



# Annual Review of Availability of Hydrologically Connected Water Supplies

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## 1. Introduction

The Nebraska Department of Natural Resources (Department) is tasked annually to review, and as necessary, evaluate the impacts of existing and new surface water and groundwater uses in each of the State's river basins. Section 46-713 of the Ground Water Management and Protection Act (Act) (*Neb. Rev. Stat. §§ 46-701 through 46-756*) outlines the requirements of the Department to evaluate the expected long-term availability of hydrologically connected water supplies. The Department is not required to evaluate river basins, subbasins, or reaches for which an integrated management plan is being developed or already exists. However, the Department may re-evaluate a basin, subbasin, or reach if there is reason to believe that a reevaluation may lead to a different determination as to whether the river basin, subbasin, or reach is fully or overappropriated. Basins, subbasins, and reaches that currently are designated as fully appropriated or overappropriated are identified in Figures 1 and 2.

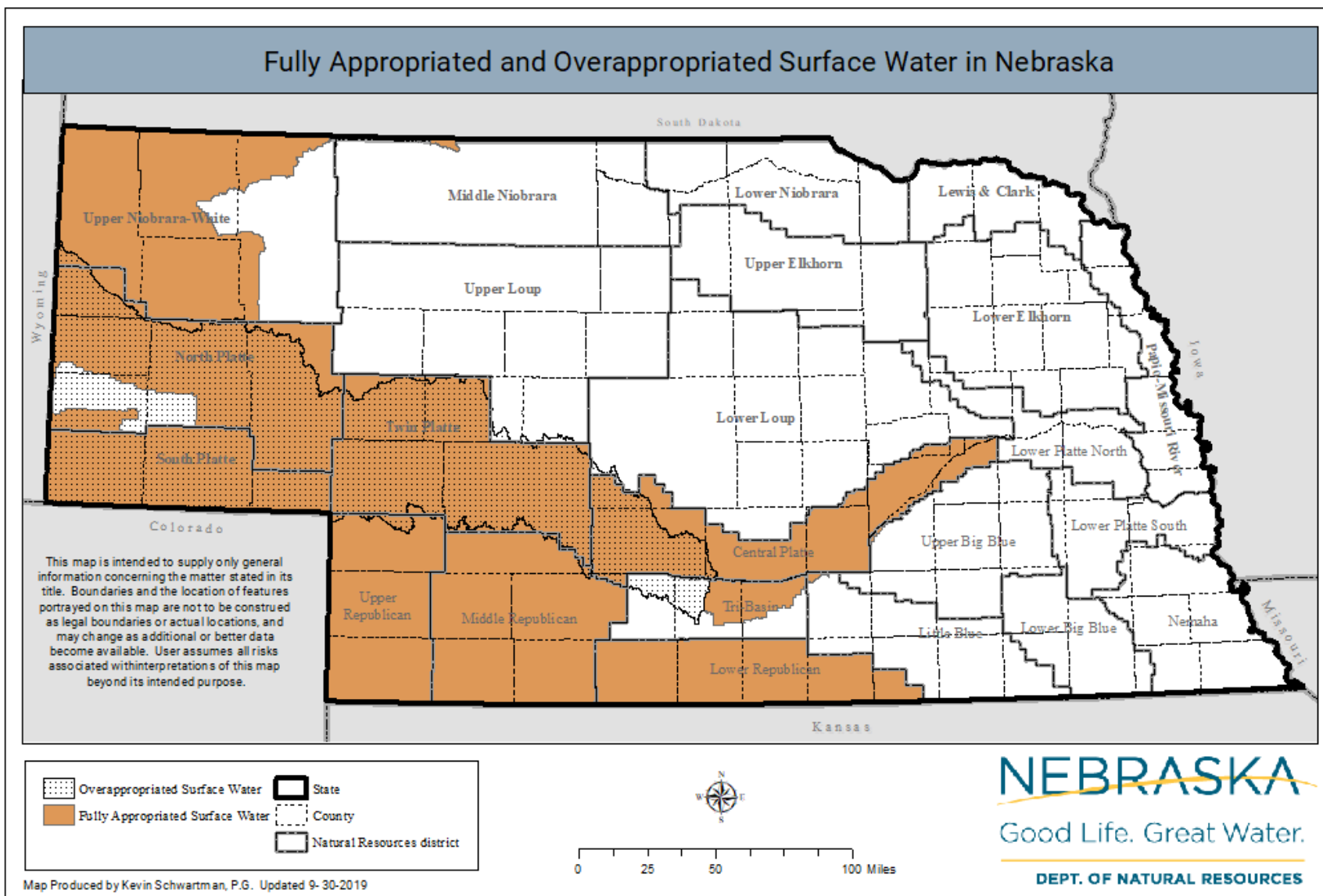


Figure 1. Areas designated as fully appropriated or overappropriated basins, subbasins, and reaches since the passage of LB 962.

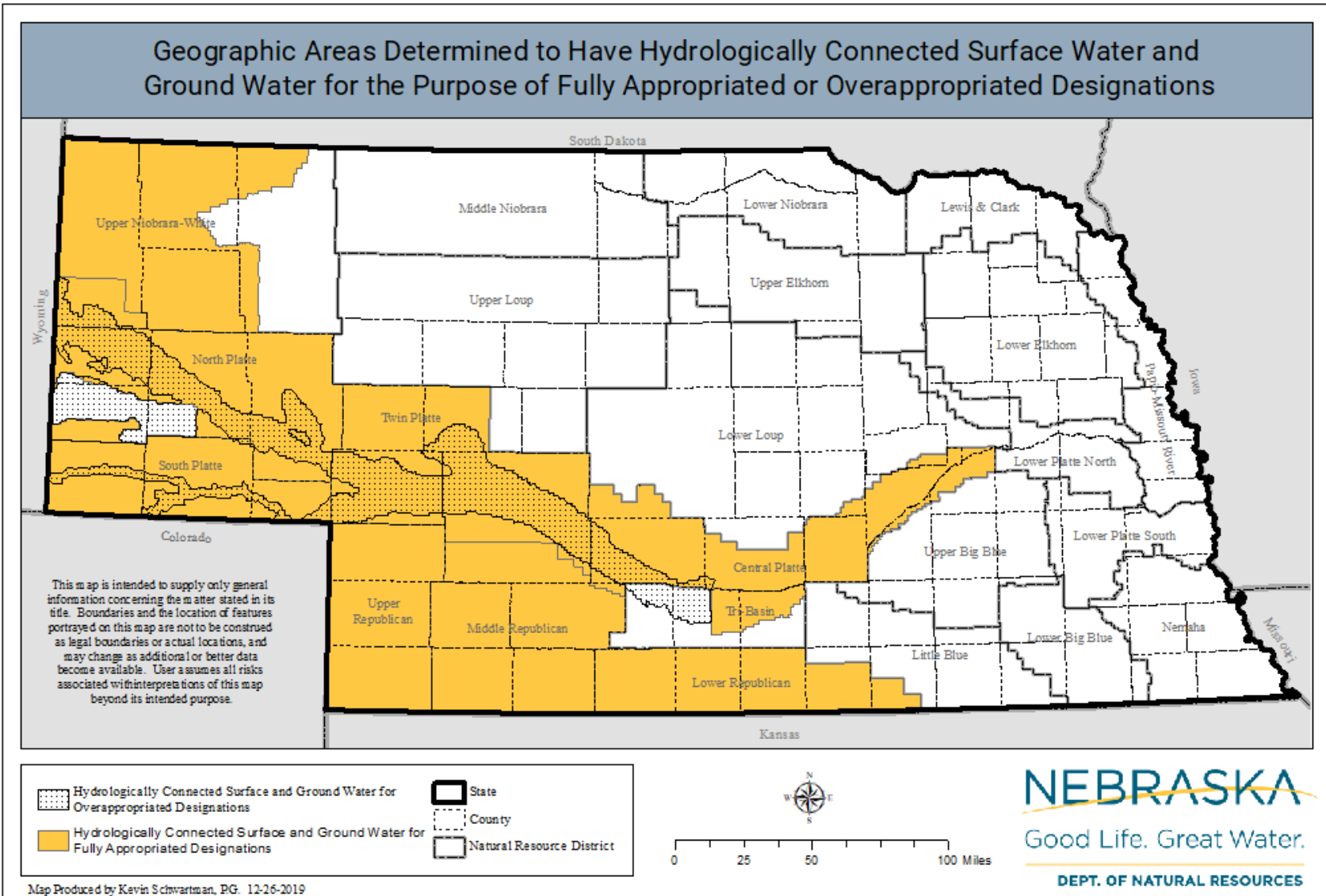


Figure 2. Areas designated as hydrologically connected to fully appropriated or overappropriated basins, subbasins, and reaches since the passage of LB 962.

The Department's annual review uses the best available science and methods to apply the Department's current rules to examine the expected long-term availability of surface water supplies and hydrologically connected groundwater supplies. The most recent full evaluation, published December 30, 2016 (2017 report), examined the expected long-term availability of surface water supplies and hydrologically connected groundwater supplies of the Blue River Basins, the Lower Niobrara River Basin, the Lower Platte River Basin, and the Missouri Tributary Basins. The 2017 report covered a 20-year period from January 1, 1995 through December 31, 2015, which incorporated new development and water administration that occurred during that time. The Department concluded that none of the basins, nor any of the subbasins or reaches within the basins evaluated, were fully appropriated and that the prior preliminary determination that none of the basins were fully appropriated would not change based on reasonable projections of future development in the basins.

The analyses performed for the fully appropriated basin evaluation are reflective of the Department's current rules, which primarily focus on assessing the water availability for junior irrigation rights as determined through water administration records. Details on the methodology used for the evaluation can be found in the 2017 report, available at <https://dnr.nebraska.gov/water-planning/annual-evaluation-availability-hydrologically-connected-water-supplies-fab-report>. There are other approaches to evaluate hydrologically connected water supplies, such as the Department's INSIGHT methodology, which assesses available water supplies, major demand categories, and water balances within basins across the state (<http://nednr.nebraska.gov/INSIGHT/>). The INSIGHT methodology provides a more comprehensive assessment that can be used to support water management decisions and guide planning processes; however, these results may vary greatly when compared to the results following from the current rule. Therefore, a basin that is not fully appropriated under the current rule could still see water supply imbalances when a more comprehensive analysis, such as the INSIGHT methodology, is applied.

Currently, all 23 Natural Resources Districts (NRD) in the State are engaged in some phase of integrated management planning with the Department, that covers all major basins, subbasins, and reaches with hydrologically connected water supplies. The Act directs the Department to forego an annual evaluation for those areas participating in or developing an integrated management plan unless there would be reason to believe the previous year's evaluation may change. To determine if there would be any changes, the Department reviewed previous evaluations and any subsequent changes that have occurred that might impact this year's analysis. Given the results of the 2017 evaluation that examined the 20-year period ending in 2015, water administration activities, active surface water rights, and groundwater well development, the Department does not find it necessary to reevaluate any of these basins at this time for the 2023 report.

Even though all NRDs/Basins are currently involved in integrated management planning activities, basins may be evaluated in future years if the extent of the hydrologically connected 10/50 area changes based on new data and model results, if there are significant water related permitting changes, if there are changes in water administration activities, or if other changes might lead to a different determination than was reached in the 2017 evaluation.

## 2. Review of Previous Annual Evaluation Results

In short, the Department's rule for the evaluation (regulation Title 457 Neb. Admin. Code Chapter 24) states that the surface water supply is deemed to be insufficient if, at current levels of development, the most junior irrigation right in a basin, subbasin, or reach has been unable to divert sufficient surface water over the last 20 years to provide 85 percent of the amount of water a corn crop needs during the irrigation season (May 1 through September 30), or if the most junior irrigation right in a basin, subbasin, or reach is unable to divert 65 percent of the amount of water a corn crop needs during the key growing period (July 1 through August 31). It is referred to as the "65/85 rule." The evaluation must also consider groundwater use in the hydrologically connected area, surface water administration, and future potential development.

The following is a summary of the analysis of the basins conducted for the most recent full evaluation (2017 report). Additional detailed information can be found in the 2017 Fully Appropriated Basin Report, available from the Department.

## 2.1 Blue River Basins

The Blue River Basins are located in south-central Nebraska and consist of all of the surface areas that drain into the Big Blue River and the Little Blue River and all aquifers that impact surface water flows in the basins (Figure 3). The Department reached a preliminary conclusion that no portion of these basins is currently fully appropriated under the current rule. The analysis of lag depletions of current development indicated a reduction in streamflow of 12 cfs in 25 years for the Big Blue River Basin and 17 cfs in 25 years for the Little Blue River Basin. The analysis of the impacts of future development based on current development trends showed an additional reduction in streamflow of 3 cfs in 25 years in the Big Blue River Basin and 10 cfs in 25 years for the Little Blue River Basin. The Department determined that the near-term and long-term availability of surface water for diversion for each basin exceeds the requirements of the 65/85 rule. The Department has also determined that based on current information, if no additional legal constraints are imposed on future development of hydrologically connected surface water and groundwater, and reasonable projections are made about the extent and location of future development, this preliminary conclusion would not change to a conclusion that the basin is fully appropriated.

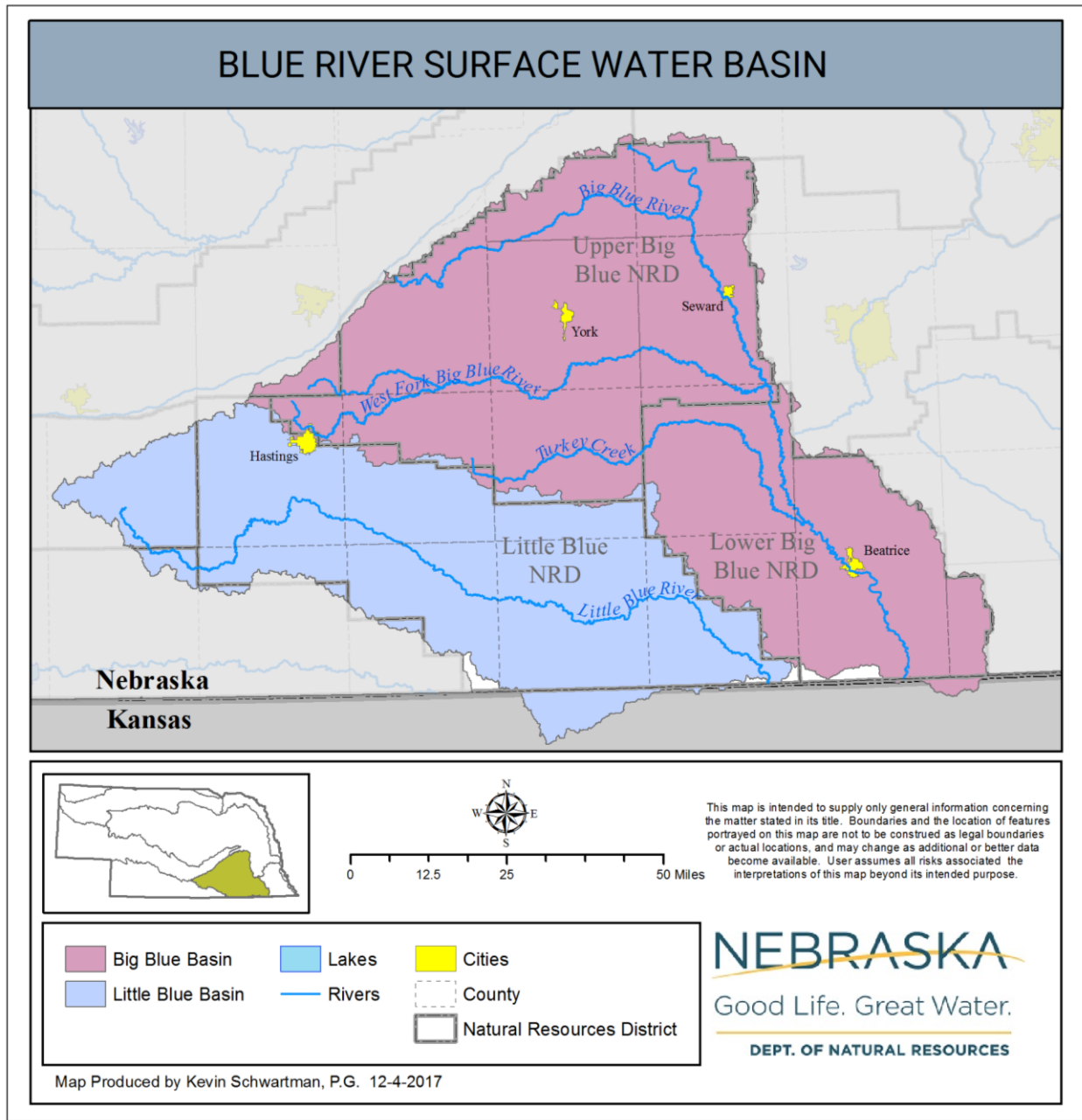


Figure 3. Blue River Basins, general basin map.

## 2.2 Lower Niobrara River Basin

The Lower Niobrara River Basin located in the northern portion of Nebraska consists of all surface areas that drain into the Niobrara River downstream of the Mirage Flats Irrigation District and all aquifers that impact surface water flows of the basin (Figure 4).



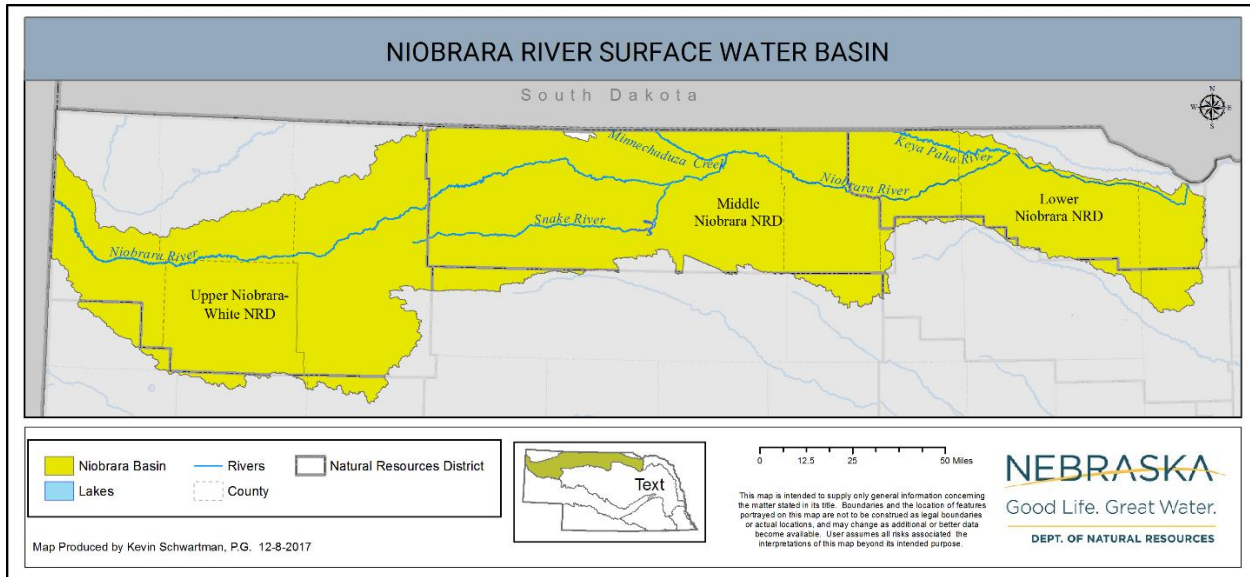


Figure 4. Lower Niobrara River Basin, general basin map.

The Upper Niobrara-White Model and CENEB Model were used to determine the 10/50 area and lag depletions due to current and projected future well development. The analysis of lag depletions of current development for the Lower Niobrara Basin indicated a reduction in streamflow of 29 cfs in 25 years. The analysis of the impacts of future development on the Lower Niobrara Basin based on current development trends indicated an additional reduction in streamflow of 84 cfs in 25 years. The Department reached a preliminary conclusion that no portion of the basin is fully appropriated under the current rule. The long-term availability of surface water for diversion exceeds the number of days necessary to satisfy the 65/85 rule, and the existing instream flow appropriations in the basin have not been eroded. The 2015 priority date instream flow permit for the lower portion of the Basin, approved in 2017, was not considered for this report but will be for future updates, if necessary. The Department also determined that based on current information, if no additional legal constraints are imposed on future development of hydrologically connected surface water and groundwater, and reasonable projections are made about the extent and location of future development, this preliminary conclusion would not change to a conclusion that the basin is fully appropriated.

### 2.3 Lower Platte River Basin

The Lower Platte River Basin located in the central and eastern portions of Nebraska consists of all surface water areas that drain into the Platte River from its confluence with the Loup River to its confluence with the Missouri River, including those areas that drain into the Loup River and the Elkhorn River, and all aquifers that impact the basin's surface water flows (Figure 5).

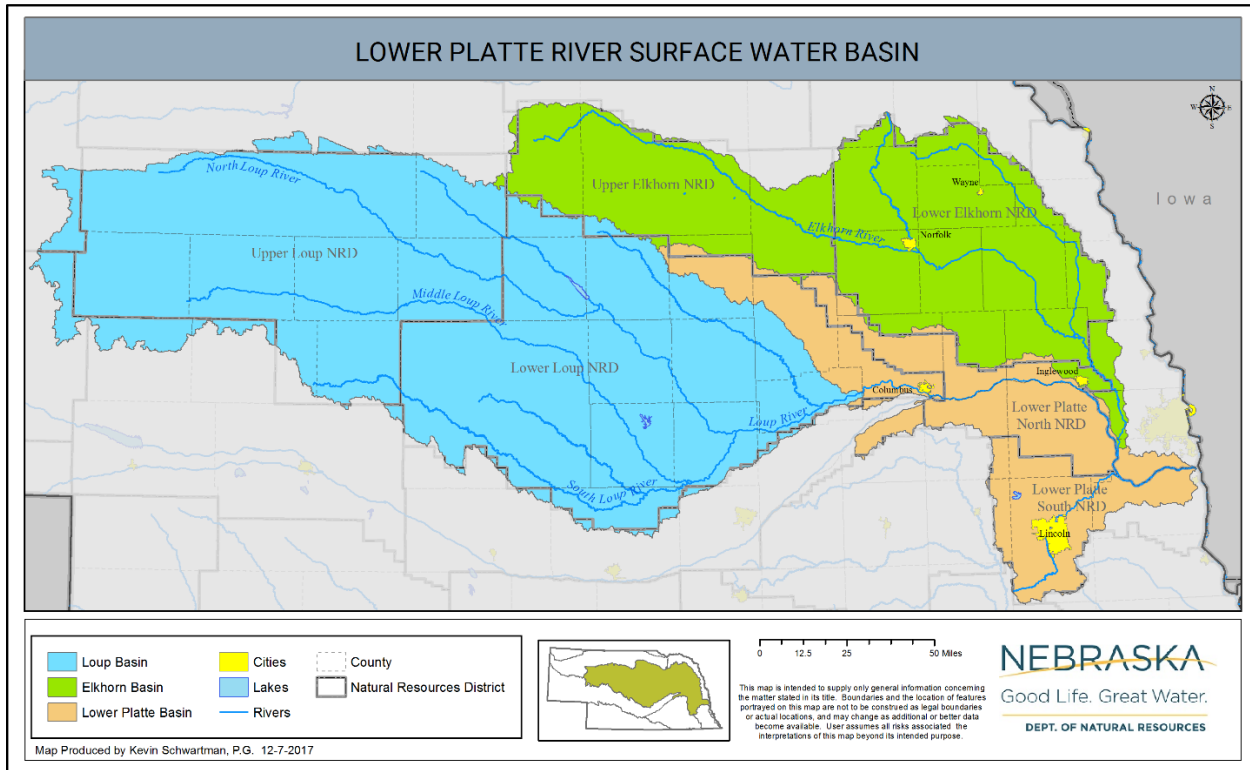


Figure 5. Lower Platte River Basin, general basin map.

The Department utilized the CENEB model to perform calculations of 10/50 areas and lag depletions for the Loup River Basin and upper portions of the Elkhorn River Basin. At the time of the 2017 report, no sufficient numerical groundwater model was available in the remaining portions of the Lower Platte River Basin; therefore, SDF methodology<sup>1</sup> was used to determine the 10/50 area and depletions for those areas. The analysis of the lag

<sup>1</sup> A description of the SDF methodology can be found on pages 18 and 19 of Nebraska Department of Natural Resources. (2017). *2017 Annual Evaluation of Availability of Hydrologically Connected Water Supplies*. Retrieved from <https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/statewide/FAB/2017AnnualReport/2017FinalFAB.pdf>

effects of current development indicated a reduction in streamflow by 337 cfs in 25 years. The analysis of the impacts of future development indicated an additional reduction in streamflow of 122 cfs in 25 years. The Department reached a preliminary conclusion that no portion of the basin is fully appropriated under the current rule. The long-term availability of surface water for diversion exceeds the number of days necessary to satisfy the 65/85 rule, and the instream flow appropriations in the basin (the junior rights for which administration occurs in the non-irrigation season) have not been eroded. The Department also determined that based on current information, if no additional legal constraints are imposed on future development of hydrologically connected surface water and groundwater, and reasonable projections are made about the extent and location of future development, this preliminary conclusion would not change to a conclusion that the basin is fully appropriated.

#### 2.4 Missouri Tributary Basins

The Missouri Tributary Basins located in the north-central and eastern portions of Nebraska consist of all surface areas that drain directly into the Missouri River (Figure 6), except for the Niobrara River and Platte River basins, and all aquifers that impact surface water flows of the basins.

At the time of the 2017 report, no sufficient numerical groundwater model was available in the Missouri Tributary Basins to determine the 10/50 area or lag effect of current development. The non-glaciated area surrounding the headwaters of Bazile Creek is the only portion of the basins where the principal aquifer is both present and in hydrologic connection with the streams. Therefore, the 10/50 area was delineated using the SDF methodology and an analysis of the lag effects of current and potential future development was performed only on that portion of the Missouri Tributary Basins.

The Bazile Creek subbasin analysis indicated a streamflow reduction by 7 cfs in 25 years. The subbasin's future development impact analysis based on current development trends indicated an additional reduction in streamflow of 21 cfs in 25 years. The Department reached a preliminary conclusion that no portion of the Missouri River Tributary Basins is fully appropriated under the current rule. The near-term

availability of surface water for diversion exceeds the number of days necessary to satisfy the 65/85 rule. For junior irrigators in the Bazile Creek subbasin, future water supplies estimates could not be projected due to limited surface water administration during the past 20 years. For all other subbasins, the inability to calculate the lag effects of existing and future groundwater development prohibited a determination of future water supplies for junior irrigators at that time. Even though the long-term water supplies were not estimated, the current number of days in which surface water was available for diversion far exceeds the number of days necessary for the 65/85 rule.

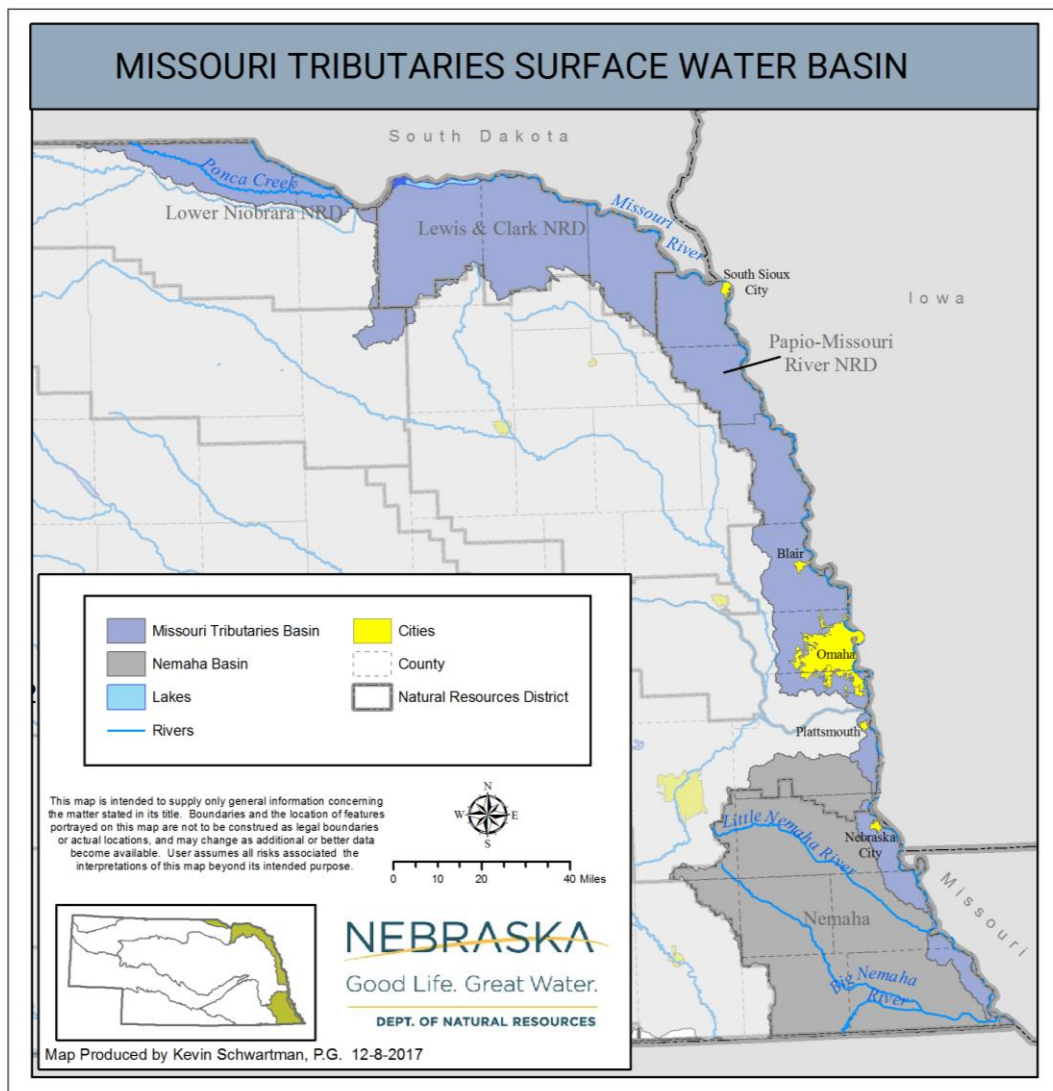


Figure 6. Missouri Tributary Basins

Table 1 and Table 2 (following) illustrate the 65/85 rule in the designated basins. Table 1 shows the 65 percent data when surface water is available for diversion July 1 – August 31, while Table 2 shows the 85 percent data when surface water is available for diversion May 1 – September 30. Both are based on the basins evaluated for the 2017 report.

Column 1 of each table shows the required number of days within each basin to meet the net corn crop irrigation requirement. Column 2 shows the number of days that surface water is available for diversion given the current level of water use development. Column 3 adds the additional water use due to the lag effect of currently existing groundwater wells. Column 4 adds additional water use to due projected future development and the lag impact. Comparing Column 1 to Columns 2, 3, and 4 give the difference between what is needed to meet water use demands and what exists or is projected to exist to meet water use demands.

**Table 1.** Summary of comparison between the number of days required to meet 65 percent of the net corn crop irrigation requirement and number of days in which surface water is available for diversion, July 1 – August 31, from the analysis conducted for the 2017 report (based on calendar year 2015).

	<b>Days Necessary to Meet 65% of Net Corn Crop Irrigation Requirement</b>	<b>Average Number of Days Available for Diversion at Current Development</b>	<b>Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts</b>	<b>Average Number of Days Available for Diversion with Future Development and 25 Years of Lag Impacts</b>
Big Blue River Basin	23.9	49.9	48.4	48.2
Little Blue River Basin	25.7	53.5	51.2	49.1
Lower Niobrara River Basin	23.6 – 36.9	43.0	42.9	42.7
Lower Platte River Basin upstream of North Bend, including the Loup River Basin	27.9	42.2	40.3	39.1
Lower Platte River Basin downstream of North Bend and upstream of Louisville including the Elkhorn River Basin	27.9	43.1	40.7	39.8
Missouri Tributary Basins	14.1 – 26.6	60.6	Not Calculated <sup>°</sup>	Not Calculated <sup>°</sup>

<sup>°</sup> This number could not be calculated due to a lack of geologic data, hydrologic data, or surface water administration.

**Table 2.** Summary of comparison between the number of days required to meet 85 percent of the net corn crop irrigation requirement and number of days in which surface water is available for diversion, May 1 – September 30, from the analysis conducted for the 2017 report (based on calendar year 2015).

	<b>Days Necessary to Meet 85% of Net Corn Crop Irrigation Requirement</b>	<b>Average Number of Days Available for Diversion at Current Development</b>	<b>Average Number of Days Available for Diversion at Current Development with 25 Years of Lag Impacts</b>	<b>Average Number of Days Available for Diversion with Future Development and 25 Years of Lag Impacts</b>
Big Blue River Basin	31.3	138.6	137.0	136.8
Little Blue River Basin	33.6	141.0	135.4	132.0
Lower Niobrara River Basin	30.9 – 48.3	115.5	115.0	111.9
Lower Platte River Basin upstream of North Bend, including the Loup River Basin	36.5	119.4	116.2	114.0
Lower Platte River Basin downstream of North Bend and upstream of Louisville including the Elkhorn River Basin	36.5	120.8	117.0	115.5
Missouri Tributary Basins	18.4 – 34.7	151.7	Not Calculated <sup>c</sup>	Not Calculated <sup>c</sup>

<sup>c</sup> This number could not be calculated due to a lack of geologic data, hydrologic data, or surface water administration.

### 3. Integrated Management Planning Activity

Integrated management planning activities are occurring across the entire state (Figure 7). Both required and voluntary plans are in place. Two additional voluntary plans are in development. Each of the existing plans, required or voluntary, is reviewed regularly by the Department and an NRD to determine if any changes are necessary. A complete summary of the planning activities occurring within each basin can be found in the Department's Annual Report and Plan of Work for the Nebraska State Water Planning and Review Process submitted to the Nebraska Legislature in Summer 2022 (<https://dnr.nebraska.gov/publications>).

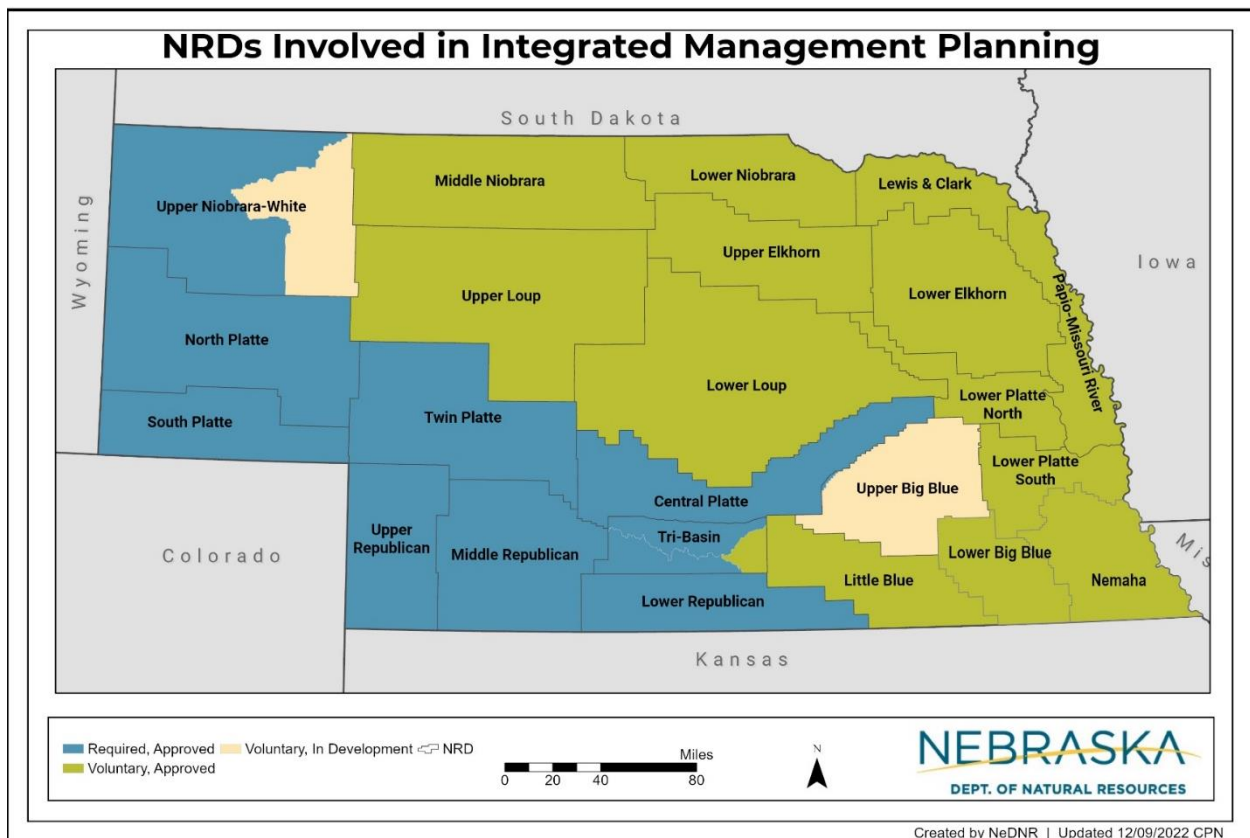


Figure 7. Statewide integrated management planning status.

The Department continues to maintain its commitment to managing Nebraska's water resources by using sound science to develop the best available data. Because water management in Nebraska is integrated between groundwater and surface water, the



Department and its partners rely on various models in their efforts, and continually work to review and update those models as necessary with current data and the best available science.

Currently, the Department and our NRD partners are working to update several models across the State. The new Blue Basin Model is in the final stages of development and is expected to be completed in 2023. In the Niobrara River Basin, a model is under development for the area of the river downstream of the Mirage Flats Diversion Dam and is expected to be completed in 2023. In the Lower Platte Basin, several subregional models are under development and are planned to be used to update the Lower Platte Missouri Tributaries model. The Lower Elkhorn NRD subregional model is complete, and the Department is beginning to perform analysis of stream and aquifer interaction. The Lower Platte North, Lower Platte South and Pappio-Missouri NRDs are currently developing the necessary model files from the Airborne Electro-Magnetic survey data to create subregional models. Each of these new models are being developed using the most current groundwater model actually supported by the United States Geological Survey, Modflow 6.

#### 4. Summary

The Department is currently participating in the development or implementation of an integrated management plan with each of the twenty-three natural resources districts in the state. The Department is not required to evaluate river basins, subbasins, or reaches for which an integrated management plan is being developed or already exists. The 2017 review and evaluation, published December 30, 2016, examined the expected long-term availability of surface water supplies and hydrologically connected groundwater supplies of the Blue River Basins, the Lower Niobrara River Basin, the Lower Platte River Basin, and the Missouri Tributary Basins. The Department concluded in that previous evaluation that none of the basins, subbasins, or reaches were fully appropriated and that the preliminary determination would not change based on reasonable projections of future development in the basins. The Department has reviewed available data and information and determined that a reevaluation of the expected long-term availability of surface water

supplies and hydrologically connected groundwater supplies likely would not result in a different determination of whether any river basin, subbasin, or reaches are fully appropriated or overappropriated. The Department will continue to annually review available data and information and may reevaluate a basin, subbasin, or reach if there is reason to believe that a reevaluation may lead to a different determination.