

Nebraska Department of Natural Resources

2017-2018 Biennial Review Report
for the
Lewis and Clark Natural Resources District
Voluntary Integrated Management Plan

October 17, 2019



Table of Contents

| | |
|---|----|
| Introduction | 1 |
| Surface Water Monitoring | 2 |
| NeDNR Surface Water Permitting Actions | 2 |
| Streamflow Monitoring..... | 5 |
| Cooperative Agreement for Bow Creek near Wynot Streamgauge | 9 |
| Voluntary Water Use Reporting | 10 |
| Collaboration with other Entities | 11 |
| Missouri River Recovery Implementation Committee..... | 11 |
| Eastern Nebraska Water Resources Assessment..... | 12 |
| Technical Studies, Research and Projects..... | 12 |
| Lower Platte Missouri Tributaries Model | 12 |
| Lower Elkhorn NRD AEM/Modeling Study | 12 |
| NeDNR Technical Assistance to Create LCNRD Well Hydrographs..... | 12 |
| NeDNR's INSIGHT Tool for Water Balance Analyses | 13 |
| NeDNR's SUSTAIN Tool for Hydrologic Modeling Analyses..... | 14 |
| Education and Outreach..... | 15 |
| Public Outreach Events..... | 15 |
| Educational Web Applications | 16 |
| Progress towards Goals and Objectives of the IMP | 17 |
| Goal 1: Develop and maintain a district-wide water inventory..... | 17 |
| Goal 2: Protect existing users while allowing for future water development | 17 |
| Goal 3: Increase public awareness and understanding of integrated water management..... | 18 |
| Jointly Identified Actions Items for Next Two Years | 18 |
| Surface Water Monitoring Actions | 18 |
| Collaboration with other Entities..... | 18 |
| Technical Projects and Studies | 19 |
| Education and Outreach | 19 |

Listing of Figures

| | |
|---|----|
| Figure 1. IMPs adaptive management framework | 1 |
| Figure 2. Locations of NeDNR surface water permitting actions in 2017 and 2018 | 2 |
| Figure 3. Map showing locations of streamgages (all USGS gages) in the LCNRD | 6 |
| Figure 4. Average annual discharge for Bazile Creek near Center, NE from 2003-2018 | 7 |
| Figure 5. Average annual discharge for the Bazile Creek near Niobrara, NE from 1953-2018 | 7 |
| Figure 6. Average annual streamflow for the Bow Creek gages, 1979-1993 and 2017-2018 | 8 |
| Figure 7. Bow Creek and West Bow Creek watersheds in the LCNRD | 9 |
| Figure 8. Voluntary water use reporting response rates for the LCNRD | 11 |
| Figure 9. LCNRD well level hydrograph example automatically created using a NeDNR tool | 13 |
| Figure 10. Department staff demonstrating physical models (left) and interactive web applications (right) at public outreach events | 15 |
| Figure 11. Screenshot of NeDNR's "Stream Simulations" interactive web application | 16 |

Listing of Tables

| | |
|--|---|
| Table 1. New surface water permits approved by NeDNR in 2017-2018 | 3 |
| Table 2. Surface water permits within the LCNRD that were partially cancelled in 2017-2018 | 4 |
| Table 3. Surface water permits within the LCNRD that were fully cancelled in 2017-2018 | 4 |
| Table 4. Surface water permits within the LCNRD that were transferred in 2017-2018 | 4 |
| Table 5. An overview of USGS streamgages in the LCNRD | 5 |

Introduction

In September of 2016, a voluntary integrated management plan (IMP) that was jointly developed by the Lewis and Clark Natural Resources District (LCNRD) and the Nebraska Department of Natural Resources (NeDNR) became effective. This IMP addresses coordinated management of groundwater (managed by LCNRD) and surface water (managed by NeDNR), and recognizes that the two sources of water are hydrologically connected in certain areas.

Integrated water management planning is an adaptive process that takes into account the changing needs of unique Natural Resources Districts (NRDs) and their constituents. Figure 1 provides a graphic that walks through the process of adaptive management used in drafting IMPs. This includes plan development, implementation, monitoring, and plan refinement. It is through this iterative process that progress is made towards achieving the goals of the plan.

The LCNRD voluntary IMP development involved consultation with a diverse group of stakeholders to help determine the goals and objectives of the IMP (Chapter 7 in the IMP). Included in the IMP is a monitoring plan (Chapter 9) that outlines data and information to be tracked and reported on as a part of plan implementation. Chapter 12 of the plan describes the IMP review process. Here, the plan lays out the framework for the LCNRD and NeDNR to conduct biennial reviews to discuss IMP implementation and assess progress towards achieving the goals and objectives of the plan. In the event that the LCNRD and NeDNR jointly decide that plan refinements are necessary, amendments could be drafted, which would require a public hearing and possible reconvening of the stakeholder group.

This 2017-2018 NeDNR biennial IMP report reviews surface water monitoring such as permitting, reporting and streamgaging. It also includes updates on collaborations with other entities, studies and research pertaining to hydrologically connected areas, and public outreach activities. As part of this review, the LCNRD and NeDNR jointly decided that no amendments were necessary at this time, as progress is being made towards achieving the goals and objectives of the IMP.

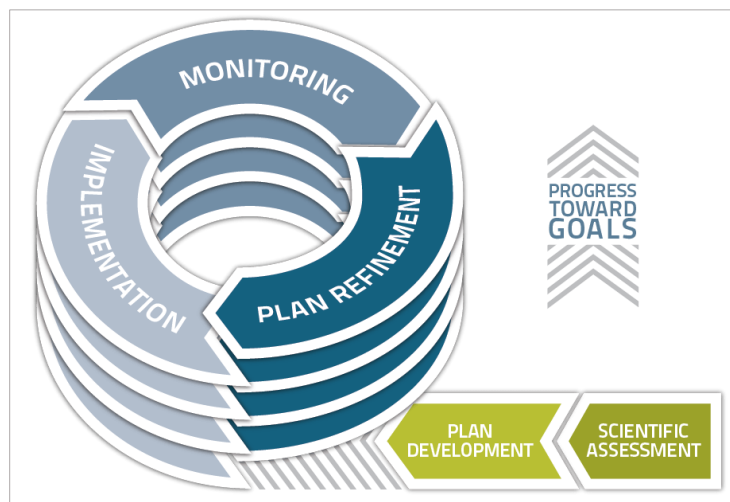


Figure 1. IMPs adaptive management framework

Surface Water Monitoring

Chapter 9 of the IMP describes the monitoring plan to gather and evaluate data, information and methodologies, which is an important part of IMP implementation. The following sections describe NeDNR's surface water monitoring activities for the 2017-2018 reporting period. These monitoring activities include surface water permitting actions, streamgauge monitoring, a streamgauge cooperative agreement for Bow Creek, and voluntary surface water use reporting.

NEDNR SURFACE WATER PERMITTING ACTIONS

NeDNR continued to monitor and administer surface water appropriations and maintain records for new, cancelled, or transferred rights. Figure 2 shows the geographic location of the 13 permitting actions that resulted in a change in surface water irrigated acres within the LCNRD. Tables 1 through 4 provide information about all surface water permitting actions that occurred in 2017 and 2018, including the type of surface water use, the general location, and the area of irrigated land and/or volume of surface water associated with that permit.

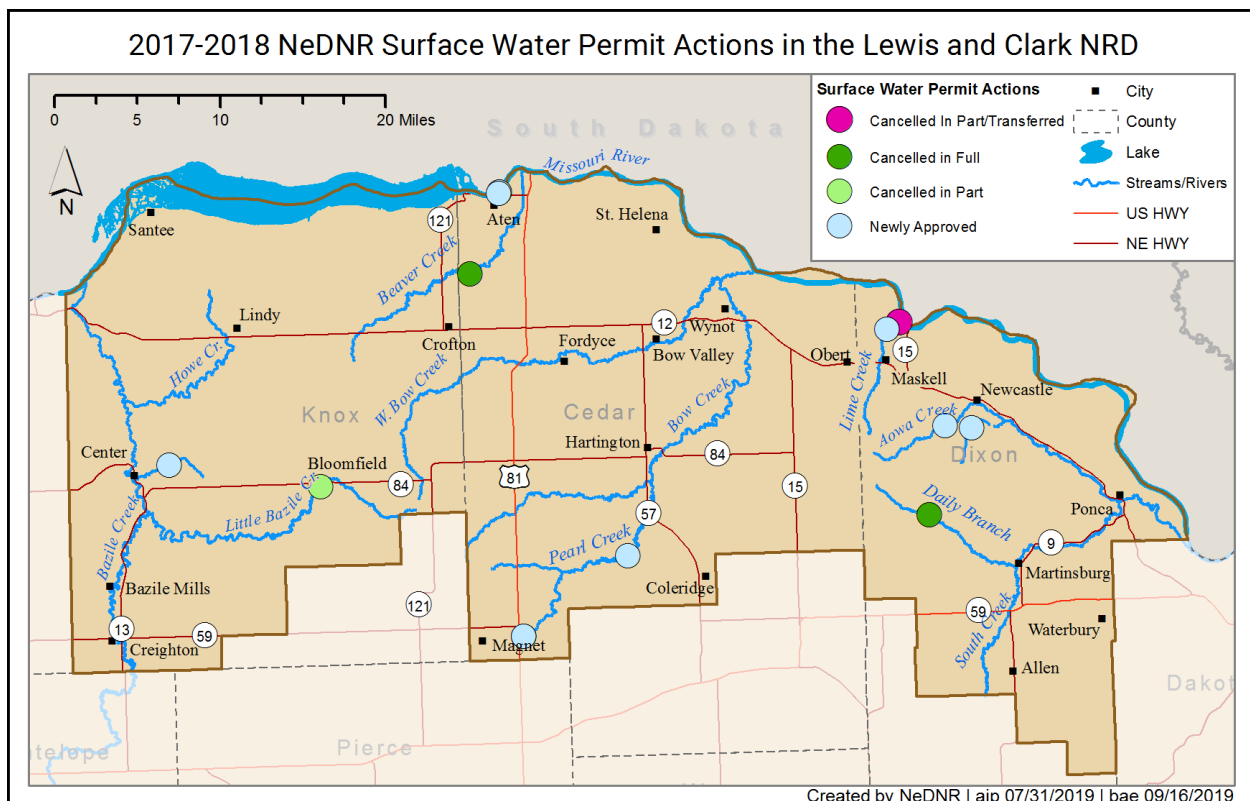


Figure 2. Locations of NeDNR surface water permitting actions in 2017 and 2018

Nebraska Department of Natural Resources
2019 Lewis and Clark IMP Biennial Review
Reporting Period: 2017-2018

Table 1 provides a listing of new permits within the LCNRD that NeDNR approved in 2017 and 2018. Eight new irrigation surface water permits totaling 1,220 acres were approved. One of these permits (A-19513) was for an “irrigation from storage” use and accounted for 495.5 new surface water irrigated acres. An additional storage use permit (A-19520) was granted alongside this permit for a reservoir that had been built in the 1960’s but was never permitted. NeDNR requires a surface water permit for storage for any water body with capacity to hold 15 or more acre-feet of water.

Seven additional permits allowed for a total of 724.9 new acres of surface irrigation from a natural stream source. One of the approved permits (A-19554) was for additional natural flow from a different source (Lime Creek) and did not add acres, as the acres were covered under a previous permit (D-1073) diverting from the Missouri River. The original D-1073 permit, however, had to be modified which is further discussed in the next sections. An additional domestic use surface water permit for 1.4 acres was granted in 2017. These acres are for personal use, typically a lawn or garden, and are not included in surface water irrigated acreage totals.

Table 1. New surface water permits approved by NeDNR in 2017-2018

| New Surface Water Permits Approved in 2017-2018 | | | | | | |
|---|--------------------------------|------------------|---------------------------|---------------|-----------|----------------|
| Permit Number | Use | General Location | Source | Date Approved | New Acres | New storage |
| A-19513 | Irrigation from Natural Stream | S9-T33-R1W | Missouri River | 6/15/2017 | 18.9 | NA |
| A-19520 | Storage | S27-T29-R1W | Tributary to Pearl Creek | 7/11/2017 | 0.0 | 41.5 Acre-feet |
| A-19523 | Irrigation from Storage | S27-T29-R1W | Skoog Reservoir | 7/11/2017 | 495.5 | NA |
| A-19557 | Domestic | S9-T33-R1W | Missouri River | 10/16/2017 | (1.4) | NA |
| A-19342 | Irrigation from Natural Stream | S6-T32-R1W | Beaver Creek | 12/22/2017 | 265.5 | NA |
| A-19579 | Irrigation from Natural Stream | S31-T31-R4W | Tributary to Bazile Creek | 2/23/2018 | 75.3 | NA |
| A-19587 | Irrigation from Natural Stream | S34-T30-R1E | Pearl Creek | 4/16/2018 | 43.9 | NA |
| A-19591 | Irrigation from Natural Stream | S30-T31-R5E | Tributary to Aowa Creek | 6/14/2018 | 134.6 | NA |
| A-19592 | Irrigation from Natural Stream | S26-T31-R4E | Aowa Creek | 6/14/2018 | 186.7 | NA |
| A-19554 | Irrigation from Natural Stream | S28-T32-R4E | Lime Creek | 10/12/2018 | 0.0 | NA |

Nebraska Department of Natural Resources
2019 Lewis and Clark IMP Biennial Review
Reporting Period: 2017-2018

Tables 2 to 3 review NeDNR actions to partially or fully cancel certain surface water permits for irrigation from a natural stream. Two permits totaling 5 acres were partially cancelled. For one of the permits (D-1073), only a portion of the granted water was cancelled due to the addition of a second source of surface water (A-19554) for the same acres (see previous and next sections). An additional two permits totaling 318.5 acres were fully cancelled. One cancellation occurred because a permit holder did not file a required map in the time allowed for a new permit.

Table 2. Surface water permits within the LCNRD that were partially cancelled in 2017-2018

| Surface Water Permits Partially Cancelled in 2017- 2018 | | | | | | |
|---|--------------------------------|------------------|---------------------|----------------|-----------------|-----------------|
| Permit Number | Use | General Location | Source | Date Cancelled | Acres Cancelled | Grant Cancelled |
| D-1073 | Irrigation from Natural Stream | S28-T32-R4E | Missouri River | 10/12/2018 | 0.0 | 1.63 cfs |
| A-19419 | Irrigation from Natural Stream | S10-T30-R3W | Little Bazile Creek | 12/18/2018 | 5.0 | 0.07 cfs |

Table 3. Surface water permits within the LCNRD that were fully cancelled in 2017-2018

| Surface Water Permits Fully Cancelled in 2017 -2018 | | | | | | |
|---|--------------------------------|------------------|--------------|----------------|-----------------|-----------------|
| Permit Number | Use | General Location | Source | Date Cancelled | Acres Cancelled | Grant Cancelled |
| A-14699 | Irrigation from Natural Stream | S26-T30-R4E | Daily Branch | 8/24/2017 | 53.0 | 0.76 cfs |
| A-19342 | Irrigation from Natural Stream | S6-T32-R1W | Beaver Creek | 7/5/2018 | 265.5 | 3.79 cfs |

One surface right was transferred during the reporting period (Table 4). This surface water permit (D-1073) was both transferred and cancelled in-part. The transfer was an expedited transfer of the location of use, which was granted because there was no change in acres and no significant change in the surface water point of diversion. In this case, the applicant desired to add a second source of water (A-19554, Lime Creek) to already permitted surface water irrigated land (D-1073); this required a partial relinquishment of surface water under the original permit (D-1073) so the maximum rate allowed by statute would not be exceeded.

Table 4. Surface water permits within the LCNRD that were transferred in 2017-2018

| Surface Water Permits Transferred in 2017-2018 | | | | |
|--|--------------------------------|------------------|------------------------|---|
| Permit Number | Use | General Location | Transfer Approval Date | Transfer Type |
| D-1073 | Irrigation from Natural Stream | S28-T32-R4E | 10/12/2018 | Expedited Transfer of the Location of Use |

STREAMFLOW MONITORING

The U.S. Geological Survey (USGS) operates six streamgages within the boundaries of LCNRD. A listing of these streamgages is shown in Table 5, and the locations of the streamgages are shown in Figure 3. Streamflow data on these gages is available on the USGS's National Water Information System (NWIS) at <http://waterdata.usgs.gov/>. NeDNR regularly assesses the need for modifications to the network in the IMP area.

Table 5. An overview of USGS streamgages in the LCNRD

| Streamgages in the Lewis and Clark NRD | | | | | |
|--|--------------|------------|-------------|-----------|--|
| Name | USGS Gage ID | Start Year | Gage Height | Discharge | USGS Cooperative Partners |
| Bazile Creek near Niobrara, NE | 06466500 | 1990 | X | X | Lewis & Clark NRD |
| Bazile Creek at Center, NE | 06466400 | 2002 | X | X | Santee Sioux Tribe of NE |
| Bow Creek near Wynot, NE | 06478522 | 2015 | X | X | Lewis & Clark NRD, NE Dept. of Natural Resources |
| Howe Creek near Center, NE | 06466470 | 2017 | X | X | Santee Sioux Tribe of NE |
| Missouri River near Maskell, NE | 06478526 | 2012 | X | | U.S. Army Corps of Engineers |
| Missouri River near St. James, NE | 06478523 | 2017 | X | | U.S. Army Corps of Engineers |

Nebraska Department of Natural Resources
2019 Lewis and Clark IMP Biennial Review
Reporting Period: 2017-2018

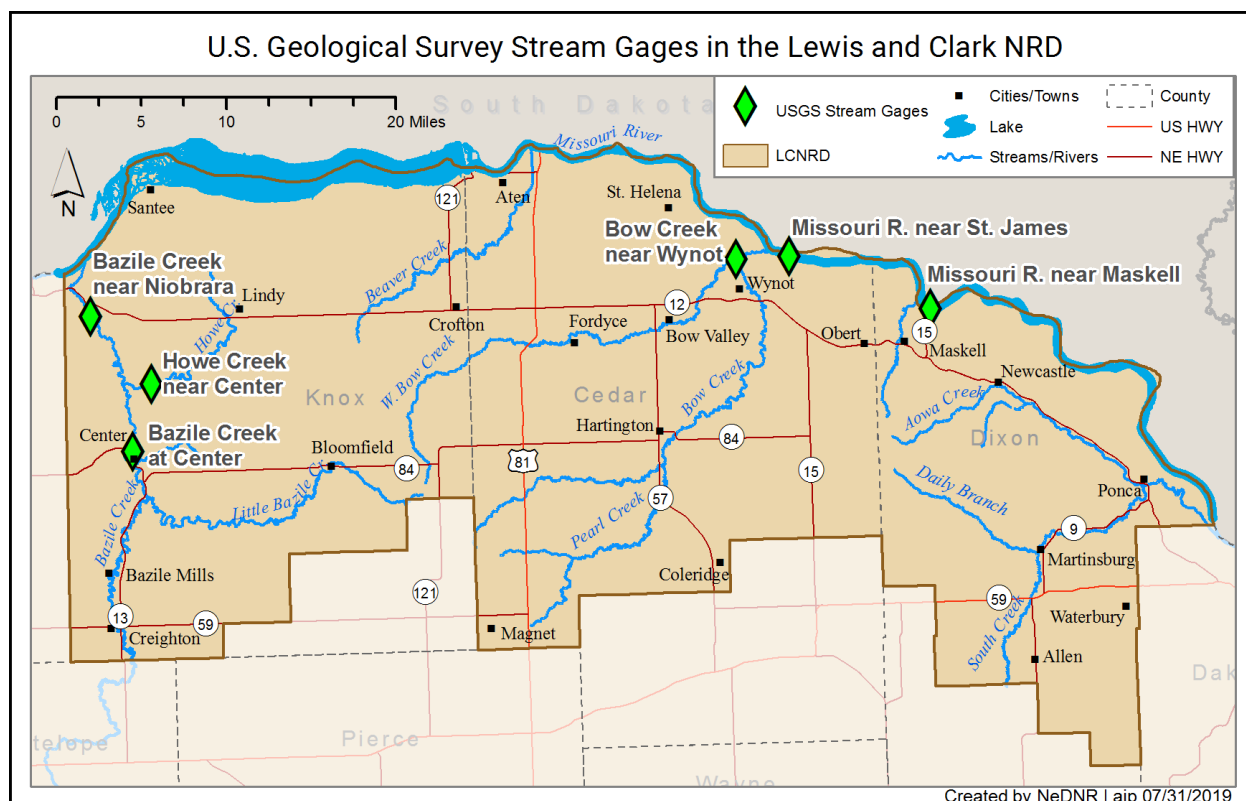


Figure 3. Map showing locations of streamgages (all USGS gages) in the LCNRD

NeDNR acquired streamflow data for select streamgages from the USGS NWIS portal (some data are provisional) as a part of this LCNRD biennial report. The streamgages include two locations on Bazile Creek and one location on Bow Creek, and provide insight to the overall water supply for a given year. The average annual streamflow (discharge) in cubic feet per second (cfs) for these streamgages is shown in Figures 4 through 6. Both the streamflow for the period of record, and period of record average streamflow are shown to provide a reference for fluctuations from average conditions. Because Bow Creek near Wynot only had two years of streamflow data, the Bow Creek near St. James was included in the chart to add fifteen years of data from a nearby location (although smaller watershed).

As indicated in the charts, 2018 was an extremely wet year in the LCNRD, with flows nearly or more than doubling the period of record flows. For example, The Bazile Creek's average annual discharge at Center, Nebraska (171 cfs) was 187% more than the historical average (91 cfs) (Figure 4). Downstream near Niobrara, Nebraska, the Bazile Creek's average annual discharge in 2018 (241 cfs) increased to more than 250% of the historical average (96 cfs) (Figure 5). Although Bow Creek near Wynot has only two years of record, the 2018 streamflow (317 cfs) was nearly double that of the 2017 streamflow (170 cfs).

Nebraska Department of Natural Resources
2019 Lewis and Clark IMP Biennial Review
Reporting Period: 2017-2018

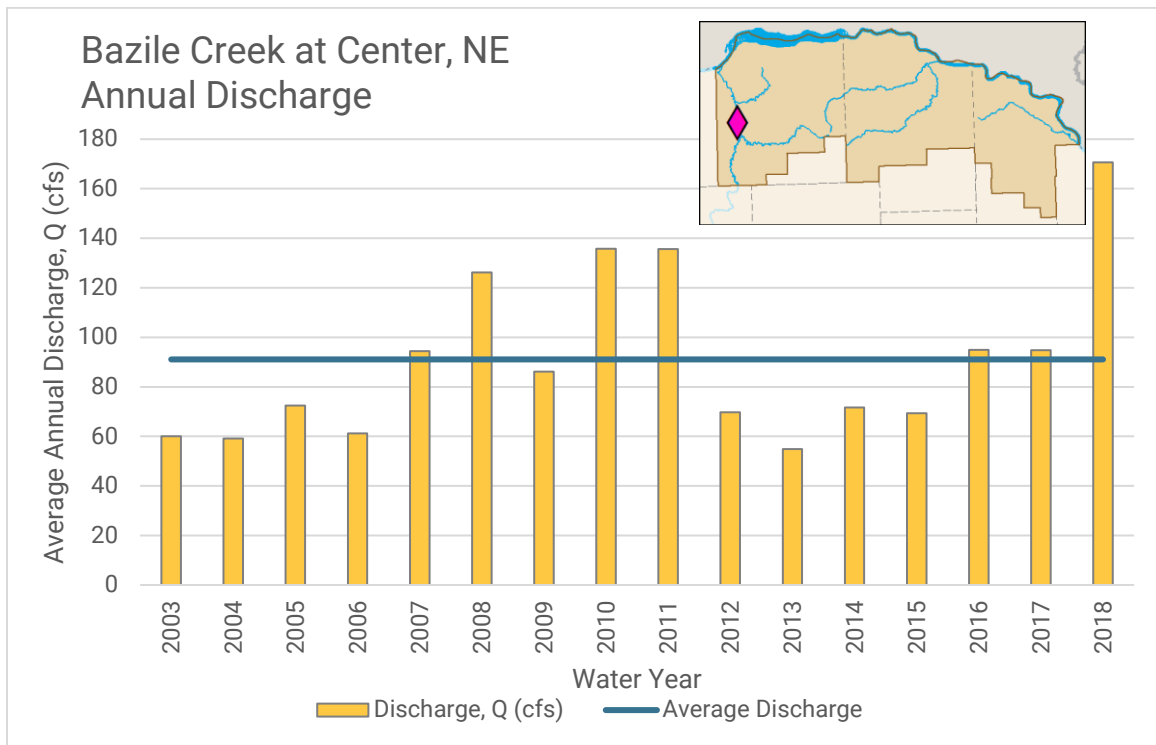


Figure 4. Average annual discharge for Bazile Creek near Center, NE from 2003-2018

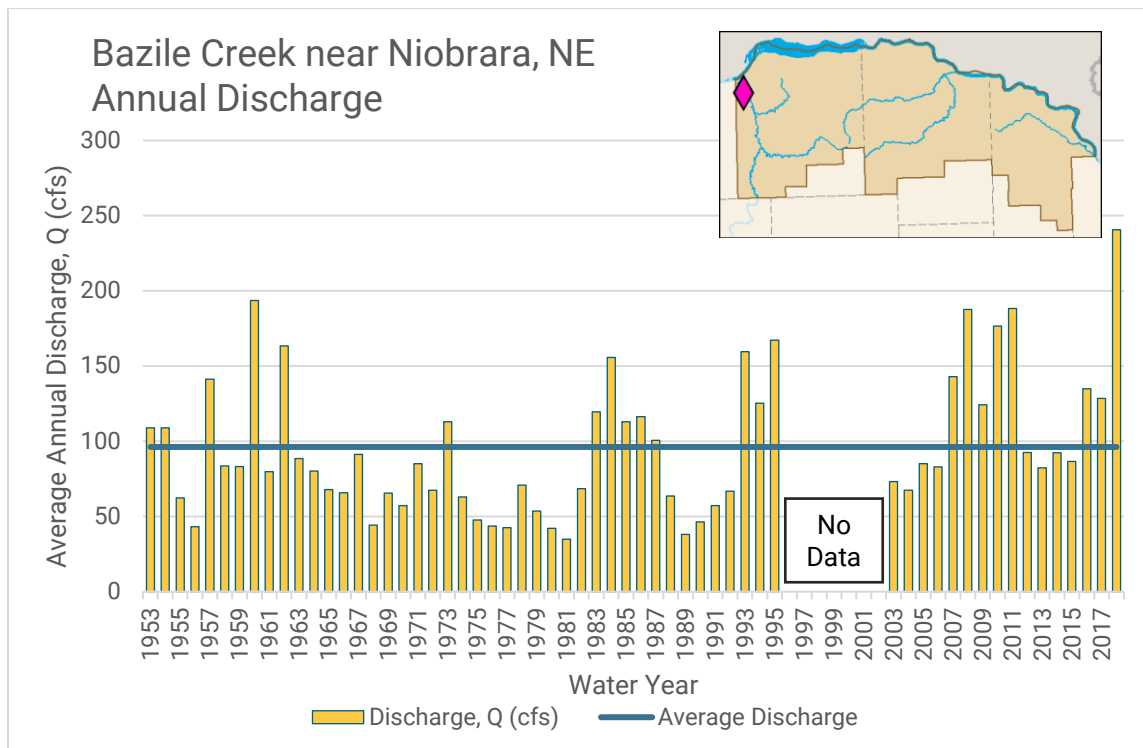


Figure 5. Average annual discharge for the Bazile Creek near Niobrara, NE from 1953-2018

Nebraska Department of Natural Resources
2019 Lewis and Clark IMP Biennial Review
Reporting Period: 2017-2018

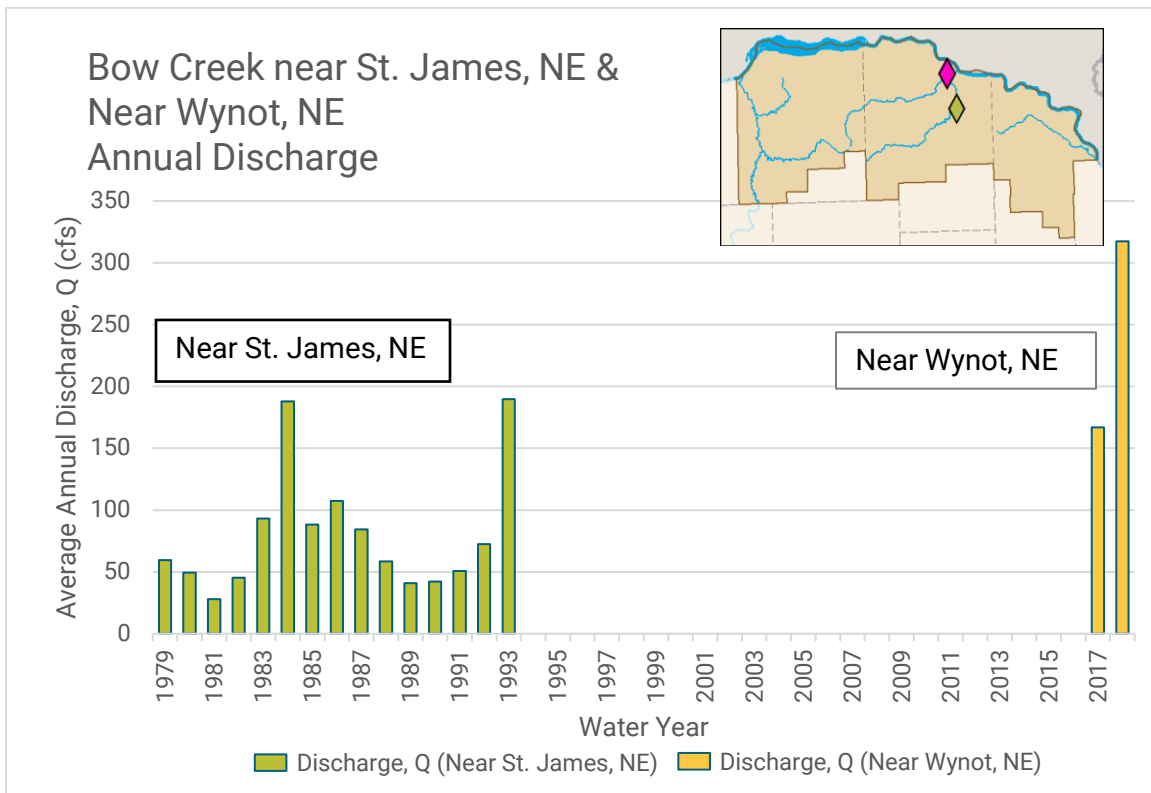


Figure 6. Average annual streamflow for the Bow Creek gages, 1979-1993 and 2017-2018

COOPERATIVE AGREEMENT FOR BOW CREEK NEAR WYNOT STREAMGAGE

The Bow Creek near Wynot streamgage is a newer streamgage that is operated and maintained by the USGS with additional funding provided by LCNRD and NeDNR. The streamgage provides stream discharge information for West Bow Creek and Bow Creek watersheds. When combined, these watersheds cover about 1/3 of the LCNRD land area (Figure 7). This land area is prone to flooding and had not been gaged since the closure of the Bow Creek near St. James gage in 1993. LCNRD and NeDNR considered Bow Creek gaging a priority to fill gaps in the water monitoring network.

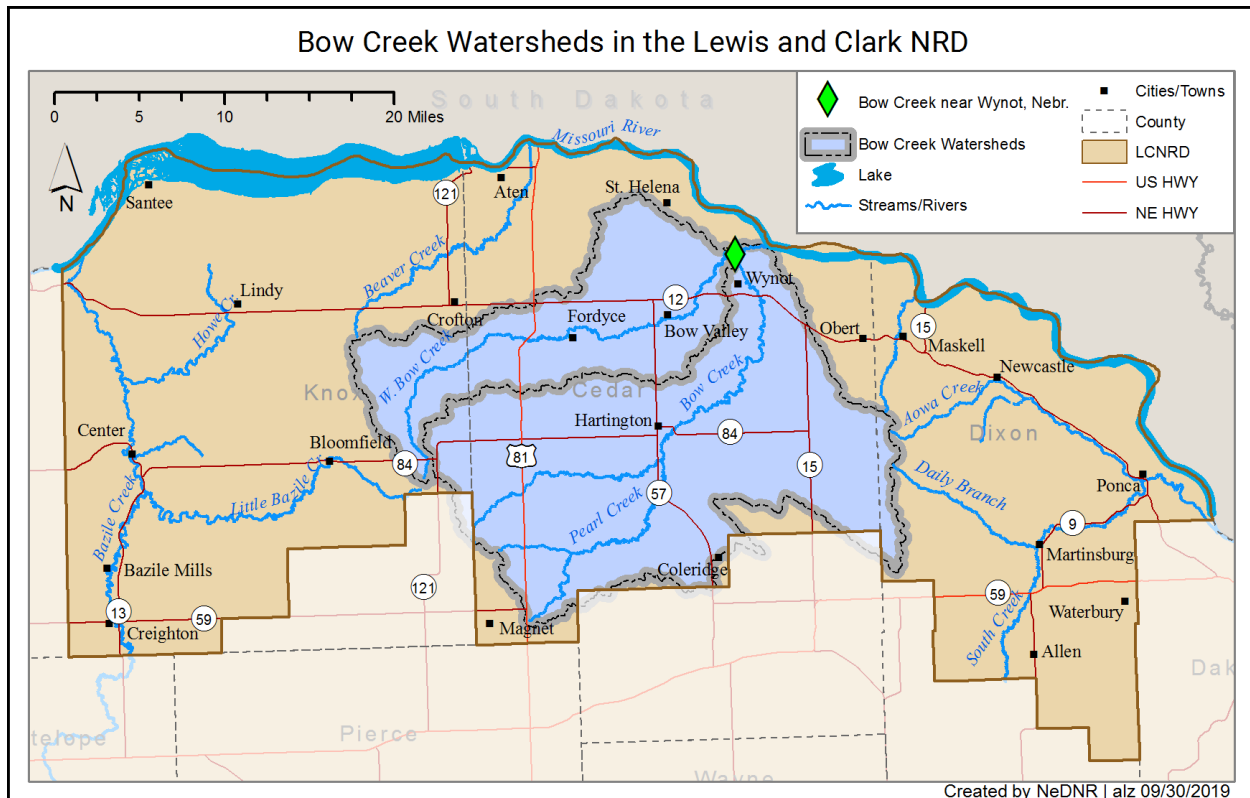


Figure 7. Bow Creek and West Bow Creek watersheds in the LCNRD

In the early 2010's, USGS installed instrumentation at the Wynot site to monitor water quality for a defined period, after which the instrumentation would be removed. Prior to removal and during IMP development, the LCNRD reached out to USGS and NeDNR to explore opportunities to keep the instrumentation in place and dedicate the site to year-round monitoring of streamflow. USGS agreed to provide roughly 40 percent of maintenance costs for continuation of the gage.

Since 2016, the LCNRD and NeDNR have been in cooperative agreements to share the remaining maintenance costs that are not covered by USGS. NeDNR has utilized Water Planning Division funds for the Bow Creek near Wynot streamgage maintenance, prioritizing the initiative as a part of statewide IMP implementation. The first cooperative agreement lasted three years and covered streamgage maintenance from June 2016 to June 2019. NeDNR and LCNRD are currently working

on a contract for a second three-year agreement, which will cover maintenance through June 2021.

Benefits of the Bow Creek near Wynot streamgage include increased knowledge about water supply at a critical point just upstream of the confluence with the Missouri River, better ability to monitor and make decisions about flooding, and improved insight into climate cycles and drought. In addition, river stages at Bow Creek can be compared to static water levels at observation wells in northern Cedar County, to increase understanding of hydrologically connected groundwater and surface water areas. The partnership between NeDNR and LCNRD to maintain the streamgage is helping to achieve IMP goals and objectives, specifically objectives 1.1 (development and maintenance of a District-wide water inventory) and 1.2 (filling gaps in monitoring networks).

VOLUNTARY WATER USE REPORTING

NeDNR requests water use data through its Voluntary Water Use Reporting Program throughout the state, including users in the LCNRD area. NeDNR sends surveys to surface water permit holders towards the end of the year that request information such as use or non-use, amount of surface water, reasons for non-use, and crops grown. NeDNR compiles all received information beginning in February of the following year.

Information from those reports was evaluated as part of this LCNRD biennial review. The response rate for the LCNRD has generally increased during the span the voluntary water use reporting program as shown in Figure 8. Of note, the 44 percent response rate in 2018 was the highest response rate for all NRDs within the voluntary program, and much higher than the average response rate of all NRDs in the voluntary program (about 30 percent for all NRDs in the program).

Responses varied widely between the reporting years of 2017 and 2018 regarding use of the surface water permits. This was primarily due to 2018 being a very wet year. In 2018, about 20 percent of respondents reported using their surface water permit for irrigation. Of those who did not use their surface water permit, the vast majority reported “adequate rainfall” as the reason for non-use. In 2017 however, over 60 percent of respondents utilized their surface water permit for irrigation. Reasons for non-use in 2017 included “not enough water in the stream”, “used groundwater wells”, and “equipment issues”.

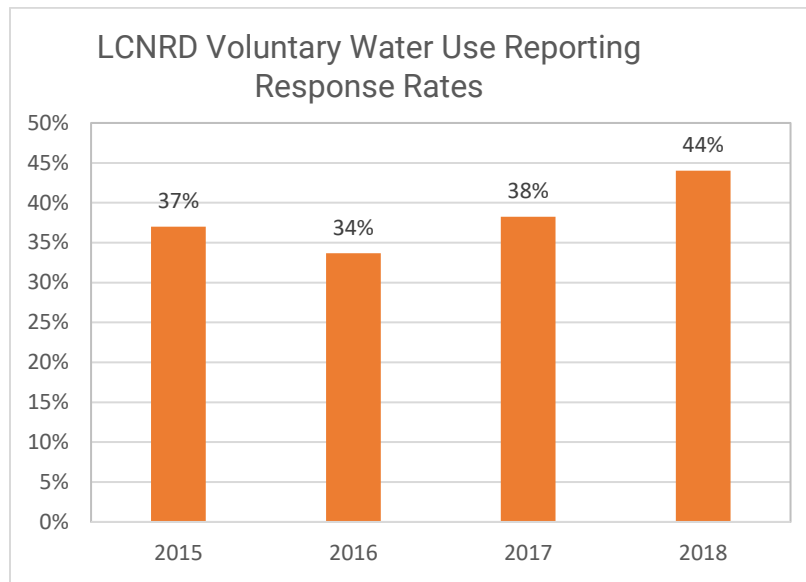


Figure 8. Voluntary water use reporting response rates for the LCNRD

Collaboration with other Entities

MISSOURI RIVER RECOVERY IMPLEMENTATION COMMITTEE

Objective 2.2 in the IMP and related action items outline specific activities for NeDNR regarding Missouri River activities. It was important to the stakeholders and the LCNRD that NeDNR share knowledge gained through participation in the Missouri River Recovery Implementation Committee (MRRIC), as long as Nebraska remains a participating member. For more information about MRRIC, please see the website at <https://www.nwo.usace.army.mil/mrrp/mrric/>.

Shuhai Zheng, PhD and Division Head of NeDNR's Engineering Division, provided representation for Nebraska at MRRIC meetings and conference calls during the IMP reporting period of 2017-2018. There were three meetings in 2018 (March, May and November) and two meetings in 2017 (August and October). Dr. Zheng reported that MRRIC's primary activities in the coming year include building interception rearing complexes for the endangered pallid sturgeon in the reach of the Missouri River below Kansas City, conducting an Environmental Impact Statement study for Ft. Peck reservoir alternate hydrographs, and maintaining existing emerging sandbar habitats for the U.S. Fish and Wildlife Service listed endangered Least Tern and the threatened Piping Plover.

Dr. Zheng noted that there have been no updates over the past two years on the US Army Corps of Engineers rule-making process regarding the potential to charge for surface water use from Lewis and Clark Lake. This topic was of particular concern to stakeholders during IMP development. The Cedar Knox Rural Water Project, which serves 880 rural customers and four communities, relies on surface water from Lewis and Clark Lake.

EASTERN NEBRASKA WATER RESOURCES ASSESSMENT

NeDNR continued to support the efforts of the Eastern Nebraska Water Resources Assessment (ENWRA) organization for the reporting period of 2017-2018. NeDNR staff attended meetings and workshops to stay up-to-date on ENWRA activities and studies, and to gain expertise on ENWRA data. A portion of ENWRA's work involves utilization of Airborne Electromagnetic (AEM) geophysical studies to assist in mapping of subsurface geology/hydrogeology in Eastern Nebraska. NeDNR's primary interest in this work is to increase understanding of the effectiveness of AEM studies in assessing hydrologic connection of aquifers and streams through groundwater modeling tools.

Technical Studies, Research and Projects

LOWER PLATTE MISSOURI TRIBUTARIES MODEL

The Department has completed the development of a regional numerical groundwater model for the Lower Platte and northern Missouri River Tributaries basins. The model is currently being used to assess changes in the extent of the hydrologically connected area. The model is also intended to support IMP monitoring and will be made available for use by NRDs upon completion through NeDNR's SUSTAIN tool (described below).

LOWER ELKHORN NRD AEM/MODELING STUDY

Additional modeling activities have been ongoing with the Lower Elkhorn NRD to evaluate approaches for future integration of Airborne Electromagnetic (AEM) data into the model. The first phase of these activities concluded in early 2019 and the second phase was initiated in mid-2019 and expected to continue through 2020. NeDNR will continue to work with the Lower Elkhorn NRD and other NRDs in the Lower Platte River Basin to explore the integration of AEM data into future model updates and releases.

NEDNR TECHNICAL ASSISTANCE TO CREATE LCNRD WELL HYDROGRAPHS

During IMP development, NeDNR developed a tool/program to automatically generate groundwater level hydrographs in spreadsheet format for the LCNRD. A series of 29 charts were created to show spring and fall well water levels from 1978 to 2014, as well as additional information about well location, well depth, well ID and aquifer characteristics. Figure 9 provides an example of the groundwater level charts created by this tool. The charts were provided to stakeholders during IMP development to be used as a reference in making decisions about goals and objectives. LCNRD had expressed interest in using the tool in-house to update with future well water level readings.

During the reporting period for this biennial review, NeDNR updated the tool for use by the LCNRD and wrote instructions for using the tool. The Python-based program and instructions were given to the LCNRD in early 2019. NeDNR has offered assistance to train LCNRD staff on use of the

tool, if this is necessary in addition to the written instructions. NeDNR has also agreed to assist LCNRD in updating the tool, as staff time allows, if program languages or software changes affect tool functionality.

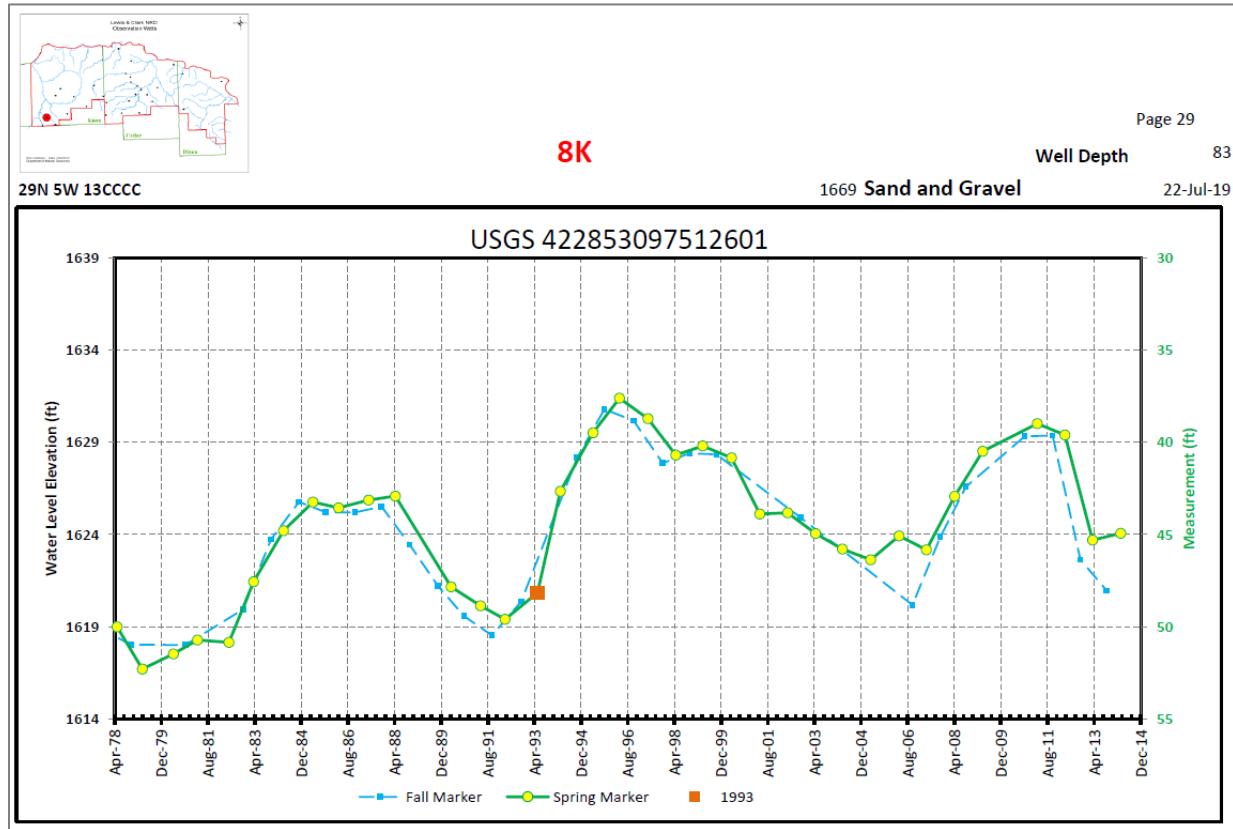


Figure 9. LCNRD well level hydrograph example automatically created using a NeDNR tool

NEBNSR'S INSIGHT TOOL FOR WATER BALANCE ANALYSES

The Integrated Network of Scientific Information and Geohydrologic Tools (INSIGHT) web portal at <https://nednr.nebraska.gov/INSIGHT/> is a water use, supply, and balance tool that was developed by NeDNR and released in 2014. INSIGHT aids water managers and other interested parties in better understanding current and future water demands, effectiveness of water management strategies, and critical areas of water shortage. The user can access information pertaining to water supplies and demands (precipitation, irrigation, hydropower, etc.), as well as view maps with associated charts that show overall water balance (current, near-term, or long-term) at a subbasin scale. A valuable feature of INSIGHT is that all the datasets that are used to compile the water balance analyses are also stored within the web portal and are available for download.

NeDNR will continue to update the current INSIGHT analysis and add other basins as new data become available. At this time, NeDNR has compiled data for the Lower Platte River, from North

Bend, NE, to Louisville, NE. It currently does not include the Missouri Tributaries basins, but these areas will be added to INSIGHT subsequent to the completion of the Lower Platte Missouri Tributaries models. The last major update for INSIGHT was the addition of data for the Republican River Basin in 2017.

NEDNR'S SUSTAIN TOOL FOR HYDROLOGIC MODELING ANALYSES

SUSTAIN stands for Sustainable Use Scenario Tool for Analysis and Informing Nebraskans. SUSTAIN is a tool which allows users to access land and water use data and test management actions for impact on streamflow and groundwater supplies. NeDNR developed SUSTAIN to increase transparency with NRDs and water managers by allowing them access to the data and models NeDNR uses to measure long-term impact of water use on streamflow. SUSTAIN allows users to quickly and easily look at historical land use and water use data. It also allows users to test possible management actions in NeDNR's groundwater models to determine the impact to aquifers and streams and give better insight into best management practices. At the current time, SUSTAIN is currently available for the Upper Niobrara White model area but will be expanded to Eastern Nebraska and beyond as data become available.

Education and Outreach

PUBLIC OUTREACH EVENTS

NeDNR has continued to actively engage with partnering local natural resources agencies across the state through water planning, floodplain management, and field office activities. In addition, the Department continues to seek opportunities to interact with stakeholders through participation in a wide variety of public outreach events. Where applicable, the Department utilizes interactive exhibits that include a touchscreen water quiz, physical models (groundwater flow model and flood simulation) and interactive web applications (Figure 10). In 2017 and 2018, the Department participated in the following statewide or regional events:

- Husker Harvest Days,
- Nebraska State Fair,
- Nebraska Women in Agriculture conference,
- Nebraska Association of Resource Districts conferences,
- Nebraska Governor's Ag conference (2017 only)
- Nebraska State Irrigation Association/Nebraska Water Resources Association joint convention, and
- Nebraska Planning and Zoning Association/American Planning Association–Nebraska Planning conference.

In 2018, the Department also participated in the following community events:

- Various, locally-sponsored water tours, and
- World O! Water in Papillion.

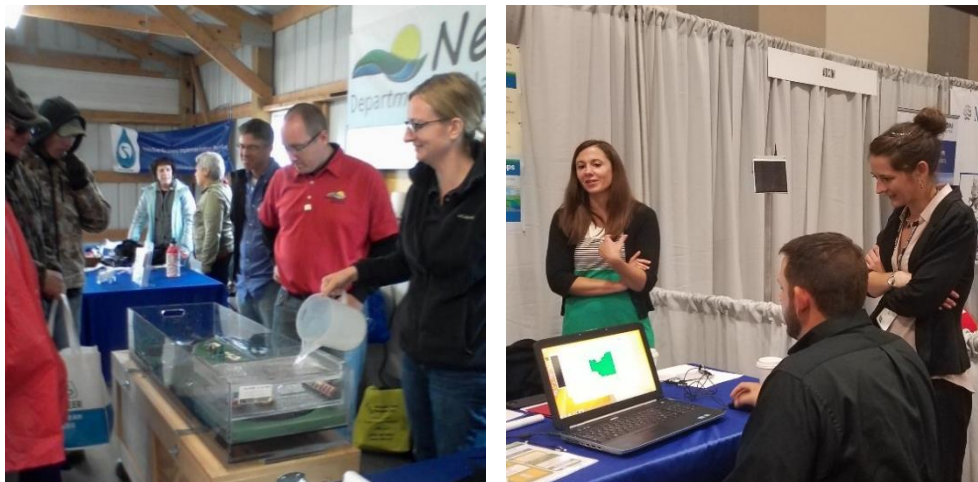


Figure 10. Department staff demonstrating physical models (left) and interactive web applications (right) at public outreach events

EDUCATIONAL WEB APPLICATIONS

In 2017, NeDNR released the first applications in a three-part series of interactive educational applications called Stream Simulations (Figure 11). The applications introduce users to basic surface water and groundwater interaction principles. The first application illustrates how water flows between a stream and an adjacent aquifer, and how precipitation and soil texture affect runoff, recharge and streamflow.

In 2018, NeDNR published a second interactive web application which shows the relationship between groundwater pumping and stream depletions under different hydrologic systems—a gaining stream, a losing stream, and a disconnected stream. It also shows how pumping can change the connectivity of a stream to its adjacent aquifer. Depending on which simulation they are exploring, users can change water table levels, precipitation intensity, soil texture, well location, or pumping intensity. The applications also feature a tutorial and optional voice narration.

Both applications can be accessed on NeDNR's website, at <https://dnr.nebraska.gov/water-planning/education>. NeDNR also has an offline, portable version of each application that can be taken to public outreach events. NeDNR can provide a copy of the offline version to an NRD for its own outreach use upon request.

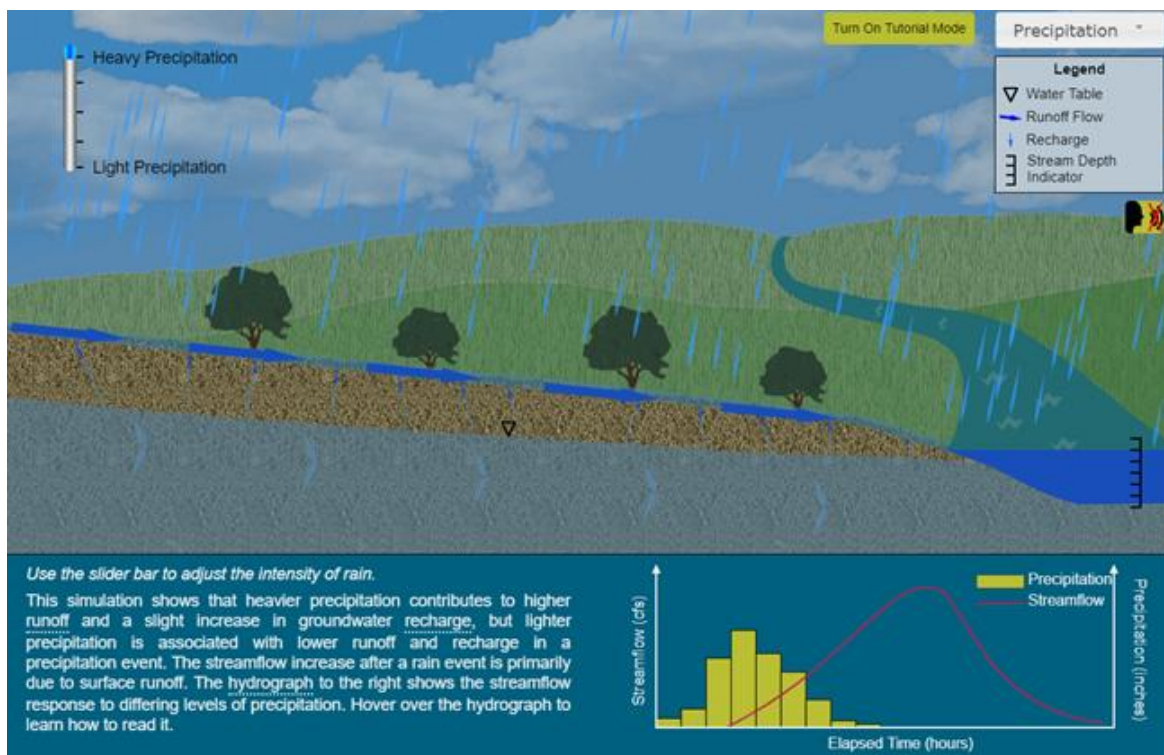


Figure 11. Screenshot of NeDNR's "Stream Simulations" interactive web application.

Progress towards Goals and Objectives of the IMP

The following sections identify action items that were worked on by NeDNR during the reporting period. These actions help LCNRD and NeDNR make progress, in incremental steps, towards achieving the goals and objectives of the IMP.

GOAL 1: DEVELOP AND MAINTAIN A DISTRICT-WIDE WATER INVENTORY

- Objective 1.1. Create and maintain a comprehensive database of groundwater and surface water
 - 1.1.1 Compile and update information concerning streamflow, surface water uses and hydrologically connected areas.
 - 1.1.5 Update hydrographs for groundwater wells monitored.
- Objective 1.2. Address data gaps in monitoring networks.
 - 1.2.1 Implement and maintain a voluntary water use reporting system for surface water users.
 - 1.2.2 Evaluate the need for new stream or well level gages, and the best location for these.
- Objective 1.3. Improve delineations of hydrologically connected groundwater and surface water
 - 1.3.1 Develop groundwater models for Eastern Nebraska to further understanding of hydrologically connected areas.
 - 1.3.2 Assess benefits/limitations of using remotely accessed electromagnetic data to aid interpretation of hydrologically connected areas.

GOAL 2: PROTECT EXISTING USERS WHILE ALLOWING FOR FUTURE WATER DEVELOPMENT

- Objective 2.1. Collaborate with local, state, and federal entities to better manage hydrologically connected groundwater and surface water.
 - 2.1 Stay up-to-date on USFWS, USACE and NPS water management efforts that may affect LCNRD and to facilitate compliance with state and federal laws.
- Objective 2.2. Maintain and Increase knowledge about activities along the Missouri River.
 - 2.2.1 Continued Department participation in MRRIC as long as Nebraska remains a participating member.
 - 2.2.2 Coordination to disseminate pertinent information to the District regarding activities along the Missouri River.
 - 2.2.3 Continued monitoring of USACE potential to charge for surface water use from storage in Lewis and Clark Lake.

GOAL 3: INCREASE PUBLIC AWARENESS AND UNDERSTANDING OF INTEGRATED WATER MANAGEMENT

- Objectives 3.2. Expand public outreach programs related to integrated water management.
 - 3.2.2 Develop informational materials about integrated water management and, as needed, other groundwater and/or surface water related topics affecting the District.

Jointly Identified Actions Items for Next Two Years

The LCNRD and NeDNR jointly identified actions that NeDNR will work on during the next two years, and report on at the next biennial review. These actions are listed below.

SURFACE WATER MONITORING ACTIONS

NeDNR will continue or initiate the following activities pertaining to surface water monitoring:

- Mapping and tracking of new surface water irrigated acres, including requirements of new applicants to file a project map prior to obtaining a surface water permit
- Tracking and reporting of surface water permit activities including new permits, cancelled permits and transfers
- Administration of surface water rights according to state law, including rules for surface water transfers
- Annual implementation of the voluntary water use reporting program
- Surface water pump field inspections
- Continue joint funding with the LCNRD for the Bow Creek near Wynot streamgauge maintenance through 2021.
- Assess new opportunities to enhance streamgauge network, as these become available

COLLABORATION WITH OTHER ENTITIES

NeDNR will collaborate with local, state and national entities, by continued participation in the following groups:

- The Missouri River Recovery Implementation Committee (MRRIC) meetings and events, and will provide updates on activities that affect the LCNRD.
- The Eastern Nebraska Water Resources Assessment (ENWRA) meetings, workshops and other activities.

TECHNICAL PROJECTS AND STUDIES

NeDNR will continue to work on the following technical projects and studies:

- Development of the Lower Platte Missouri Tributaries model, including refinement of hydrologically connected area delineations; convey progress and outcomes to LCNRD
- Pilot projects such as the Lower Elkhorn NRD study, to assess Airborne Electromagnetic (AEM) data incorporation into NeDNR models
- Training and support for LCNRD staff, as needed and as staff time permits, for the well hydrograph tool that NeDNR developed for LCNRD
- Upgrades to NeDNR's INSIGHT and SUSTAIN web tools, expanding the network to Eastern Nebraska as data become available.

EDUCATION AND OUTREACH

NeDNR will continue or initiate the following activities pertaining to education and outreach:

- Participation in state and local public outreach events
- Development of interactive web tools to educate on groundwater and surface water interactions
- Specific work with LCNRD to develop a joint educational handout on Integrated Water Management. The handout will be used by both entities as an education requirement for new surface water or groundwater uses, as specified in the IMP.