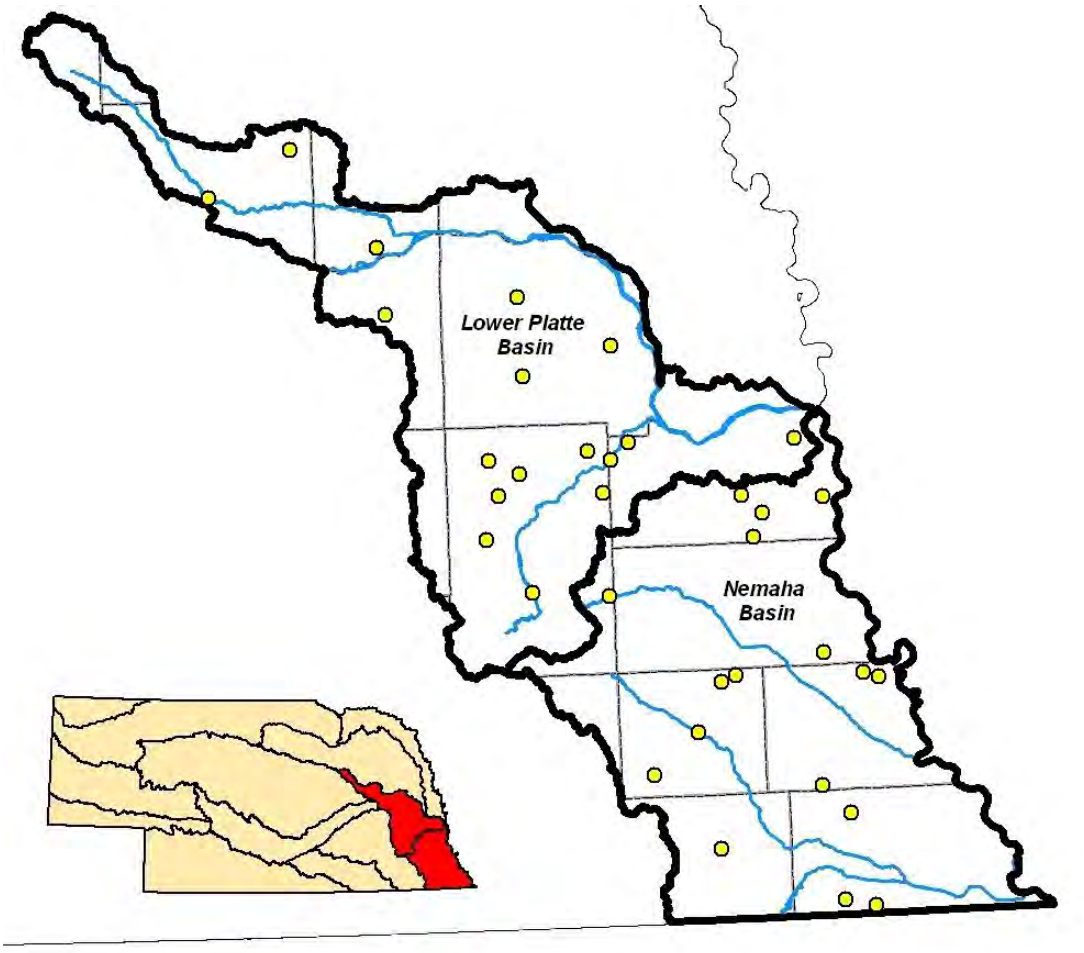
2009 Update

Thirty-four stream locations were sampled as part of the 2009 SBMN (see figure below).



Sampling Locations in the Lower Platte and Nemaha Basins, 2009.

Preliminary assessments of the biological collections made in 2009 are provided in the following graphs. Relative species abundance and species richness describe key elements of biodiversity which the Department uses to determine stream health. Relative species abundance refers to how common or rare a species is relative to other species in a given stream location while species richness simply refers to the number of species collected.

Thirty-one fish species were collected in the Lower Platte and Nemaha river basins throughout the 2009 sampling season with sand shiners, red shiners, and fathead minnows being the most abundant. The most abundant of the major macroinvertebrate taxa included the larvae life stages of the aquatic flies (e.g., midges, black flies, and mosquitoes), mayflies, and caddisflies.

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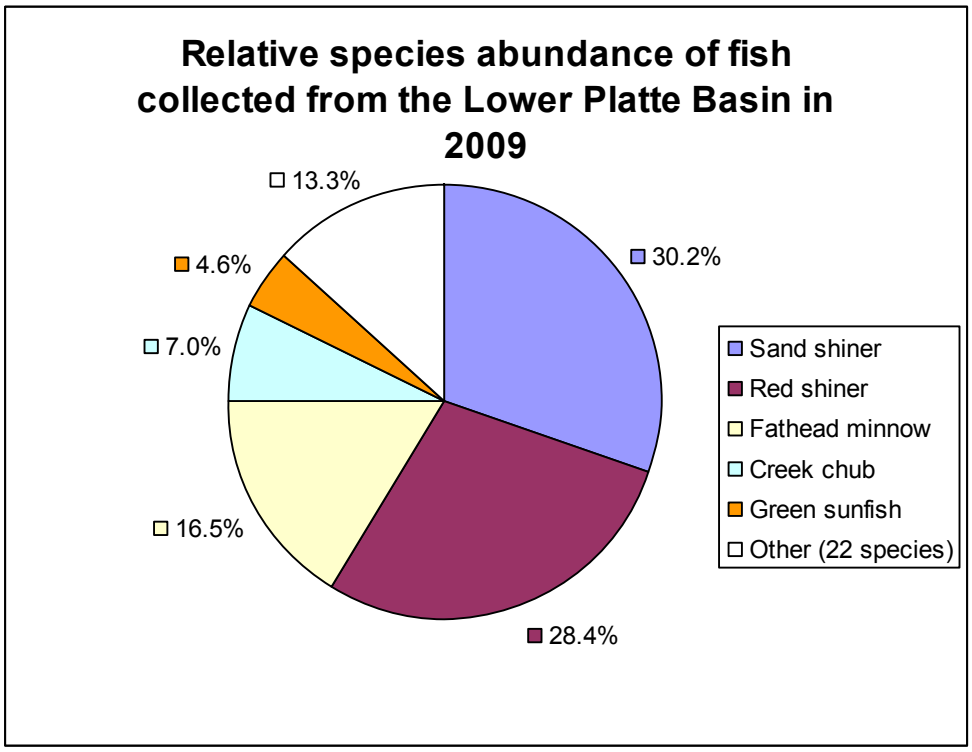

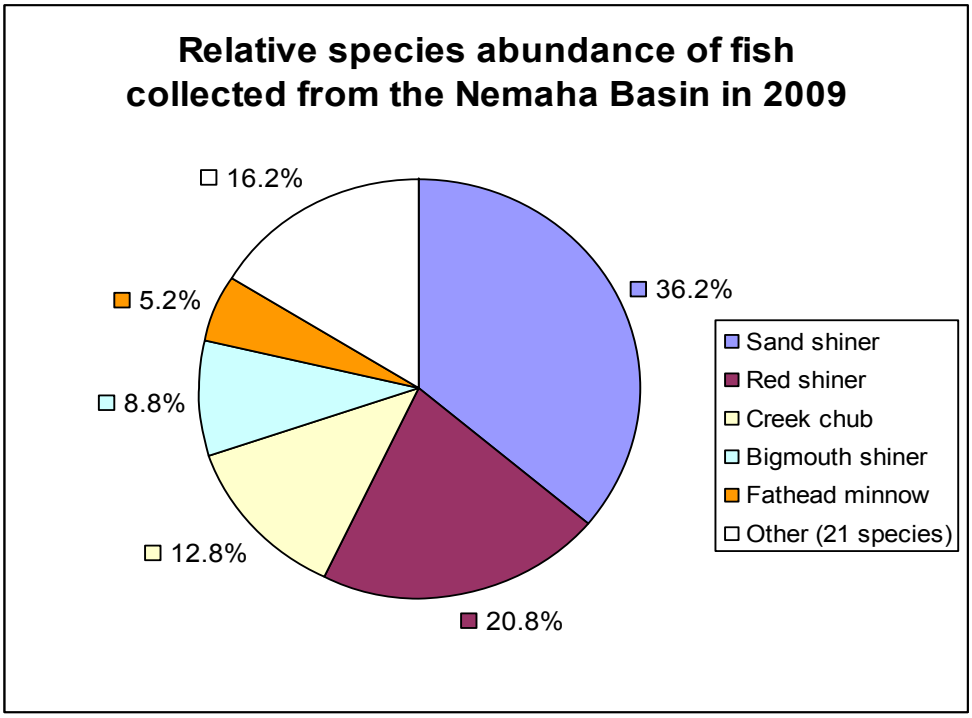

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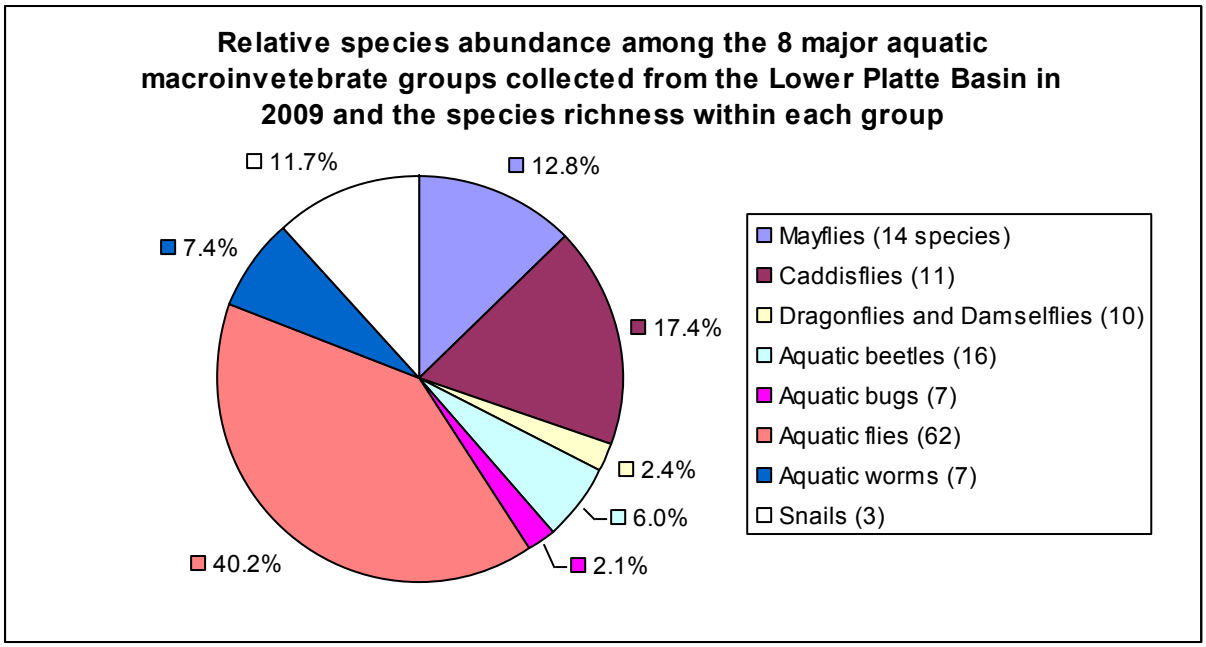

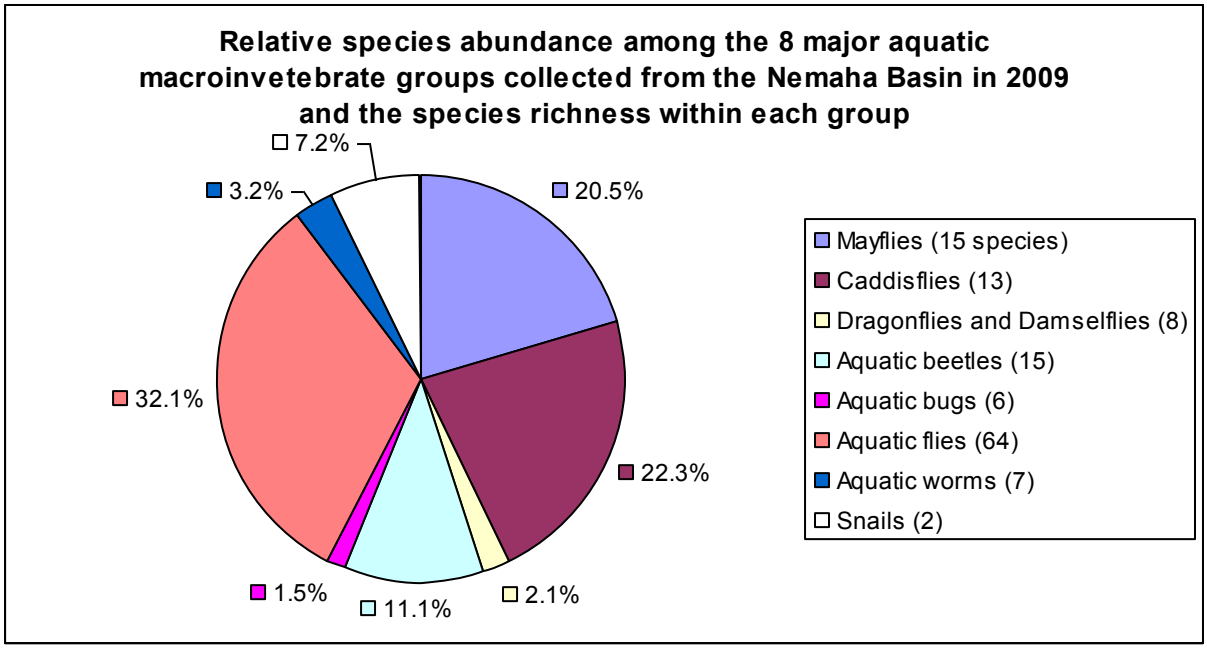

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For More Information
The Department's Stream Biological Monitoring Program is conducted and managed out of the main office located in Lincoln. **For more information contact:** Ken Bazata at 402/471-2192 or ken.bazata@nebraska.gov or Dave Schumacher at 402/471-4232 or david.schumacher@nebraska.gov

NDEQ staff seining fish on the North Platte River near Oshkosh

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Surface Water Quality: the Good and the Bad

Nebraska's Assessment of Lakes and Rivers

The federal Clean Water Act (CWA) requires states to assess the water quality of their lakes and rivers to determine if they meet state and federal water quality objectives. Nebraska's water quality objectives are defined in *Title 117- Nebraska Surface Water Quality Standards* (NDEQ, 2007). 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);
- drinking water (public drinking water supply); and
- agricultural supply (livestock water supply).

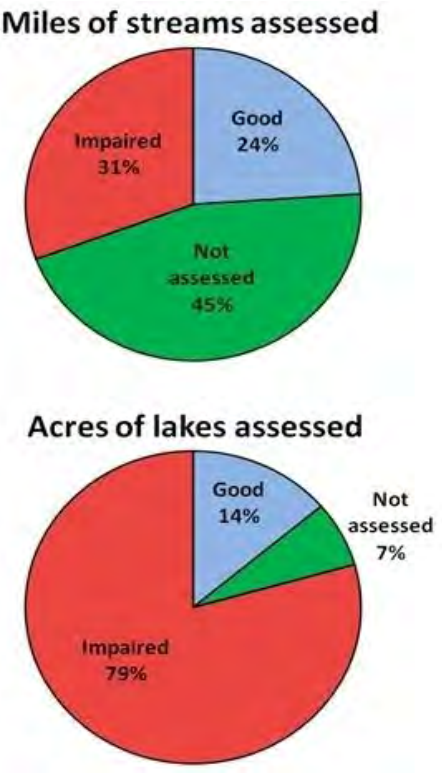
Title 117 also specifies the numeric levels of pollutants such as *E. coli* bacteria and nitrate that can be present in a waterbody without impairing the assigned beneficial uses. When determining the water quality for a specific waterbody, NDEQ determines the assigned beneficial uses for that waterbody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

Reporting Water Quality Conditions

Every two years the CWA requires that states develop an "Integrated Report" (NDEQ, 2010) that summarizes the water quality condition of all surface waterbodies in the state. For this report, states evaluate all available water quality data and determine which waterbodies are or are not supporting their designated beneficial uses. Waters that do not fully support all of their assessed beneficial uses are considered "impaired" and place on an impaired waterbodies list (303(d) list), waters that support all assessed uses are considered "supporting" or good quality waters.

Summary of Nebraska's 2010 Integrated Report

Nebraska has 1558 stream segments flowing over 16,000 miles and 528 lakes and reservoirs that cover more than 148,000 acres. For the 2010 Integrated Report, NDEQ staff conducted assessments on 413 stream segments and 225 lakes equating to more than 9,000 miles of streams and 138,000 lake acres being assessed (see figure to the right). While numerous waterbodies still need assessment, NDEQ has made a concerted effort to focus sampling and assessments on the waterbodies used more widely by the public. This has resulted in assessments on all lakes over 50 surface acres in size and all mainstem rivers (see map, below).



Proportion of streams and lakes assessed and the impairment status of the assessed waterbodies

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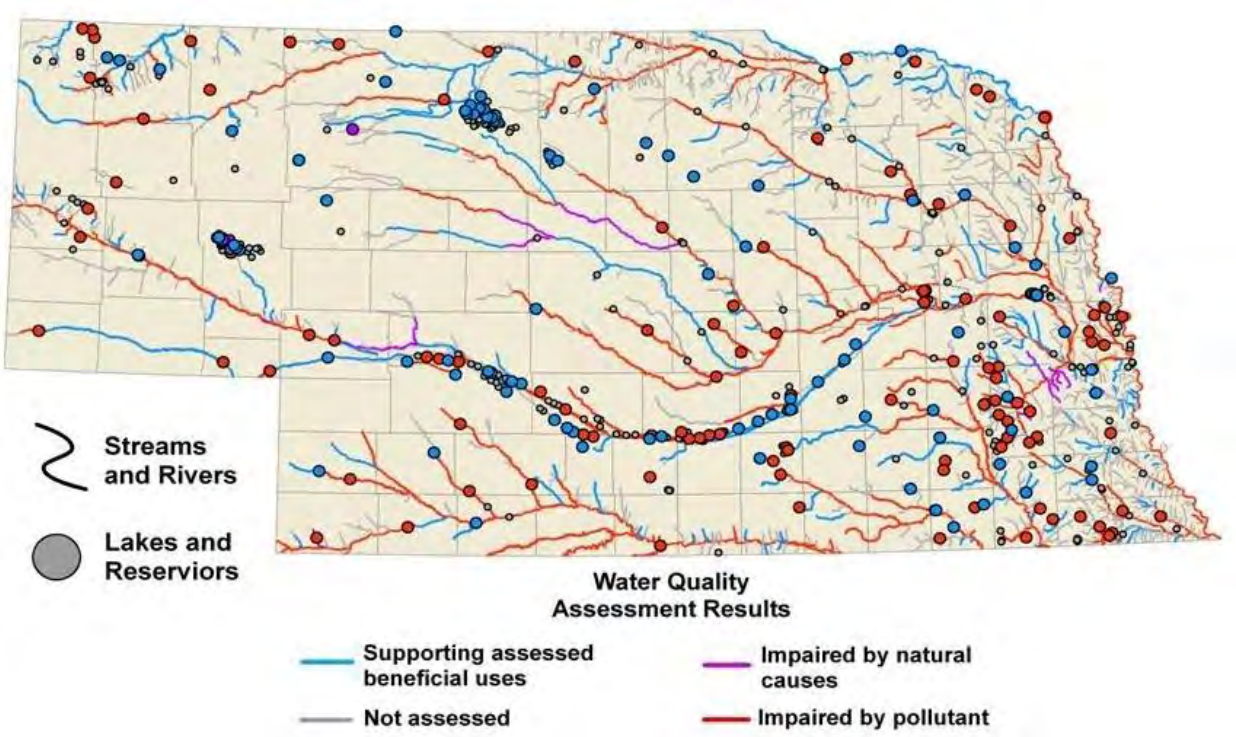
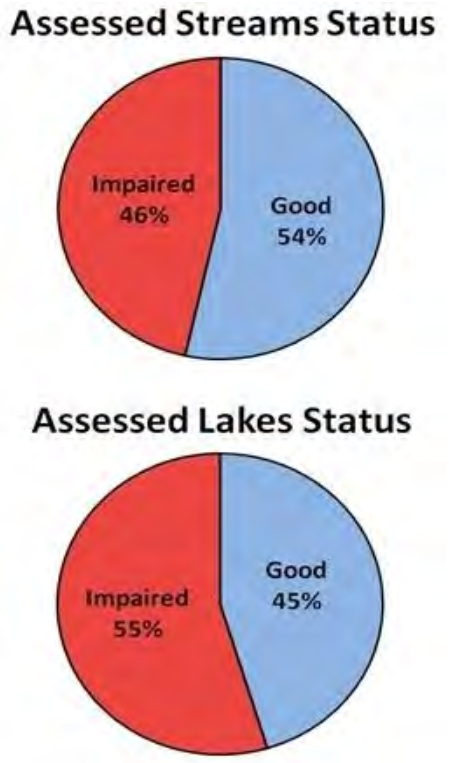


2010 Water Quality status of all of Nebraska's lakes and rivers.

Of the 413 stream segments assessed, 221 were supporting their assigned uses, while 192 were impaired (see figure to the right). Lake assessments found 123 of the lakes assessed to be impaired and 102 to be supporting their uses (see figure to the right).

The most common impairments for Nebraska streams were *E. coli* bacteria, impaired stream biology, high levels of atrazine, and fish consumption advisories. The most common lake impairments were high levels of nutrients, fish consumption advisories, elevated pH, and low dissolved oxygen (see graphs below).



Proportion of assessed streams and lakes that were impaired or good quality.

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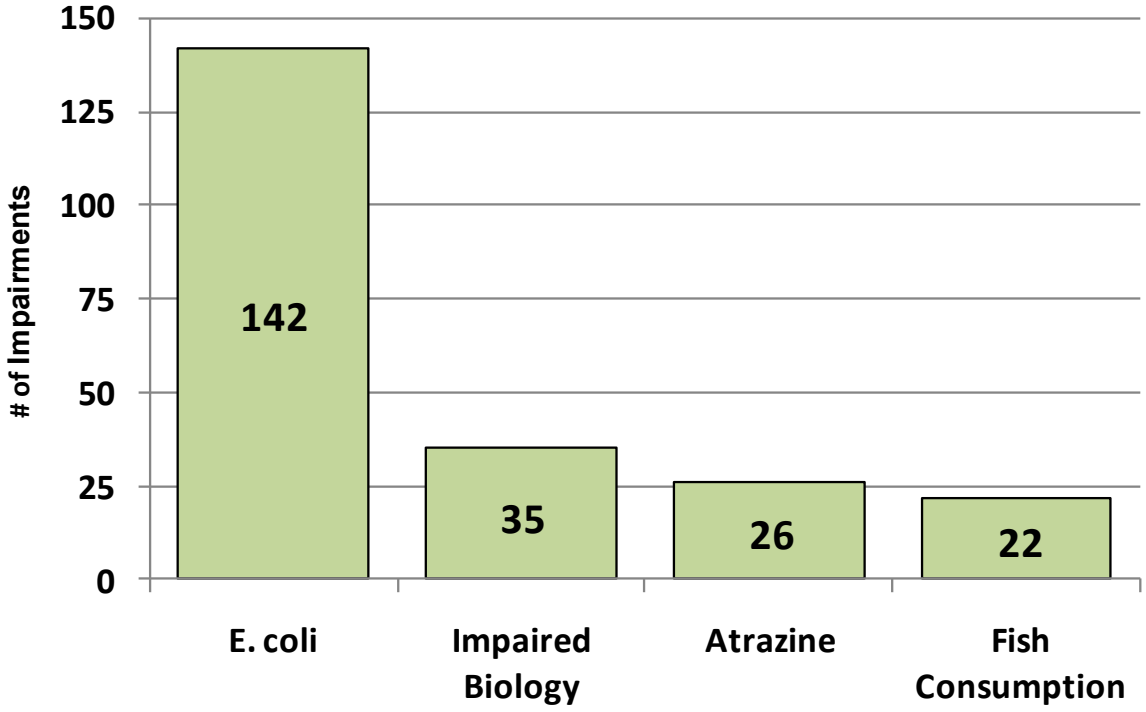
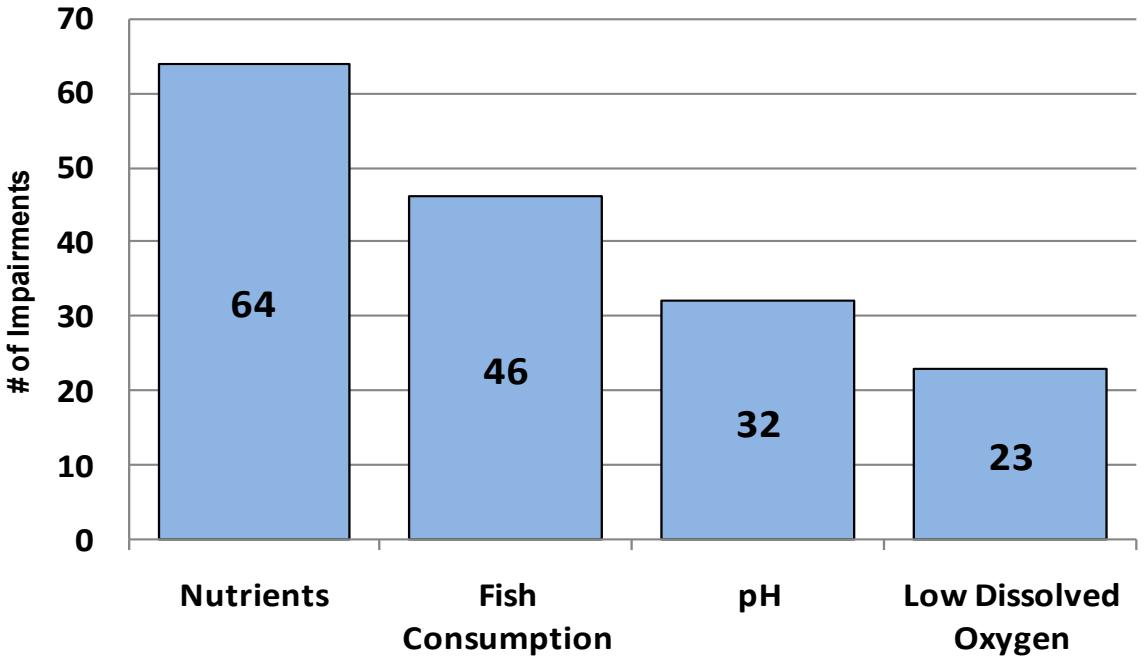
Common Stream Impairments



Common Lake Impairments



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

Strategies to Resolve Water Quality Impairments

Once a waterbody is determined to be impaired, the state is responsible for developing a plan or method to reduce pollutant levels so that waterbody in no longer deemed impaired. Three types of pollution control plans are commonly implemented: Point source pollution is managed via the National Pollutant Discharge and Elimination System (NPDES) permitting program (see "Water Monitoring and the NPDES Program" and "NPDES Compliance Monitoring", Sections 10 and 11 respectively, in this Report) and nonpoint source pollution is managed via Total Maximum Daily Loads (TMDLs) and Watershed Management Plans. Both of these nonpoint source pollution plans involve determining the cause and sources of the water quality impairment, working with the stakeholders to develop and implement pollution control strategies, and continuing monitoring water quality to determine if the plan is working of needs modification.

References:

NDEQ, 2007. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

NDEQ, 2010. 2010 Water Quality Integrated Report. Nebraska Department of Environmental Quality. Water Quality Planning Unit. Lincoln, NE

More Information

For more information on the quality of Nebraska's streams and lakes, the most recent *Surface Water Quality Integrated Report* are available on the Department's website at http://deq.ne.gov/. Or contact Chris Pracheil at (402) 471-4249; chris.pracheil@nebraska.gov or Luke Zakrzewski at (402) 471-3382; luke.zakrzewski@nebraska.gov.

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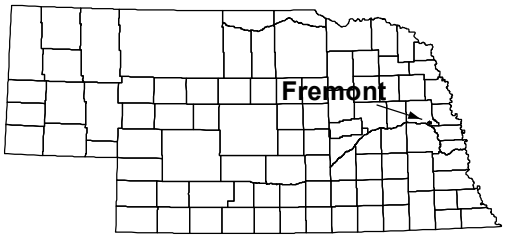
Success Story –
Fremont Lake #20



Visitors to the Fremont Lake State Recreation Area in eastern Nebraska have a choice of 20 sandpit lakes for fishing and passive recreational activities. However, only two of the lakes provide opportunities for swimming. One of those, Fremont Lake #20, was not open for swimming from June 2004 through September 2007.

Known for its two swimming beaches and boating, Fremont Lake #20 remained closed for approximately 36 weeks during this period because of microcystin, which is a toxin produced by some types of blue-green algae. This toxin can produce rashes, lesions, and blisters on humans, pets, and livestock. In extreme cases, microcystin can be fatal if ingested. From June of 2004 through September 2007, 68 of the 209 (33%) of the algae toxin samples collected from Fremont Lake #20 exceeded beach posting criterion. After detecting high concentrations of microcystin in Fremont Lake #20, management agencies closed the beaches and posted information advising the public to exercise caution when boating or potentially coming into contact with the water. At that point, a project team consisting of representatives from the Nebraska Game and Parks Commission (NGPC), University of Nebraska-Lincoln (UNL), and NDEQ began evaluating treatment options for the lake.

It has been well documented that excessive nutrients, primarily phosphorus, are the primary cause of blue green algae blooms. Since Fremont #20 does not have a defined watershed, the only source of nutrients is from the lake itself. Studies conducted by the University of Nebraska-Lincoln and NDEQ indicate organic “muck” on the bottom of the lake as being the major source of internal nutrients. This internal source of nutrients is the result of years of accumulation and decomposition of organic matter (e.g., leaves, algae, dead fish). The state of the fisheries in the lake may have also been a contributor to the problem. The NGPC characterized the fishery as rough fish dominated - primarily with carp and white perch. In addition to direct nutrient contributions through excrement, rough fish can re-suspend nutrients bound to bottom sediments.

The best way to address blue-green algae problems is to reduce inputs of nutrients whether from internal sources, external sources, or both. While external loadings can be addressed through many avenues such as land treatment, fertilizer reductions and waste management, fewer options are available to address internal nutrient loadings. Phosphorus precipitation/inactivation through an alum application was selected by the

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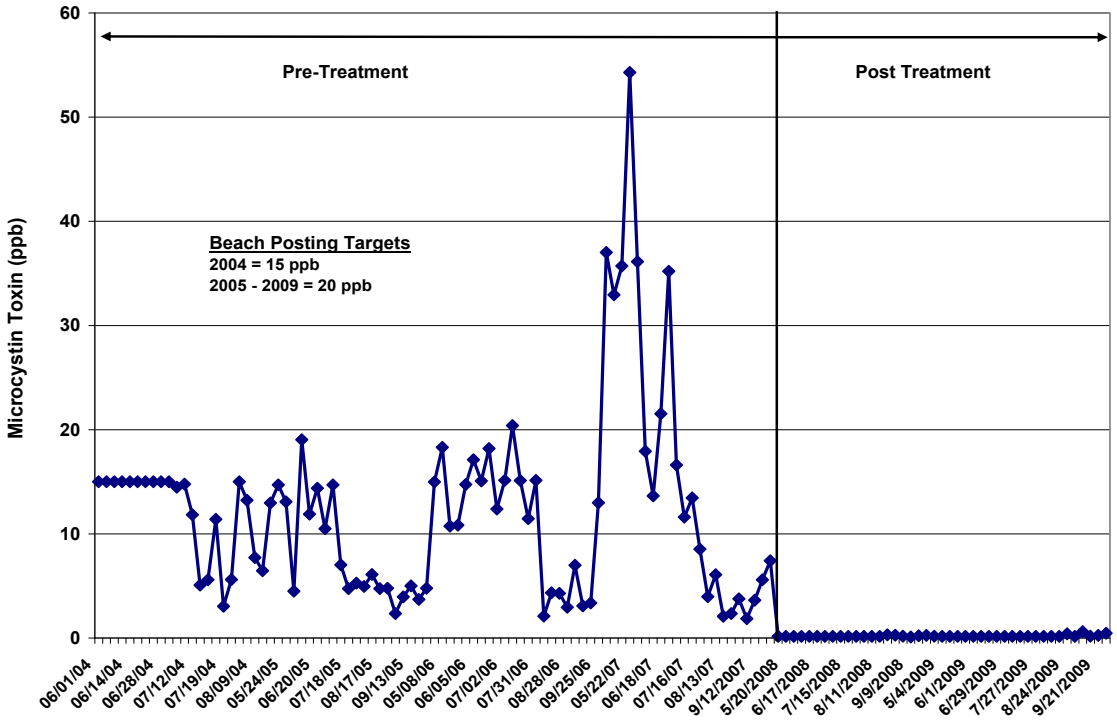
project team as the primary treatment option for Fremont #20. This procedure targets the removal of phosphorus from the water column and controls its release from bottom sediments in order to achieve phosphorus limiting conditions to algal growth. Alum has long been used in advanced wastewater treatment to remove phosphorus and this technique has been extended to lake management. Since early lake treatments in the 1960s, considerable advances in our knowledge of dose, effectiveness, costs, side effects and other factors have occurred.

The fish renovation was completed in the spring of 2007 and prior to the alum treatment in October 2007, copper sulfate was added to the lake to reduce existing algal communities. The treatments resulted in an 83 percent decrease in phosphorus in the lake. This decrease in phosphorus has significantly limited the production of blue green algae and associated toxins which have decreased by 98 percent. There have been no samples that have exceeded the beach posting criteria since the treatments have been completed. The total cost of the fish renovation and alum treatment was approximately $140,000.



Algae Toxin (Microcystin) Concentrations in Fremont Lake #20

For More Information: Contact Paul Brakhage at paul.brakhage@nebraska.gov or 402/471 4224.

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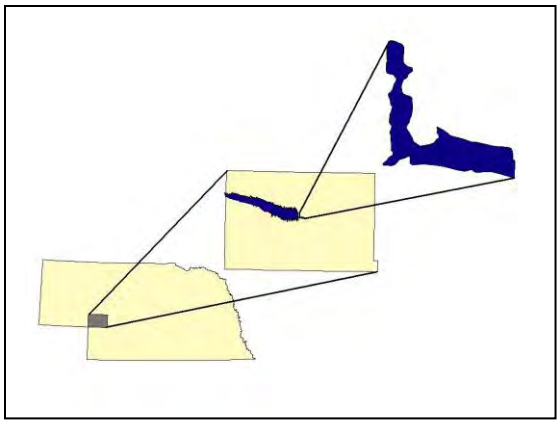
Success Story – Lake Ogallala

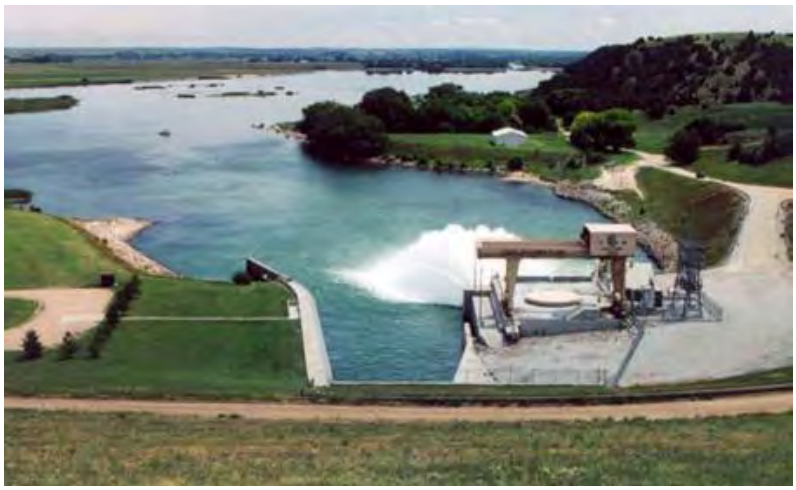
Nebraska's waters offer a wide variety of options for those who want to test their angling skills. From big reservoir walleye to farm pond bass and catfish, there is usually an opportunity for all. While trout fishermen often think of mountain streams, Lake Ogallala in Keith County provides year round opportunities to those who prefer to pursue rainbow trout.



Lake Ogallala is located immediately downstream of Lake McConaughy on the North Platte River in Keith County and was formed in the late 1930's when the dredging of materials for construction of Kingsley Dam resulted in a large borrow pit. Water supplied to Lake Ogallala is primarily from deep-water releases from Lake McConaughy. The cold temperatures of the water in the releases has been shown to be ideal for survival and growth of salmonid fishes and Lake Ogallala has been known as one of the state's popular "put and take" trout fisheries offering year-round opportunities to anglers.

Lake McConaughy and Lake Ogallala form the upstream components of a series of lakes and canals operated by Central Nebraska Public Power District (Central) and Nebraska Public Power District (NPPD), which provide several beneficial uses to the public along with the support of aquatic life. Lake Ogallala is one of many reservoirs on Central and NPPD's system that store water and regulate flows through the entire system. Water passing through the system provides electricity from five hydroelectric facilities, cooling water for two fossil-fuel plants, irrigation water, recreation and recharge of groundwater supplies.

Escalating fossil fuel prices in the mid and late 1970s led to federal and state policies that encouraged the use of renewable resources such as hydropower to supply the state's electricity needs. In response to these policies, Central began construction of the Kingsley hydroelectric plant in 1981 with commercial operation beginning in 1984.



Hydroelectric power generation at Kingsley Dam and Lake Ogallala

Water Quality Problems:
Prior to the installation and operation of the hydroelectric unit water

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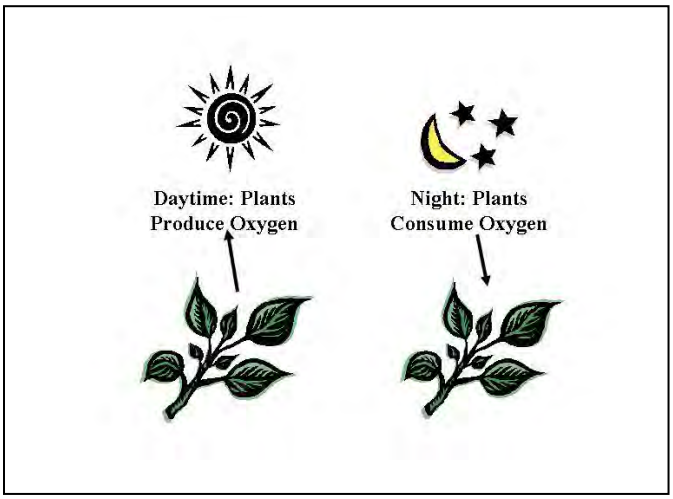
delivered to Lake Ogallala contained sufficient oxygen to maintain aquatic life. Once operation commenced, lake oxygen levels were measured to be near lethal levels for trout and other aquatic life within some areas of the lake.

A common misconception associated with Lake Ogallala is that the hydroelectric unit alters the water quality. The water quality in Lake Ogallala is mainly influenced by water in Lake McConaughy and the North Platte River valley. Aeration of the water during the critical periods using the "Howell-Bunger" valve attempts to remedy these problems.

Much research has been conducted at Lake Ogallala with the focus being the water quality, resulting dissolved oxygen, and the impacts to the cold-water fishery. The overall conclusions of these studies point to the water quality of Lake McConaughy as being the driving factor.

Reservoirs like Lake McConaughy trap sediment and other constituents (pollutants) from the flowing waters in the upstream watershed. During years when water is plentiful, Lake McConaughy is subject to thermal stratification. During periods of stratification, oxygen demand exceeds oxygen production, meaning the water released into Lake Ogallala has low dissolved oxygen as well as oxygen-demanding constituents. During the daylight hours, photosynthetic activity often provides sufficient oxygen to supply all needs. During the night however, photosynthetic activity ceases and continued respiration causes oxygen depletion in Lake Ogallala.



The complex problems within Lake Ogallala extend beyond Lake McConaughy into the North Platte River valley. Controlling and reducing the sources of pollutants in the North Platte valley is being addressed through regulatory and non-regulatory programs. While reducing future pollutants is important, management of the pollutants already captured in Lake McConaughy is necessary to ensure the aquatic resource is protected while allowing for other uses of the waters to continue.

Fixing the Problem:

Addressing the water quality issues within Lake Ogallala, while at the same time avoiding any negative impacts to other beneficial uses, provided unique challenges. Several scenarios were discussed and evaluated by the technical advisory team that ranged from injecting oxygen into the Lake McConaughy releases, vegetation management, aeration grids, and physical modification of the lake. The alternative selected combined two of the options – dredging a channel through an existing wetland and enhancing the existing Keystone basin channel.

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The creation of a channel through the wetlands is an unconventional approach to dealing with water quality impairments. While areas of the lake are lacking dissolved oxygen, other areas have a sufficient supply. The intent of the channel would allow waters from the two areas to mix and provide an escape route for the fish to exit areas with poor water quality.

Grants were obtained from the Nebraska Environmental Trust and EPA's Section 319 Nonpoint Source Control Program administered by the NDEQ. In-kind and other financial support was provided by Central, NPPD and the Nebraska Game and Parks Commission. The original estimates of funds to complete the project were $815,000 and up to four months to complete.

In September 2009, the lake was lowered and the work was initiated. Along with the channel excavation, the partners used the low lake levels to complete other projects including a servicing and repair of the hydroelectric generating turbine by Central, a repair of the river outlet gates by NPPD, and renovation of the fishery (removal of undesirable fish species) by the Nebraska Game and Parks Commission.

Working at the rate of about 100 feet per day, the channel was completed on December 3, 2009. Final project cost was approximately $316,000, well below the initial estimate. During the project, the crews were able to take advantage of an existing channel that was a remnant of the North Platte River.

Nebraska Game and Parks returned trout to the lake at the end of 2009 and stockings continued through 2010. Harvest results from the initial stocking indicate the fish are healthy and exhibit growth rates of 1 inch per month with some already reaching 20 inches.

Work being done on Lake Ogallala, fall 2009.

Documenting Success:
Central monitored dissolved oxygen at several locations in Lake Ogallala during 2010. The data indicates the channel is working as envisioned and there where no violations of the site-specific dissolved oxygen criteria either within the channel or at the outlet of the channel in the Keystone basin. It appears the channel has been successful at meeting the goal of elimination of one of the dissolved oxygen dead spots.

Addressing water quality in Lake Ogallala required a departure from accepted and practiced pollutant management. Partners were able to collective agree upon a solution that enhances habitat and circulation within the lake while still allowing usage of the water for hydro-electric generation and other beneficial uses.

For more information:
For more information, contact Patrick O'Brien 402/471-2219 or patrick.o'brien@nebraka.gov

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2010 Surface Water Sampling Summary

As discussed in the previous short reports, the NDEQ performs surface water monitoring throughout the state. This section summarizes the number of samples and parameters analyzed for each monitoring program. 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.

Antelope Creek Valley near downtown Lincoln
(photo by Mike Mascoe LPSNRD)

AMBIENT STREAM NETWORK

Network: 97 Sites Statewide
Frequency: Once per Month (first full week), 12 Months per year
Parameters:

- **Traditional:** Total Suspended Solids (TSS), Chloride, Ammonia, Nitrate-Nitrite, Kjeldahl Nitrogen, Total Phosphorus
- **Field Measurements:** Temperature, Oxygen, pH, Conductivity, Turbidity, Discharge.
- **Pesticides:** Once per month, April – Sept; Atrazine, Acetochlor, Metolachlor
- **Quarterly Metals:** 4 Times per year (Jan., Apr., July, Oct.)
    - **Bottom of Basin:** All Metals, 17 Sites (11 NDEQ + 6 USACE) Total - Selenium & Mercury and; Dissolved - Sodium, Magnesium, Calcium, Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Silver, Zinc

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- **All other Sites** "partial metals list": Dissolved: Sodium, Magnesium, Calcium, Arsenic and Total Selenium

2010 Ambient Stream Sample Totals by Parameter

- **Traditional & Field** (97 Sites X 12 Events) **= 1164**
- **Pesticides:** (97 Sites X 6 Events) **= 582**
- **Metals (all metals)** (17 Sites X 4 Events) **= 68**
- **Metals (partial metals list)** (80 Sites X 4 Events) **= 320**
- **QC Samples/Year** (DEQ 14 + USACE 2 X 12 Events) **= 192**

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

BASIN ROTATION NETWORK

As explained in a previous section (Basin Rotation Monitoring), the state is covered by more intensive sampling on a six year rotating schedule, shown below.

Year	River Basins
2010	Elkhorn & Missouri Tributaries
2011	North Platte, South Platte & White-Hat
2012	Big Blue, Little Blue & Republican
2013	Loup & Middle Platte
2014	Niobrara
2015	Lower Platte & Nemaha

2010 Basin Rotation Network Summary

Network: 49 Sites**:** 32 streams (including 13 shared ambient) and 17 lakes in the Elkhorn & Missouri Tribs Basins.

Frequency: Weekly, May 1 – September 30 (22 weeks)

Parameters:

- **Traditional:** (Rivers/Streams only) TSS, Chloride, Ammonia, Nitrate-Nitrite, Kjeldahl Nitrogen, Total Phosphorus
- **Field Measurements:** All Rivers/Streams & Lakes) Temperature, Oxygen, pH, Conductivity, Turbidity & Discharge.
- **Pesticides:** (Rivers/Streams only) Atrazine, Metolachlor, Acetochlor
- **Bacteria:** (Rivers/Streams and Lakes) E. coli

2010 Basin Rotation Sample Totals

- Total Stream Samples (traditional, bacteria & field) = 704 Samples
- Total Lake Samples (bacteria & field measurements) = 374 Samples
- Total Bacteria Samples (Basin Rotation Only) = 1,078 Samples

Assistance: LENRD, UENRD, LCNRD

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LAKE BEACH BACTERIA AND TOXIC ALGAE (Beach Monitoring)

Blue-green bacteria Swan Creek 5A Lake, near Tobias, Saline County, spring 2010 (photo by Dave Bubb, NDEQ).

Network Summary

2010 Bacteria & Toxic Algae Routine Weekly Samples

48 Sites X 22 Weeks = 1,056 Samples

Additional Toxic Algae Samples

- Routine Quality Control Samples
  - Duplicates (85) and Blanks (85) = 170
- Special Concern Samples (Fish Kills/Complaints)
  - Leisure Lake – Cattle Aborting Problem = 2
  - Brentwood Lake – Toxic Algae Concern = 1
  - Willow Creek Lake – Toxic Algae Spatial Distribution Data = 2
  - Post season high level tracking. Willow Creek Lake & Red Willow Lake – 5 weeks X 2 lakes = 10
  - NRD Lake #9A near Adams Eutrification Concern = 4

2010 Total Toxic Algae Samples (Including QC + Special Samples) = 1,245

Assistance: MNNRD, NNRD, URNRD, LRNRD, LLNRD, LBBNRD, LENRD, LPSNRD, UENRD, LCNRD, City of Carter Lake, Nebraska Game and Parks Commission (NGPC), Nebraska Public Power District (NPPD), USACE

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LAKE MONITORING

2010 Lake Monitoring Network

Deep Water Sites (44 lakes)

- **DEQ:** 26 lakes X 5 Months = 130
- **USACE:** 14 lakes X 5 Months = 70
- **NNRD:** 4 lakes X 5 Months = 20
- **QC Samples:** 10 DEQ, 10 USACE = 20

2010 Total Deep Water Samples: = 240

Frequency: Monthly from May through September

Parameters:

Traditional: TSS, total phosphorus, dissolved orthophosphorus, nitrate/nitrite nitrogen, kjeldahl nitrogen or total nitrogen, alkalinity.
Pesticides: Atrazine, Metolachlor, Acetochlor
UNL Lab: Chlorophyll-a
Field Measurements: Profiles (pH, conductivity, temperature, oxygen & turbidity), water transparency

Mid-Lake Site Profiles (33 lakes)

Frequency: Monthly from May through September
Parameters: Mid-Lake Profile (pH, conductivity, temperature, oxygen & turbidity)
2010 Mid-Lake Network Samples:

DEQ: 19 Lakes x 5 months = 95
USACE: 14 lakes x 5 months = 70
Total Mid-Lake Profiles: = 165

Run-Off Sampling

Network: 27 Inflow Sites to 18 Reservoirs (DEQ 19; USACE 8)
Frequency: Up to 6 events during significant rainfall from April - Sept
Parameters:

Traditional: TSS, Suspended Sediment Concentrations (SSC), total phosphorus, nitrate/nitrite nitrogen, kjeldahl nitrogen
Pesticides: Atrazine, Metolachlor, Acetochlor
Bacteria (E. coli): 6 Sites (Wagon Train & 2 sites at Holmes, 2 sites at Bluestem and 1 site at Swan Lake 5A)

2010 Total Run-Off Samples

DEQ: No Run-Off Samples collected during 2010 = 0
USACE: 8 Sites X 6 Events = 48

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Additional Lake Monitoring Projects (Nonpoint Source Programs)

Study/Lake	Parameter
Wagon Train Arsenic	Bi-weekly Arsenic
Lake Bathymetric Surveys	Lake Volume
UNL "Category 3" - Small Lakes Beneficial Use Assessment	Bacteria, Nutrients & Field Parameters
Carter Lake Pre-Project Evaluation Watershed/Shore Restoration, Fish Renovation, Alum Treatment,	Bacteria & Toxic Algae
Holmes Lake Biological Assessment Evaluate biological effects of project	Biological
Wagon Train Lake Run-Off Evaluation of nutrient reductions	Nutrients, sediment & pesticides
Conestoga Pre-Project - Watershed Treatment	Nutrients/Biological
UNL CALMIT Remote Sensing	Over-Flight imagery in Carter Lake
Buck & Duck Creek Study	Nutrients, Bacteria & Pesticides

Assistance: USACE, NNRD, City of Carter Lake, UNL, NGPC

Carter Lake near Omaha, before lake renovation.

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FISH TISSUE MONITORING

2010 Fish Tissue Network

- 50 fish samples from 25 streams and 25 lakes

Assistance: NGPC, Nebraska Health & Human Services (NHHS), Nebraska Dept. of Agriculture (NDA), EPA

Illustration of Smallmouth Bass by Virgil Beck (from Wisc. DNR website)

STREAM BIOLOGICAL MONITORING PROGRAM

Network:
34 stream sites in the Elkhorn and Missouri Tribs basins
Field measurements: Temperature, pH, oxygen, conductivity, turbidity and discharge
Fish and Aquatic Insect communities and habitat assessed

Collecting fish samples on the Elkhorn River (photo by Ken Bazata, NDEQ).

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FISH KILLS AND CITIZEN COMPLAINTS

Timeframe: July 1, 2009 to June 30, 2010

Number	Fish Kill Attributed to
16	Low dissolved oxygen levels (flooding, season change)
4	Disease or parasites
2	Improper algaecide application
1	Reservoir water release and abrasion
1	Ammonia fertilizer release
1	Livestock waste discharge to pond
TOTAL	**25 Fish Kills**

Between July 1, 2009 and June 30, 2010, the Department received 21 notifications of complaints concerning surface water issues. NDEQ has incorporated a new electronic complaint notification tracking system so these numbers are not comparable to past numbers. Sixteen of these were referred to other agency programs that more closely related to the problem and five complaints were investigated with on-site visits by the surface water staff.

Assistance: NGPC, U.S. Fish & Wildlife (USFW), NRDs, NDA, Lincoln Lancaster County Health Department (LLCHD)

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TUTTLE CREEK NONPOINT SOURCE STUDY

Primary Objective: Provide data to assess effectiveness of Best Management Practices implemented in watershed in reducing pesticides from nonpoint source pollution.

Network:

- **Routine:** 13 stream sites located in the Big Blue Basin in Nebraska and Kansas collected weekly, April 1 through September 30, 2010. (26 weeks)
- **Run-Off:** 4 sites collected at times of significant rainfall. Up to 6 events April through September.

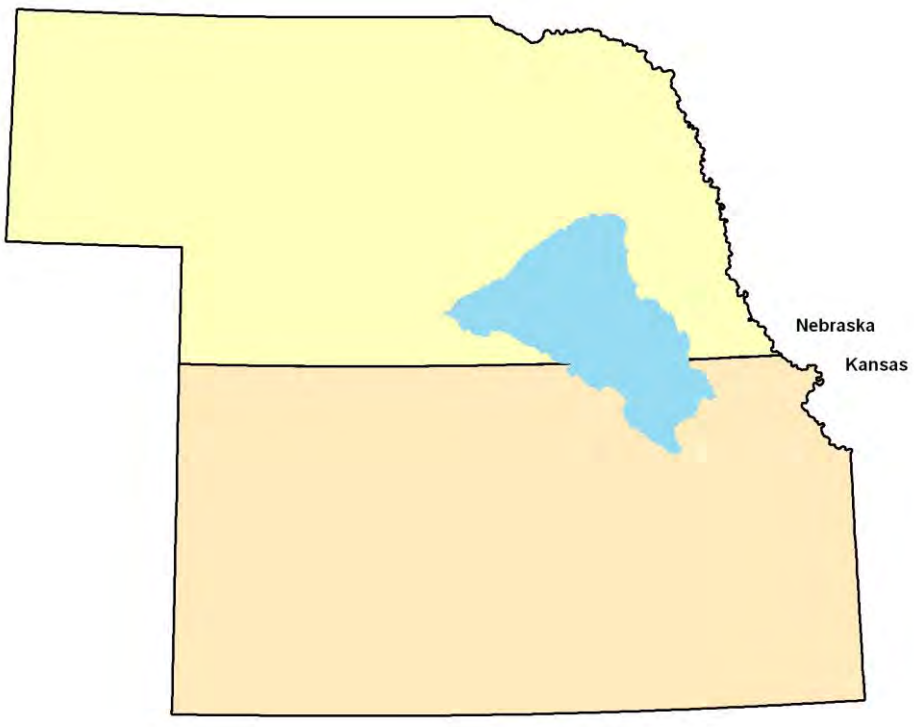
Parameters:

- **Traditional:** Total Nitrogen, Total Phosphorus, Suspended Sediment Concentration (SSC) & TSS.
- **Pesticides:** Atrazine, Metolachlor, Acetochlor, & Alachlor
- **Field Measurements** (routine samples, not run-off)**:** Temperature, Oxygen, pH, Conductivity, Turbidity & Discharge.

Total Samples

- **Routine:** 13 Sites X 26 Weeks + 52 QC = 390
- **Run-Off:** 4 sites X 6 events +12 QC = 36

Assistance: LBBNRD



Tuttle Creek Watershed

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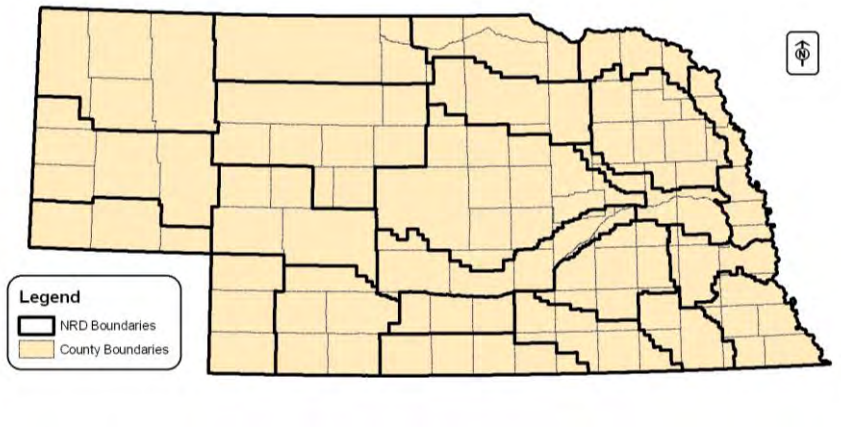
Natural Resources Districts, Abbreviations And Headquarter Cities

Central Platte NRD	CPNRD	Grand Island
Lewis and Clark NRD	LCNRD	Hartington
Little Blue NRD	LBNRD	Davenport
Lower Big Blue NRD	LBBNRD	Beatrice
Lower Elkhorn NRD	LENRD	Norfolk
Lower Loup NRD	LLNRD	Ord
Lower Niobrara NRD	LNNRD	Butte
Lower Platte North NRD	LPNNRD	Wahoo
Lower Platte South NRD	LPSNRD	Lincoln
Lower Republican NRD	LRNRD	Alma
Middle Niobrara NRD	MNNRD	Valentine
Middle Republican NRD	MRNRD	Curtis
Nemaha NRD	NNRD	Tecumseh
North Platte NRD	NPNRD	Scottsbluff
Papio-Missouri River NRD	PMRNRD	Omaha
South Platte NRD	SPNRD	Sidney
Tri-Basin NRD	TBNRD	Holdrege
Twin Platte NRD	TPNRD	North Platte
Upper Big Blue NRD	UBBNRD	York
Upper Elkhorn NRD	UENRD	O'Neil
Upper Loup NRD	ULNRD	Thedford
Upper Niobrara-White NRD	UNWNRD	Chadron
Upper Republican NRD	URNRD	Imperial



More Information:
For more information about any of the specific programs summarized in this section go to the section which has more detail and use the contact information there, or contact Will Myers, NDEQ, at 402/471-4227 (will.myers@nebraska.gov).

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