LOWER LOUP
NATURAL RESOURCES DISTRICT

2024 Spring Static Water Level Monitoring Program

2024 Static Water Level Summary

LLNRD staff collected static water levels (SWL) on 448 irrigation and monitoring wells from March 25 to April 11, 2024. Compared to Spring 2023, 169 wells (37.72%) reported a decline in water levels, with an average change of -0.79 ft. 277 wells (61.83%) had a higher water level reading compared to spring 2023, with an average change of 0.80 ft. Two wells (0.45%) reported no change from spring 2023. Overall, this is a -0.19 ft average SWL decline.

Six counties averaged a positive SWL change and the remaining nine decreased on average. Merrick County reported a 100% decrease (5/5). Sherman (14/16), Boone (23/27), Buffalo (19/23), Platte (37/46), and Nance (23/30) Counties all showed declining SWL at 77% or greater of wells measured. No measurements were taken in Hall County while only one measurement was taken in Butler County. The largest single well decline was -5.50 ft in Platte County and the largest single well increase was 9.73 ft in Boone County, approximately 19 miles away.

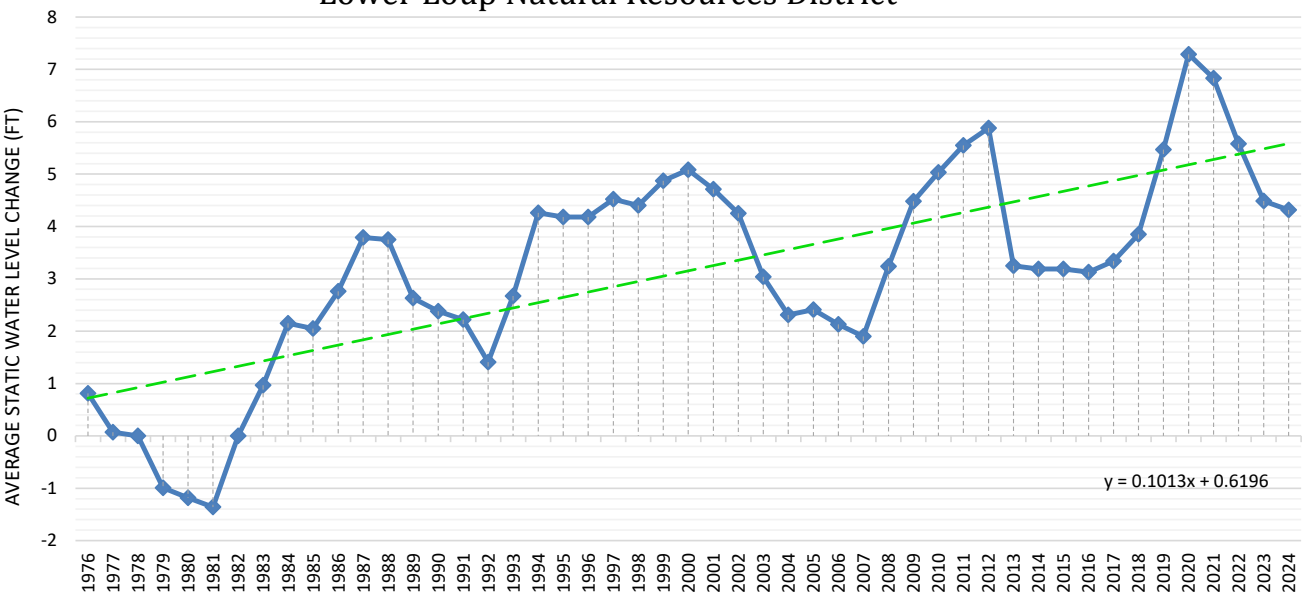
165 SWL locations measured in Spring 2024 have a historical record dating back to at least 1982, the baseline date for water level comparisons per the LLNRD Groundwater Management Plan. The largest concentration of decreasing water levels continues to be found south of the Loup River as well as in Buffalo and southern Custer Counties, south of the South Loup River. The largest decrease in water level between 1982 and 2004 is -12.57 ft in Merrick County. Increases in water levels continue in the North Loup River Groundwater Transfer Basin where recharge from existing canals and surface water irrigation is abundant. The largest SWL increase from 1982 to 2024 is 37.84 ft in Valley County.

In the district-wide *Static Water Level Change* and *Trend* maps, SWL measurement locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2019 through Spring 2024) were not included in interpolation analyses. The inverse distance weighted (IDW) spatial interpolation method was used with default settings. IDW assumes that wells close to one another have more similarities than those that are farther apart. The area between two measured points is assigned a value based on the trends calculated on all other wells in proximity. The software used for all maps in this report was Esri ArcGIS Pro v3.2.2 with the Spatial Analyst extension.

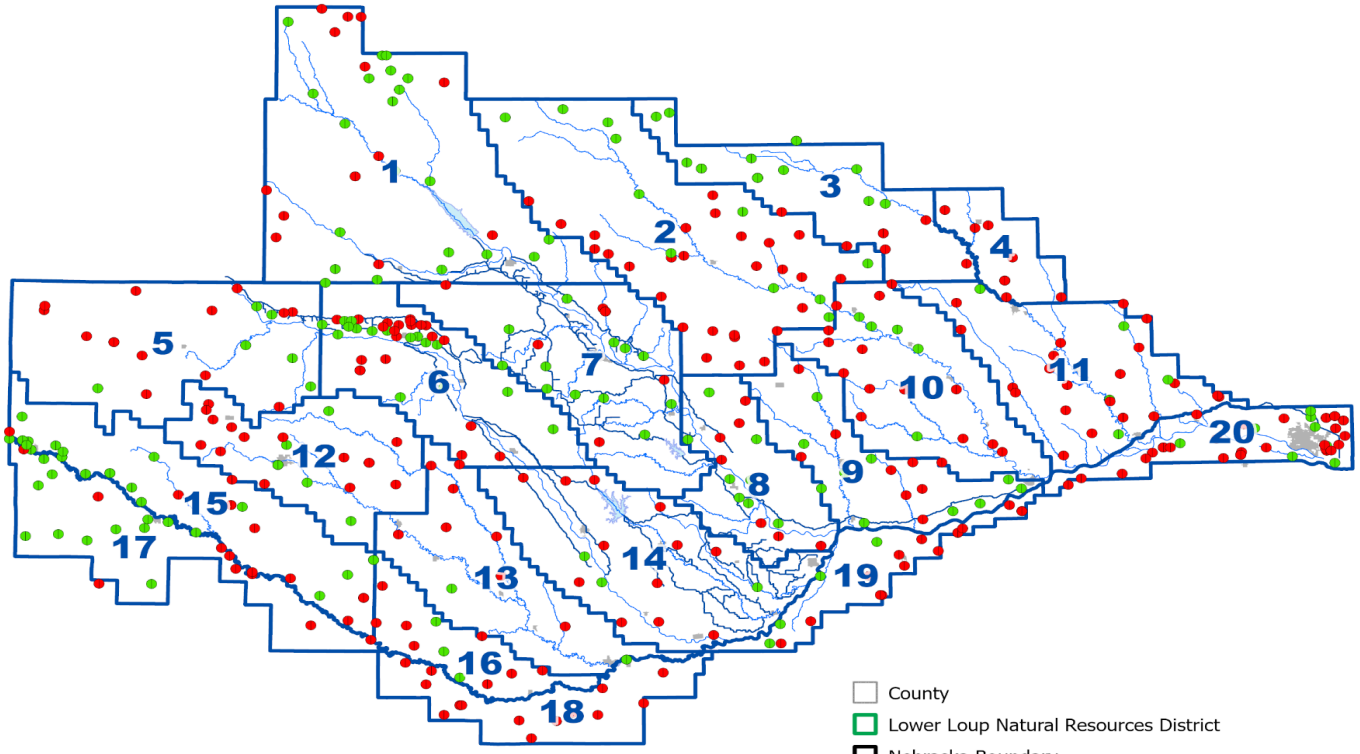
In the *Static Water Level Change [All/number] Years* map, negative values indicate that the groundwater level has gone down. The *Static Water Level Trend All Years* map represents the linear regression coefficient from the observed depth to SWL measurements plotted back to spring 1982 or when first available thereafter. Negative trend values indicate a decrease in depth to water, which represents an increase in water level over time. Furthermore, trend values can be interpreted as an expected water level increase or decrease in feet.

These district-wide maps are further broken down to show change and trend by county and Quantity Area. 20 Quantity Areas were established in 2023 by the LLNRD Board of Directors from the previous 10 Groundwater Quantity Management Areas. These larger scale maps utilize all 448 measurements available in 2024 to show individual changes in measurement sites between spring 2023 and spring 2024 and trend graphs going back to the baseline 1982 measurement and earlier where data is available.

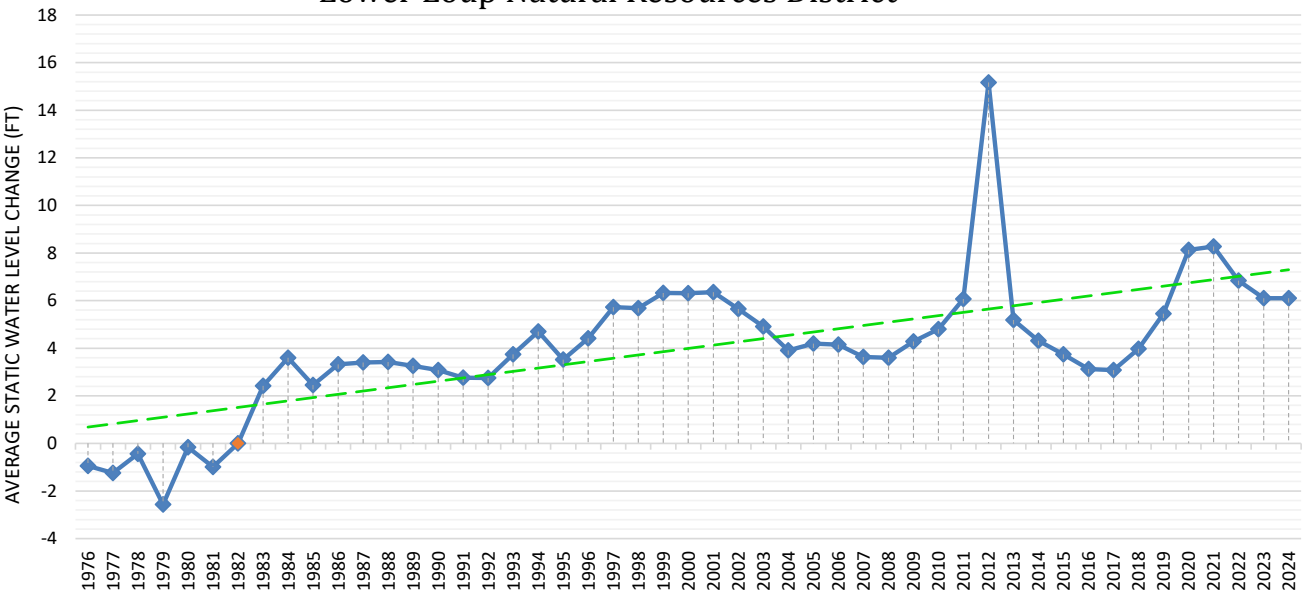
District-Wide Spring SWL Change
Lower Loup Natural Resources District



The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

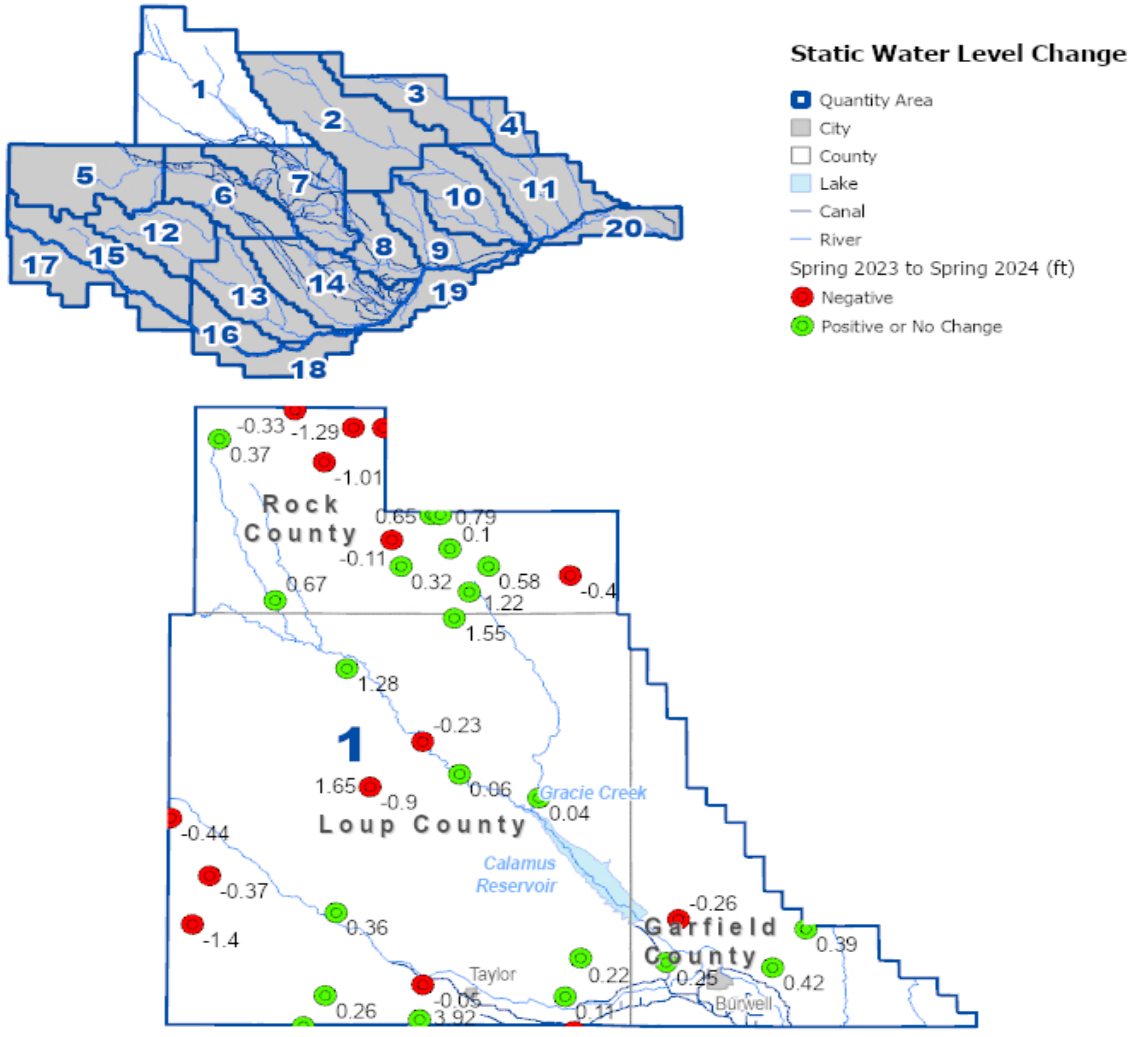


Quantity Area 1 - Spring SWL Change
Lower Loup Natural Resources District

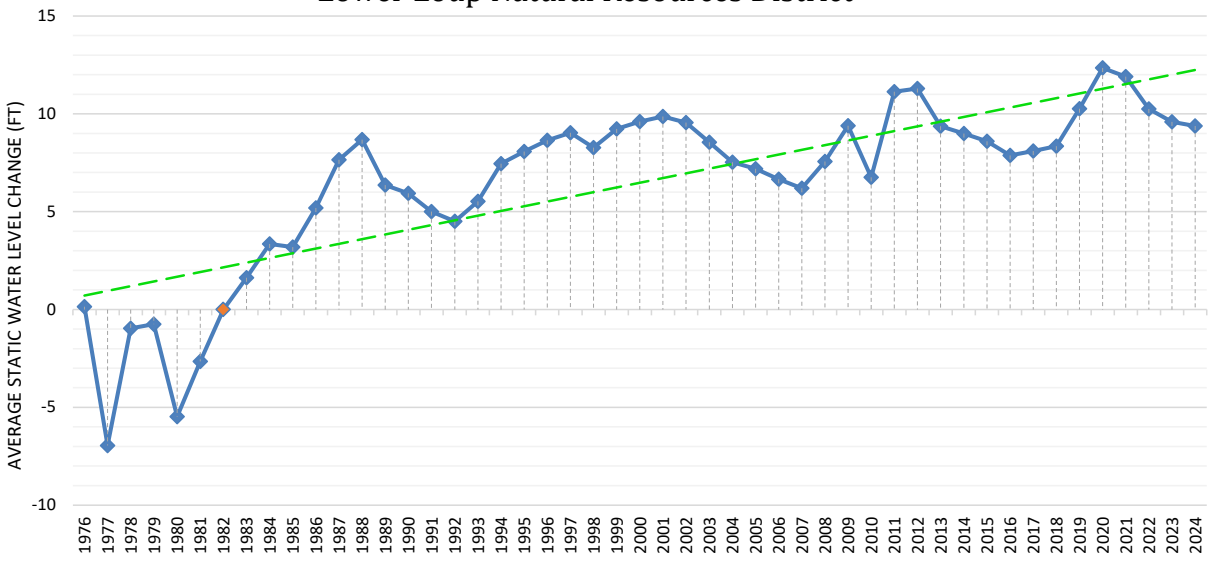


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1377x + 0.5482

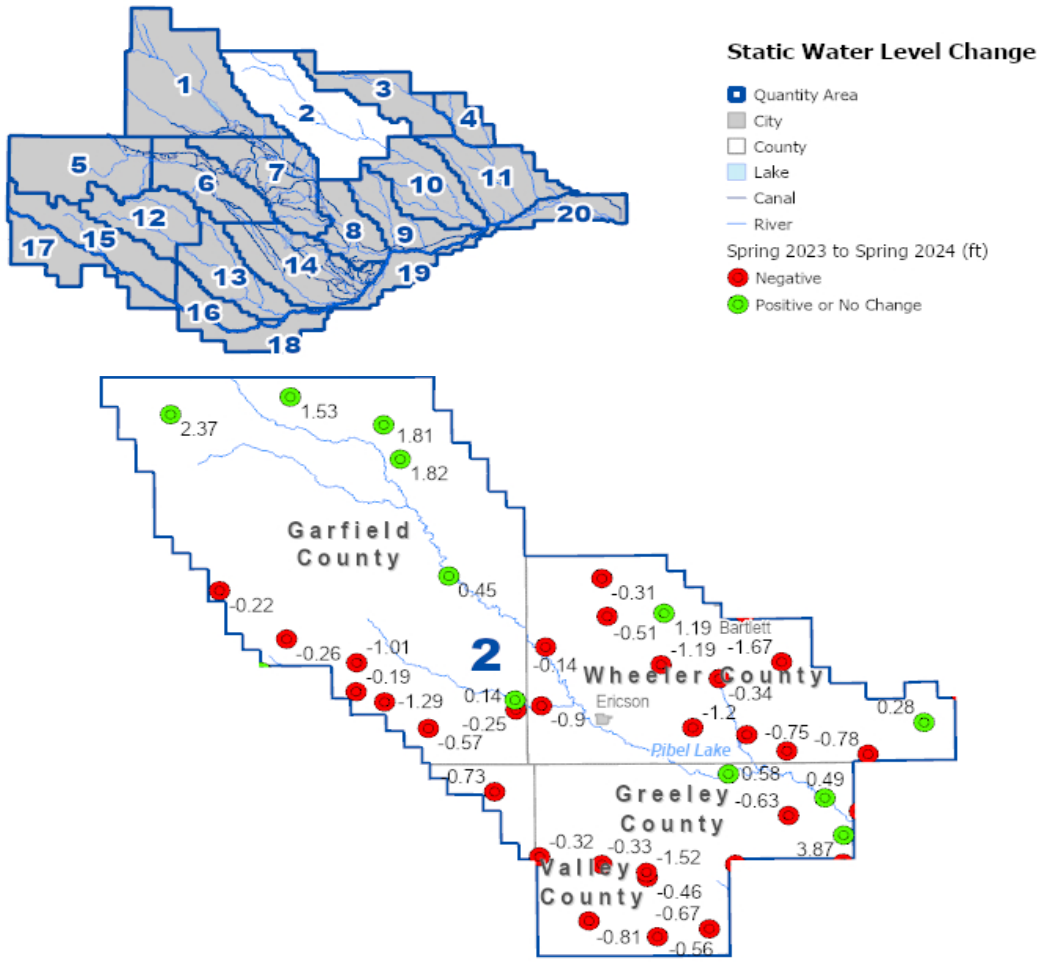


Quantity Area 2 - Spring SWL Change
Lower Loup Natural Resources District

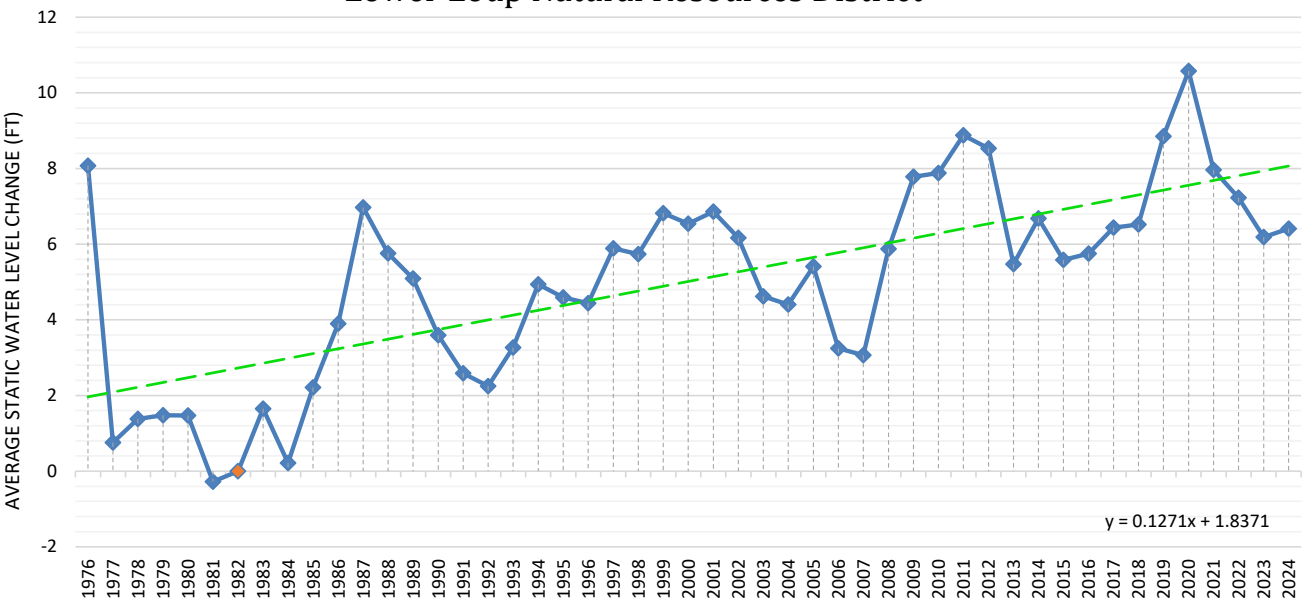


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

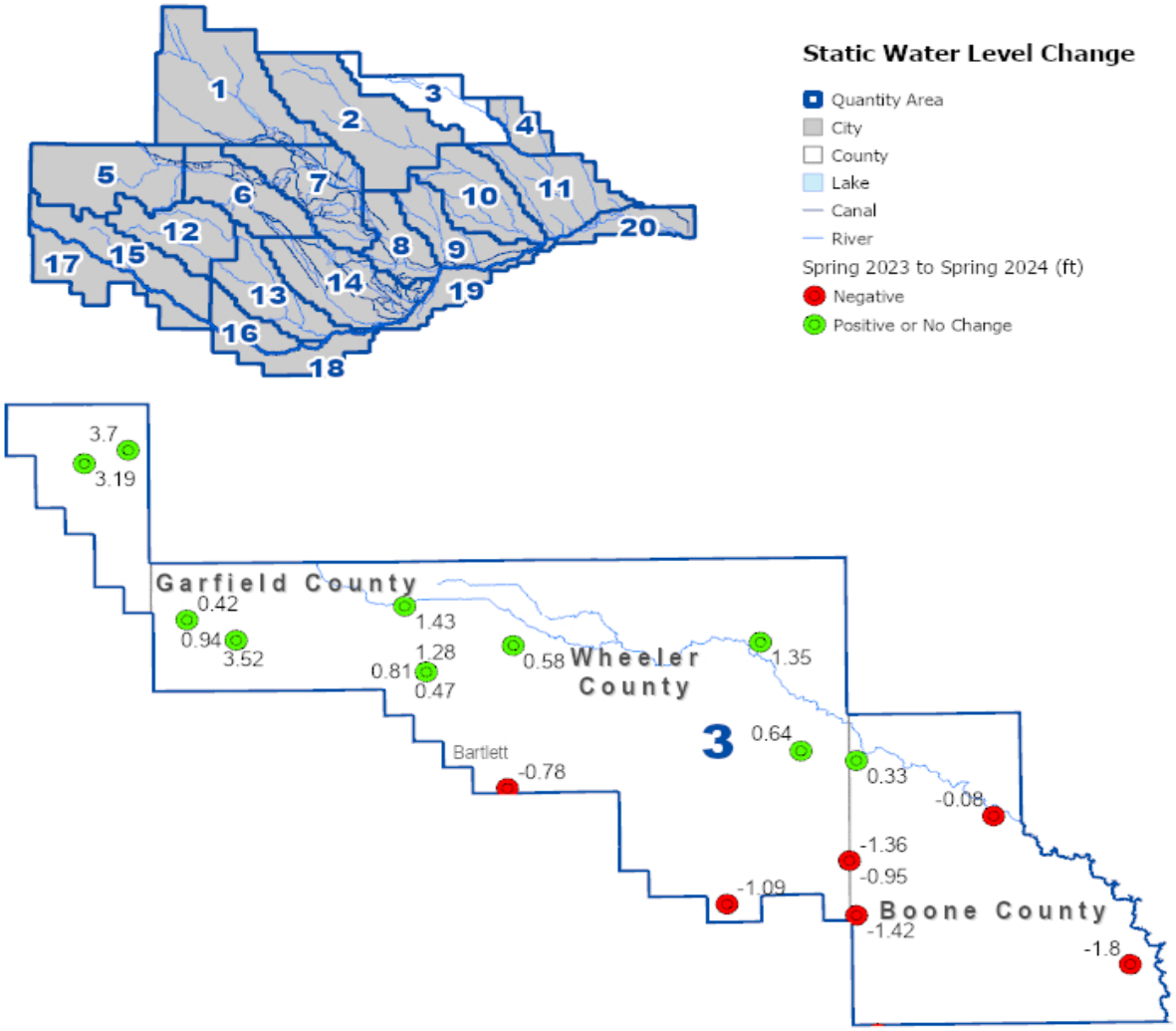
y = 0.2402x + 0.4732



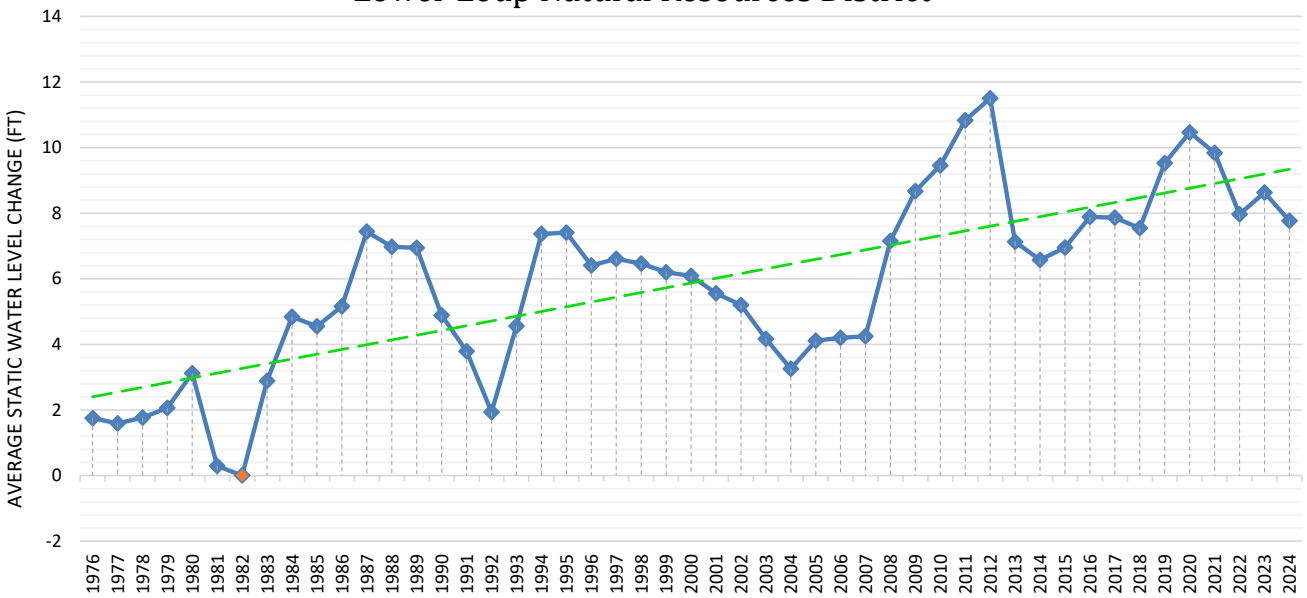
Quantity Area 3 - Spring SWL Change
Lower Loup Natural Resources District



The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

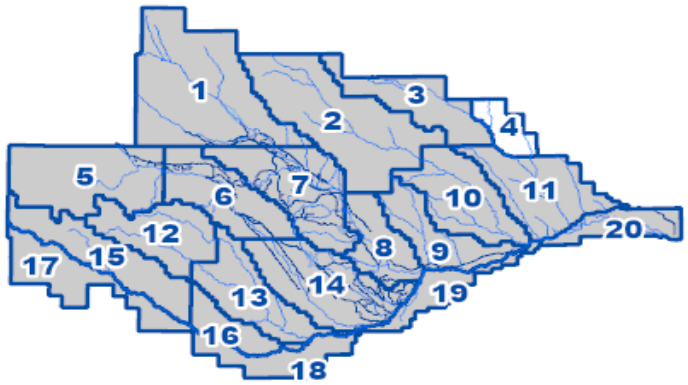


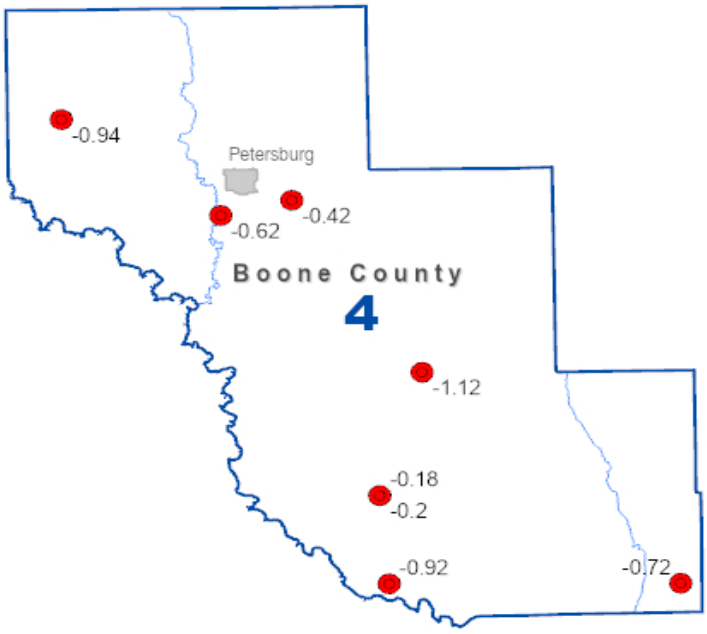
Drought Zone 4 - Spring SWL Change
Lower Loup Natural Resources District



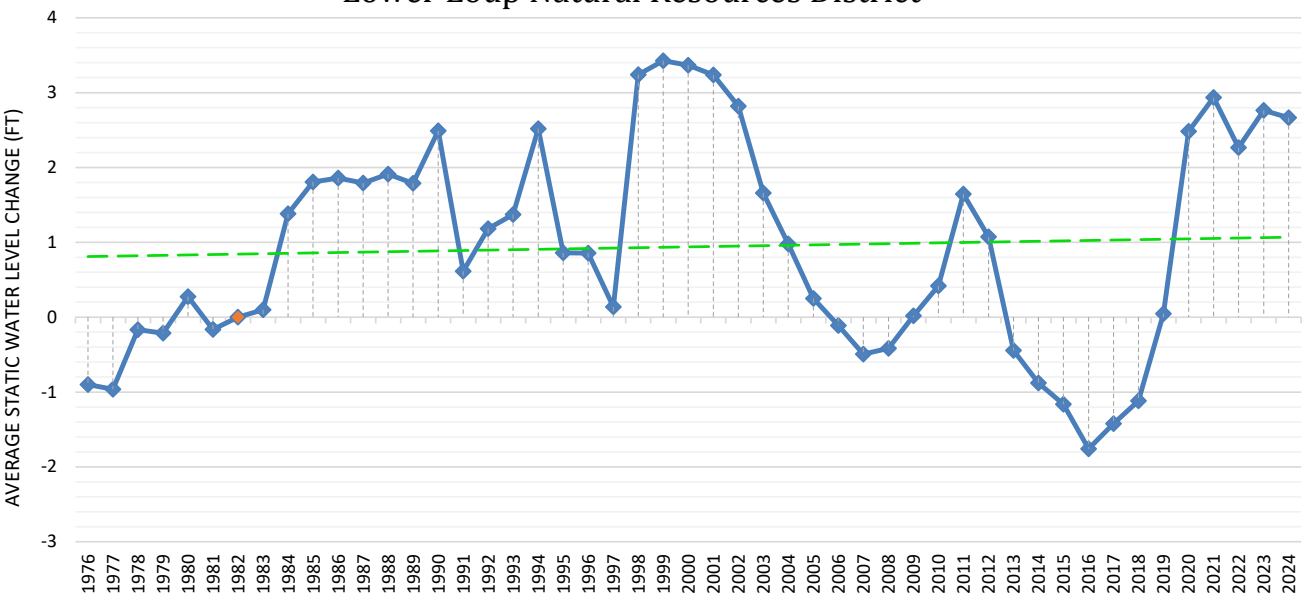
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1446x + 2.2551



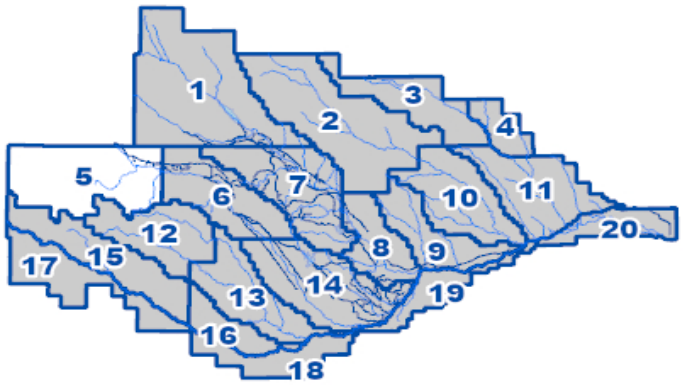


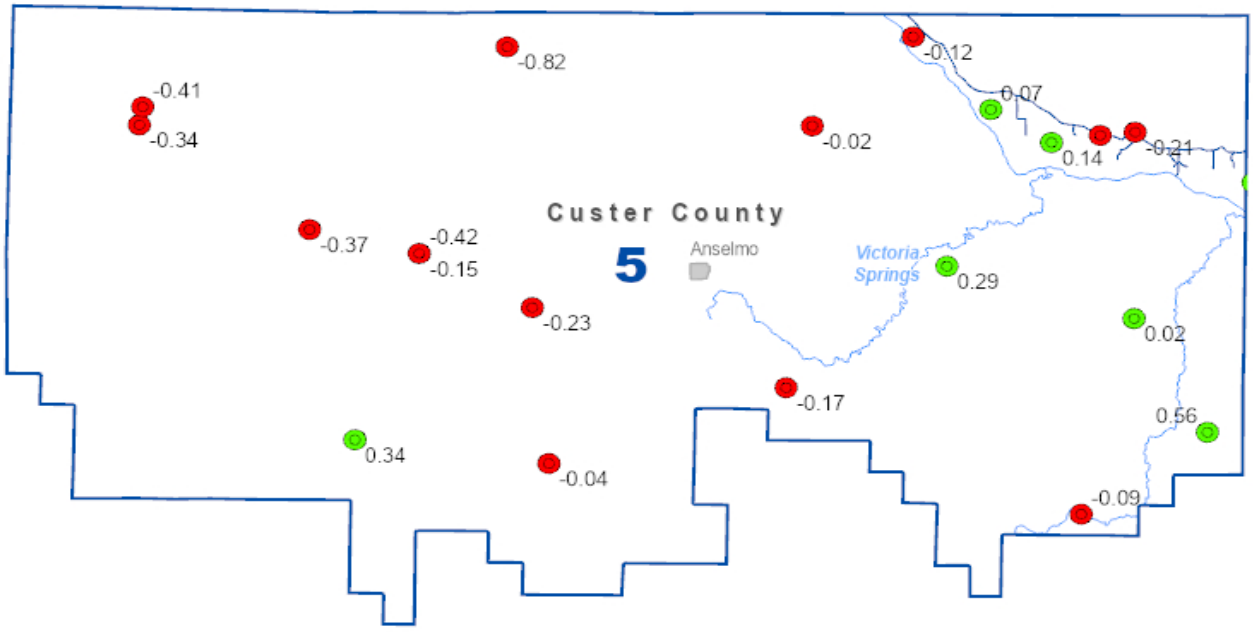
Quantity Area 5 - Spring SWL Change
Lower Loup Natural Resources District



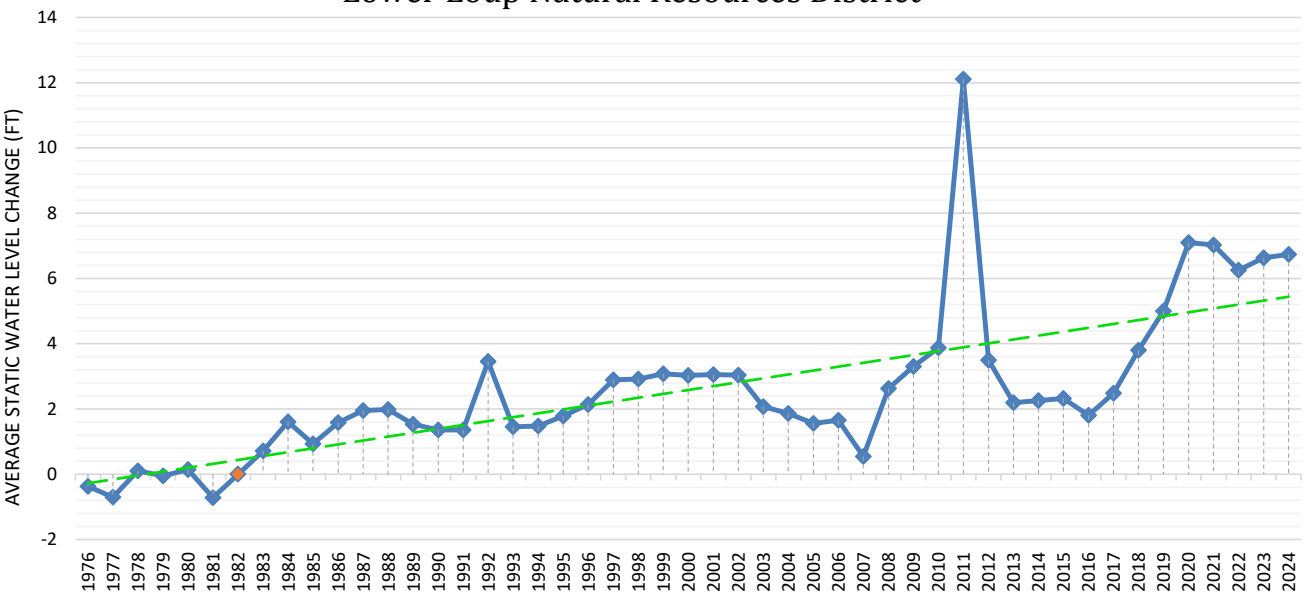
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.0054x + 0.8048



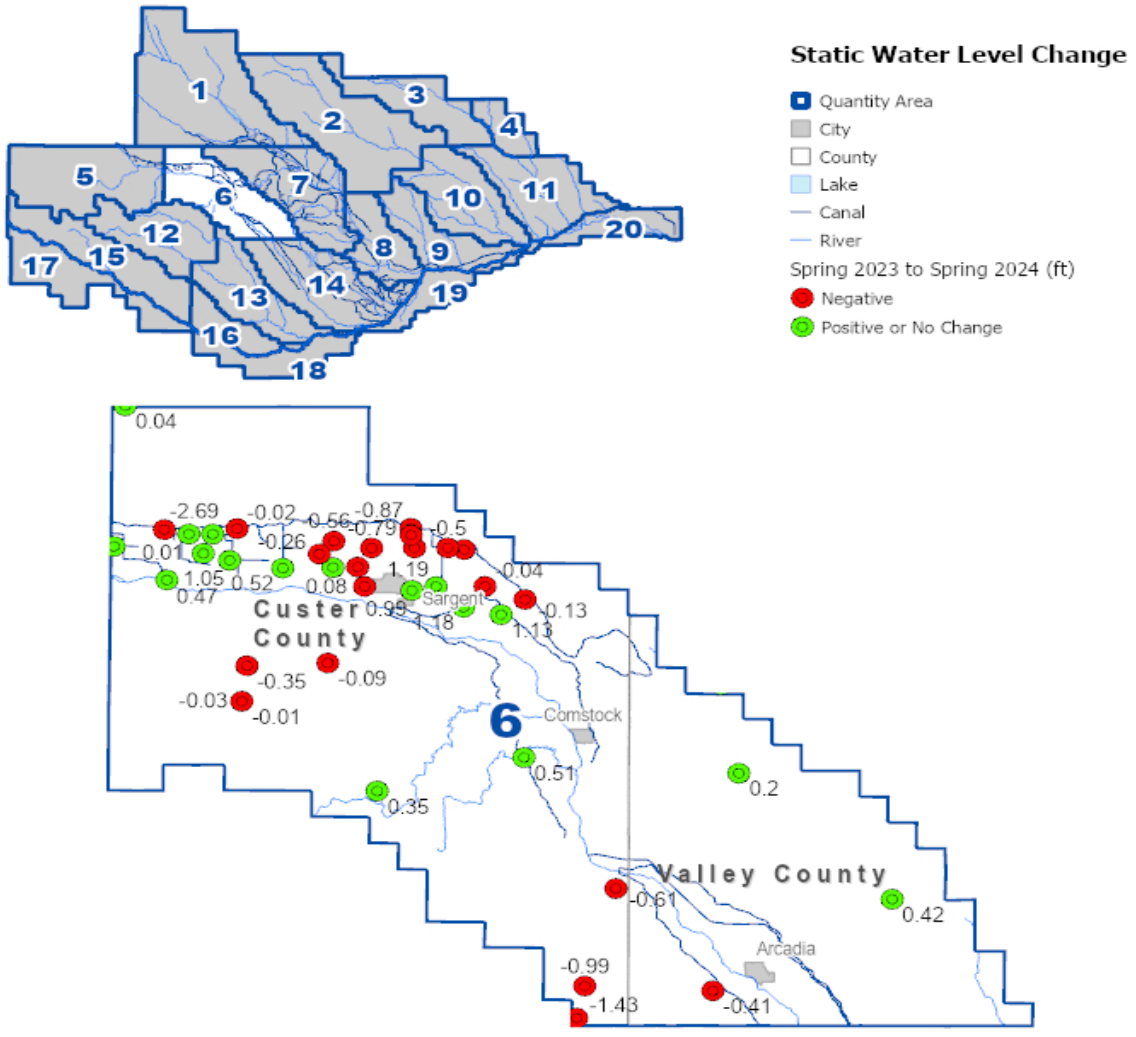


Quantity Area 6 - Spring SWL Change
Lower Loup Natural Resources District

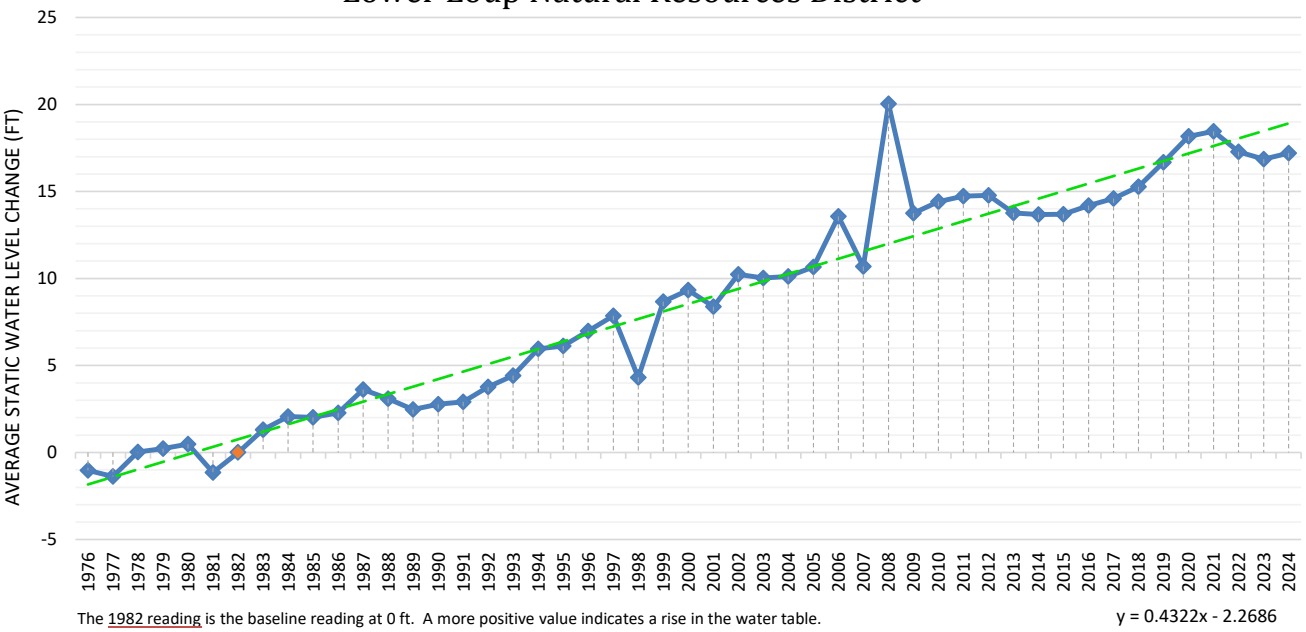


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1191x - 0.3954

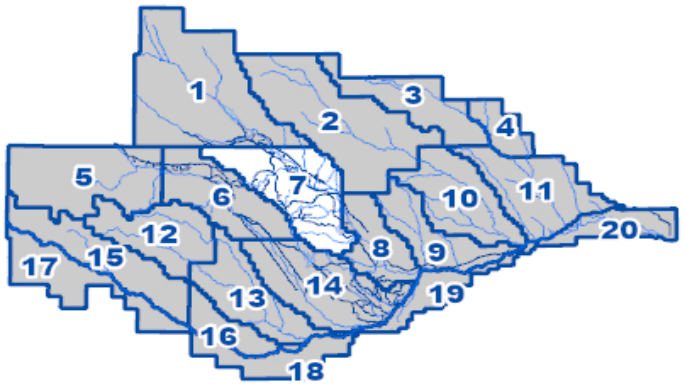


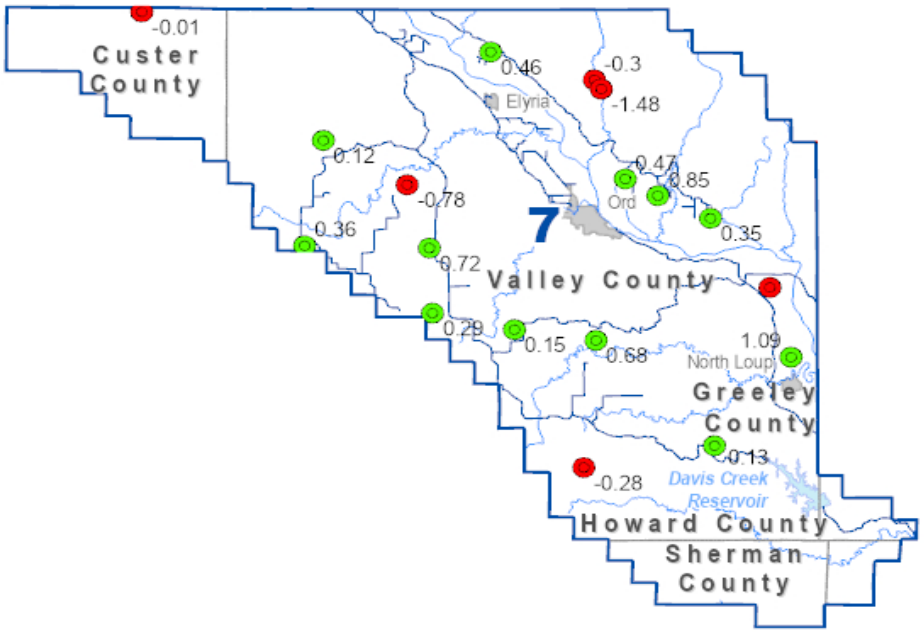
Quantity Area 7 - Spring SWL Change
Lower Loup Natural Resources District



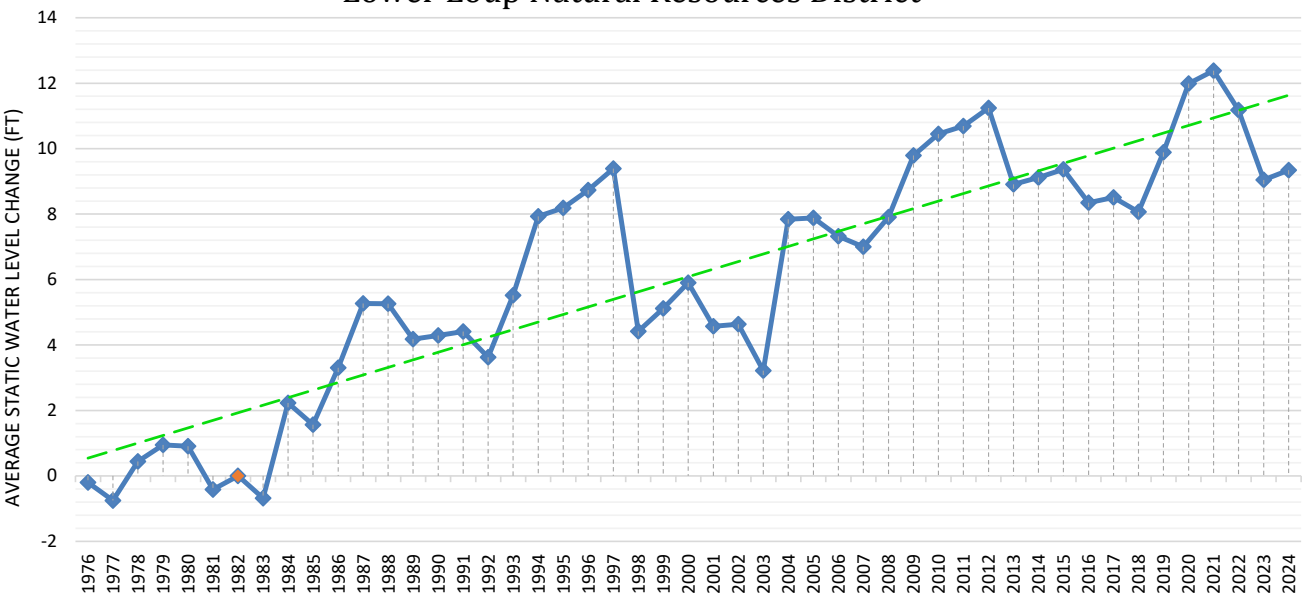
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.4322x - 2.2686



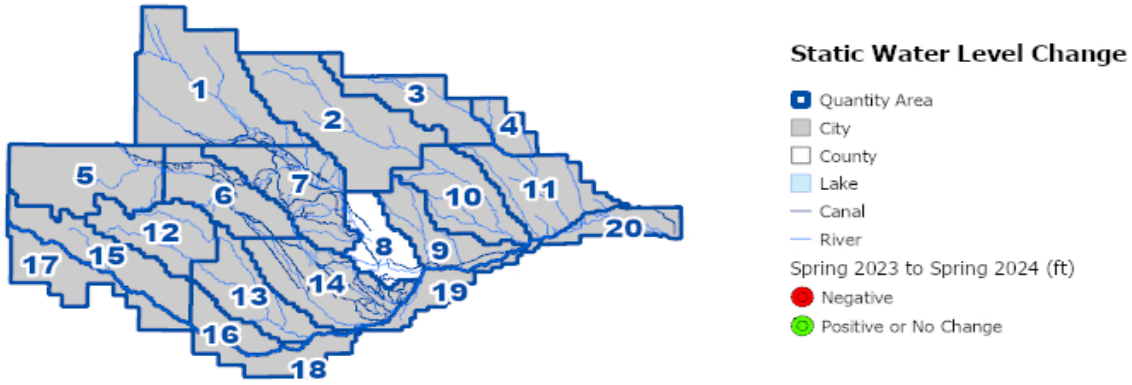


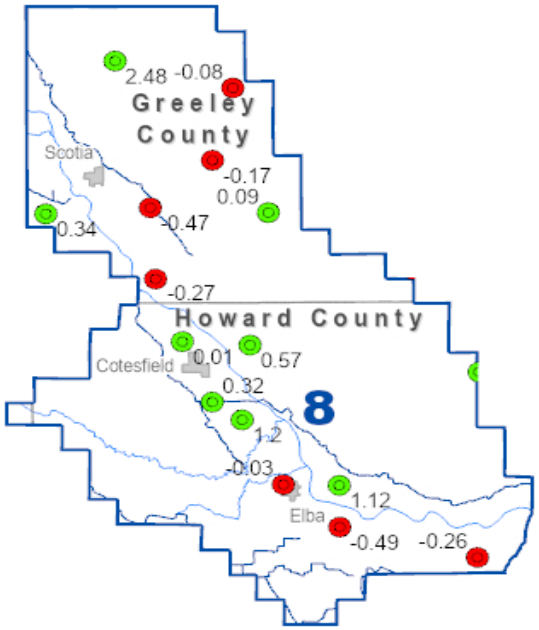
Quantity Area 8 - Spring SWL Change
Lower Loup Natural Resources District



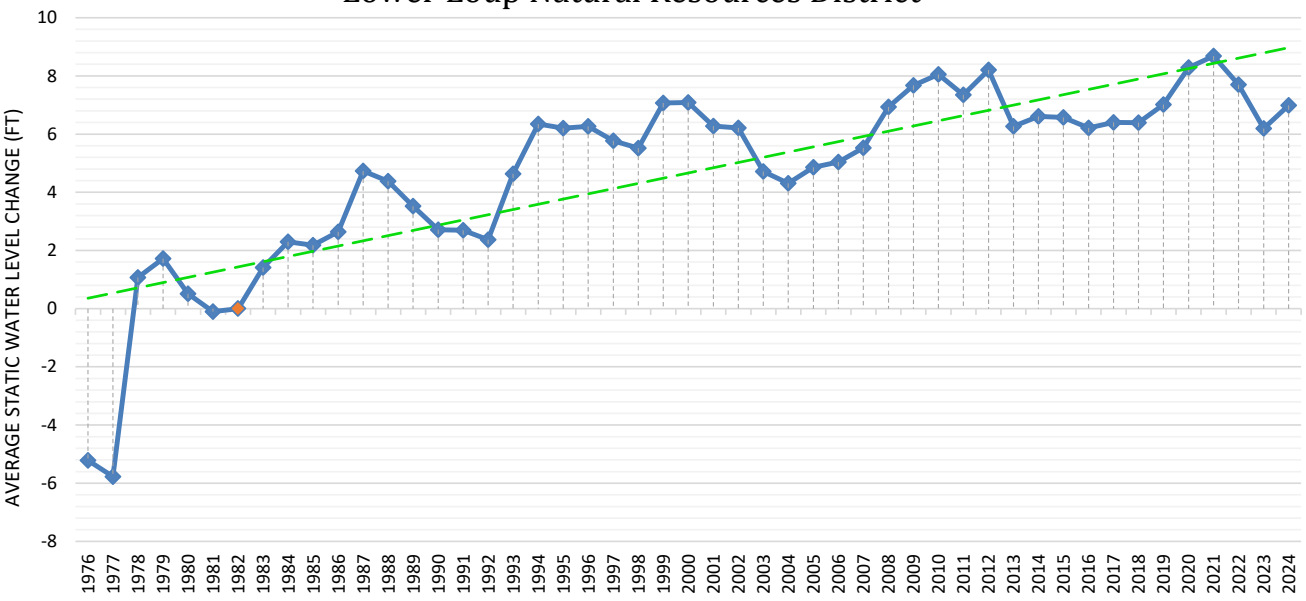
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.231x + 0.3124



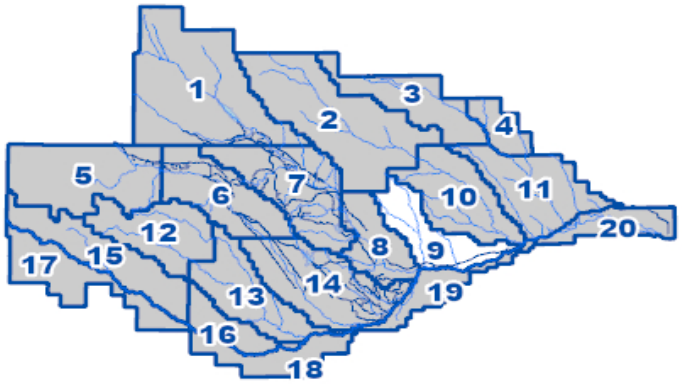


Quantity Area 9 - Spring SWL Change
Lower Loup Natural Resources District



The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1794x + 0.178

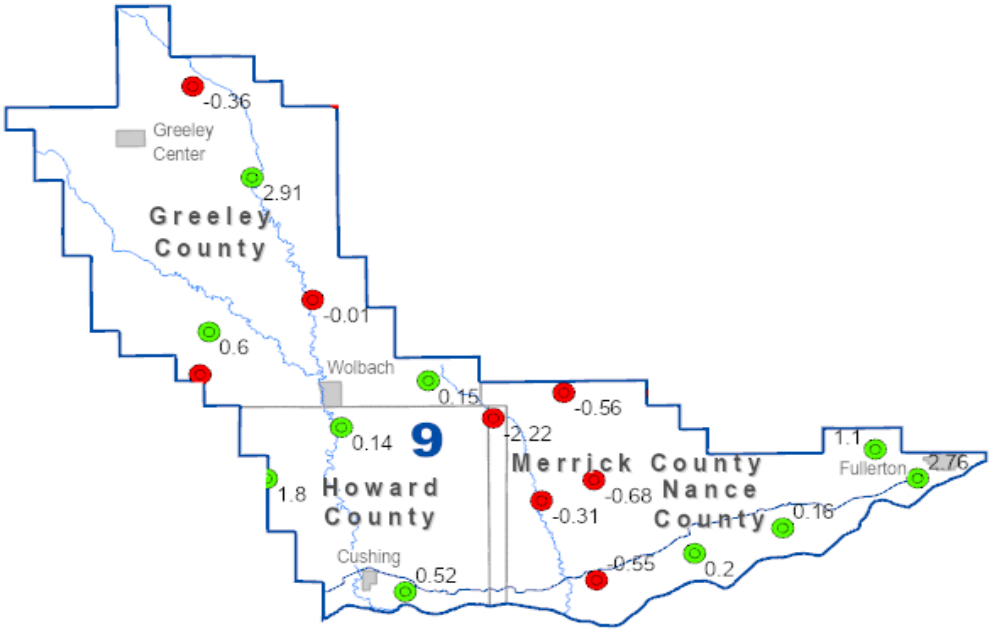


Static Water Level Change

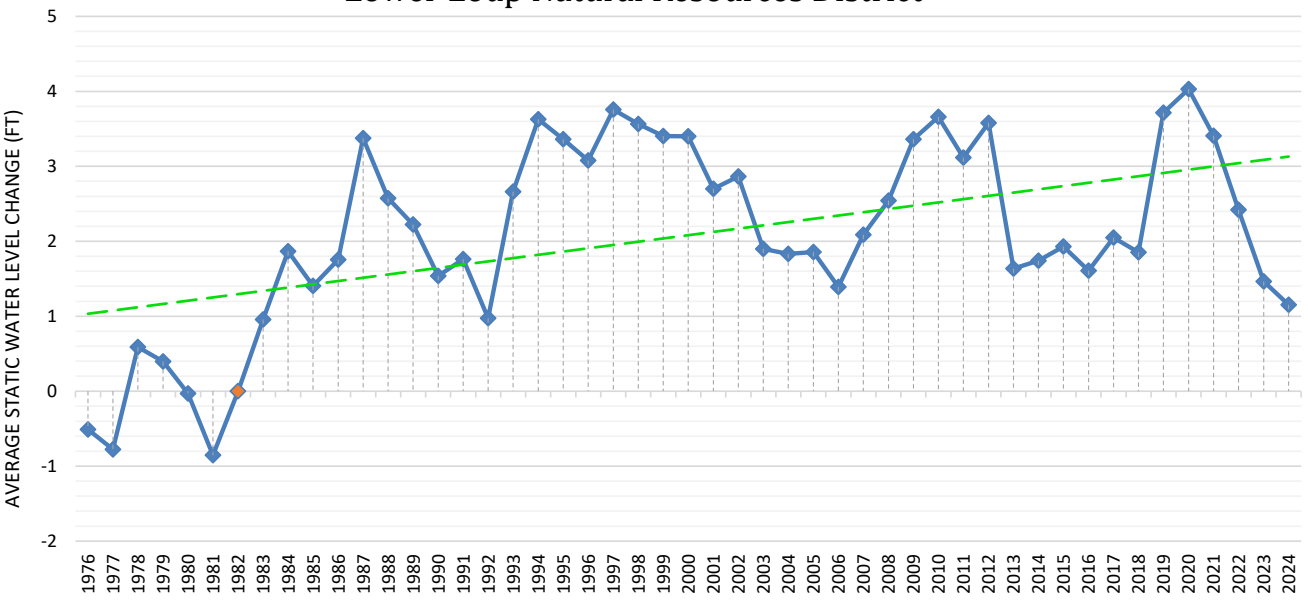
- Quantity Area
- City
- County
- Lake
- Canal
- River

Spring 2023 to Spring 2024 (ft)

- Negative
- Positive or No Change

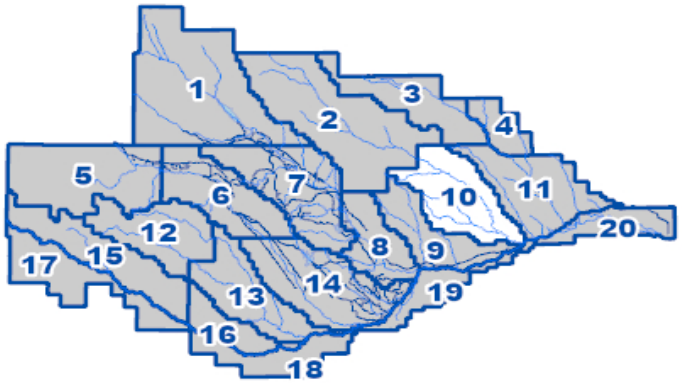


Quantity Area 10 - Spring SWL Change
Lower Loup Natural Resources District



The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.0437x + 0.9892

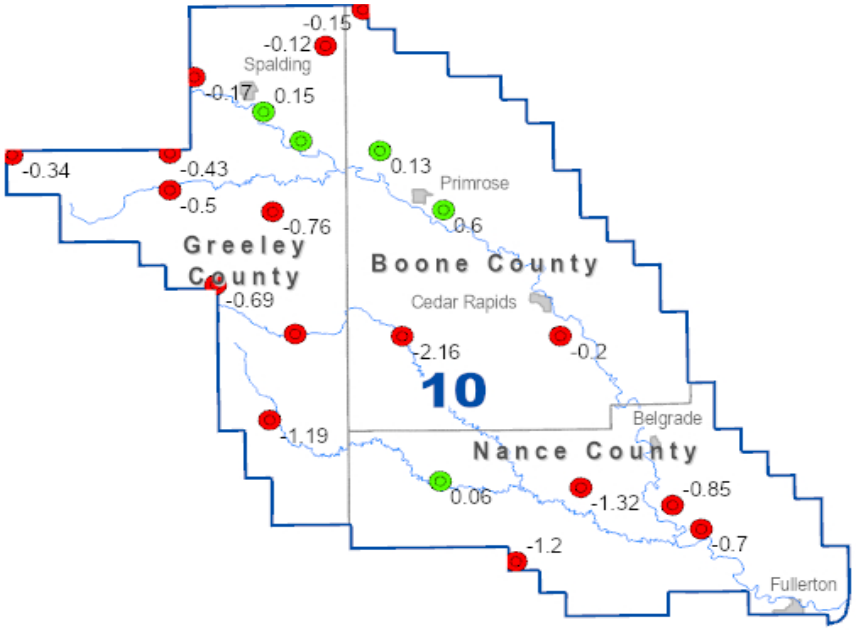


Static Water Level Change

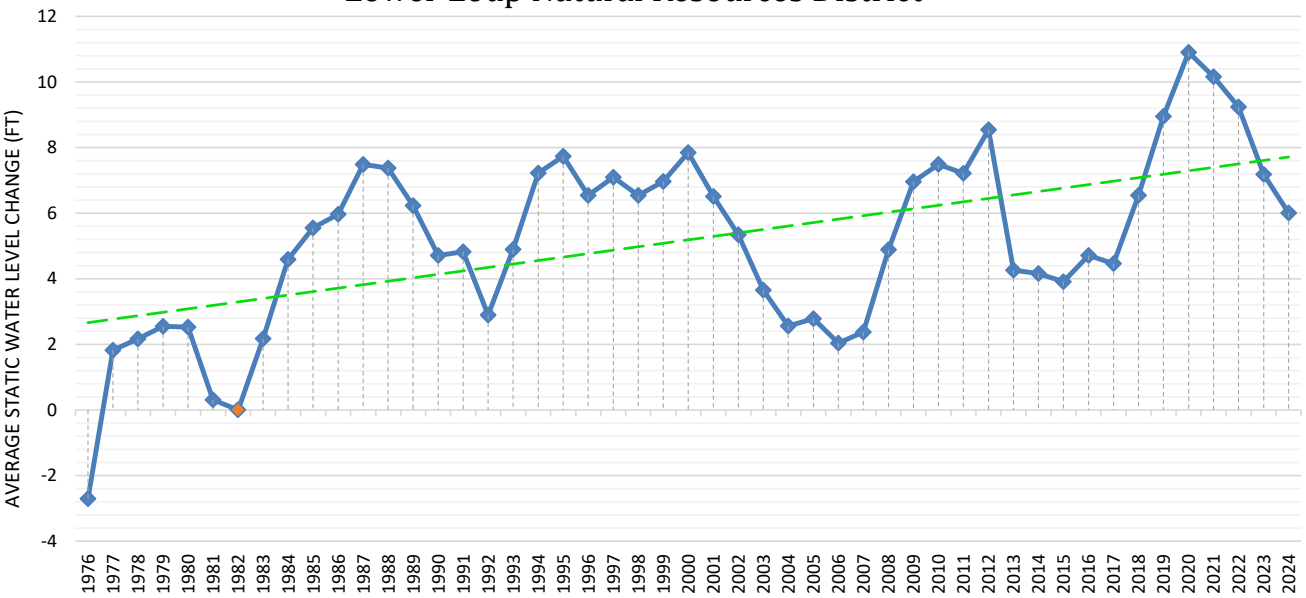
- Quantity Area
- City
- County
- Lake
- Canal
- River

Spring 2023 to Spring 2024 (ft)

- Negative
- Positive or No Change

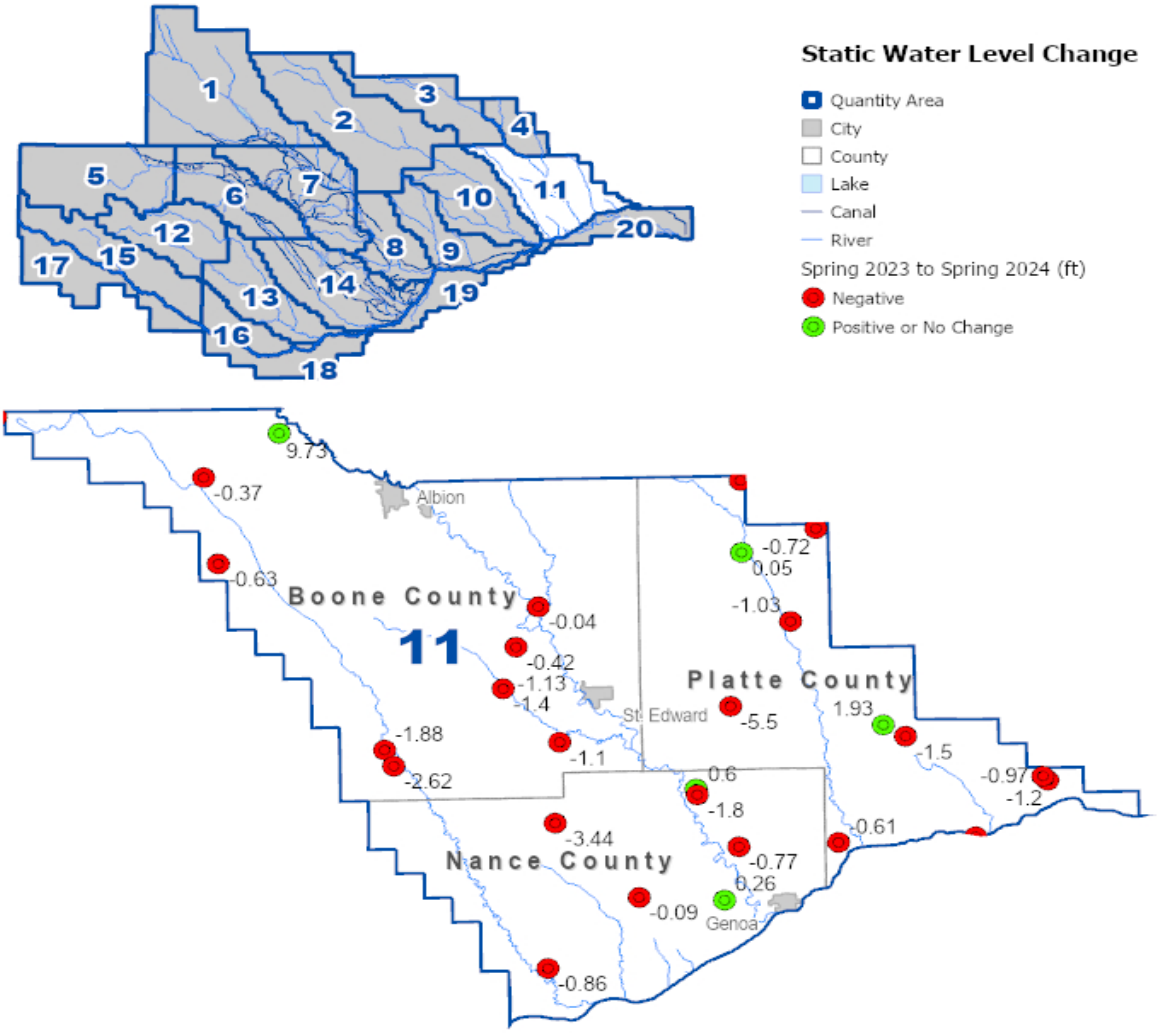


Quantity Area 11 - Spring SWL Change
Lower Loup Natural Resources District

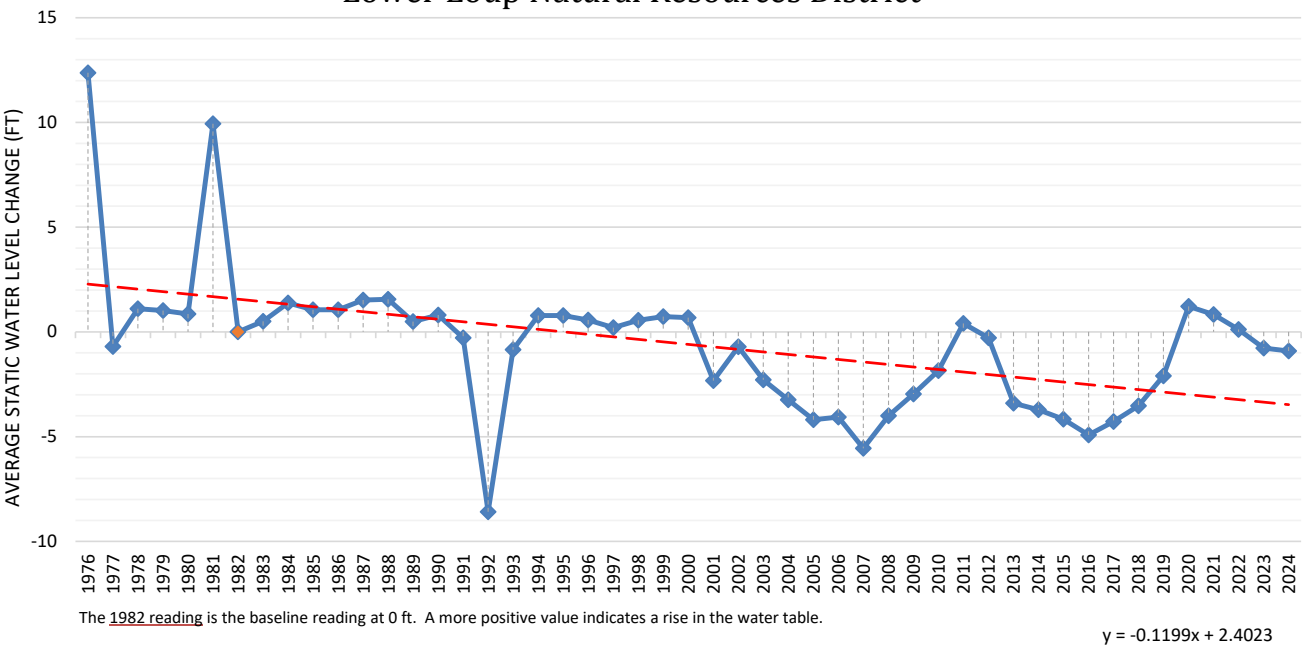


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1052x + 2.5566

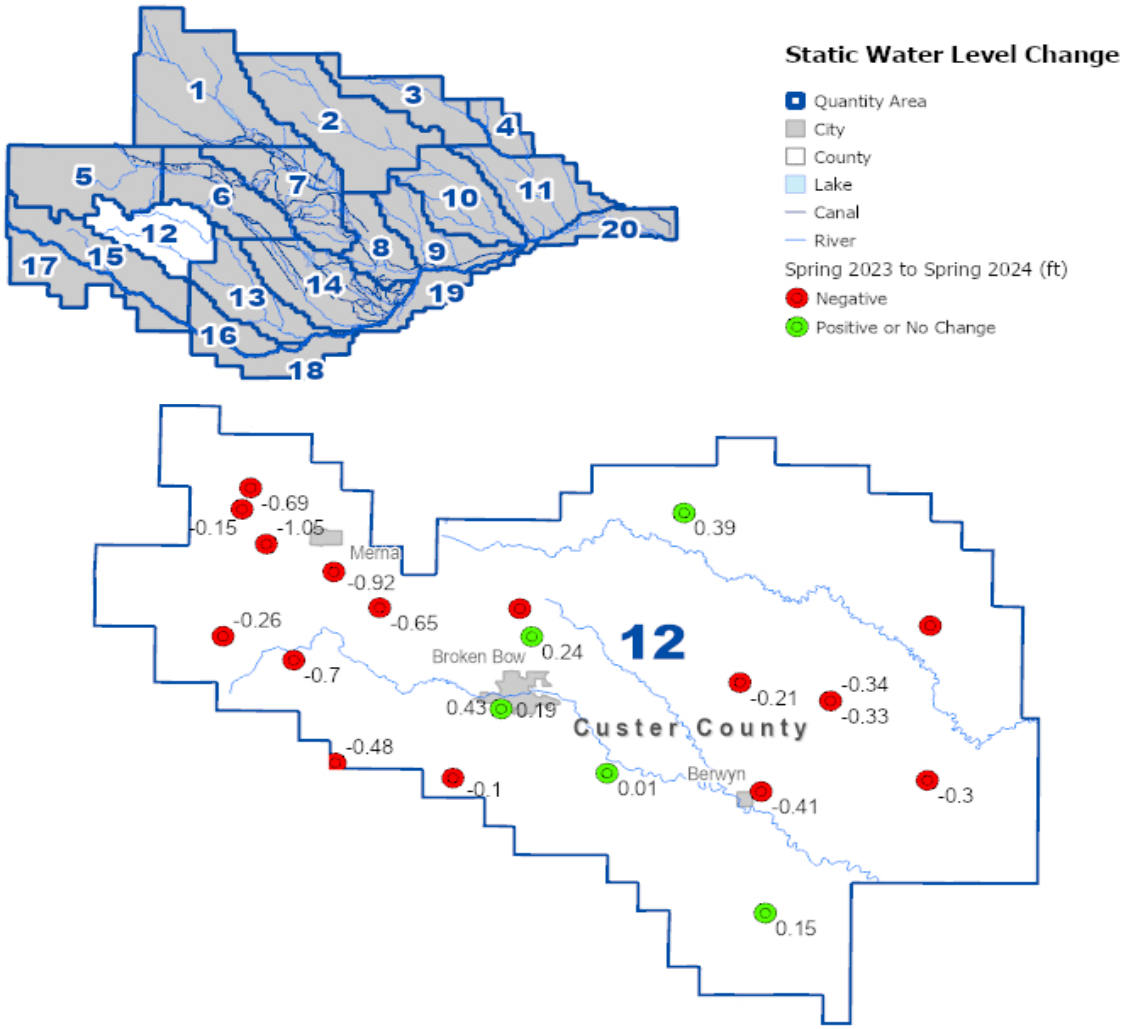


Quantity Area 12 - Spring SWL Change
Lower Loup Natural Resources District

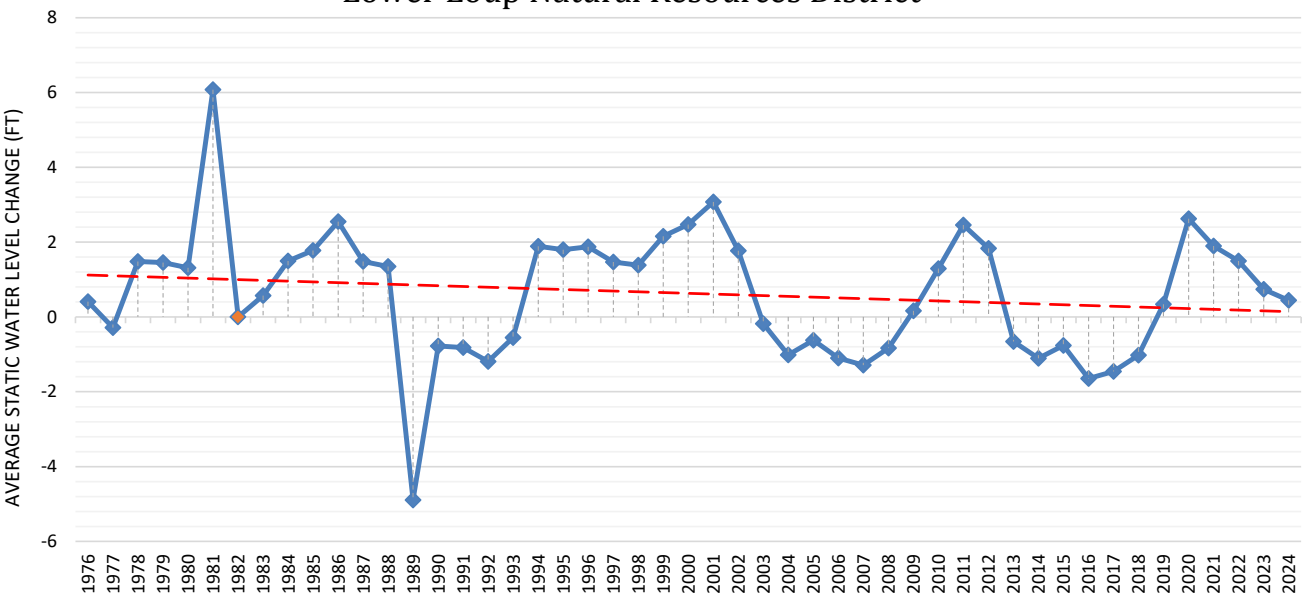


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.1199x + 2.4023

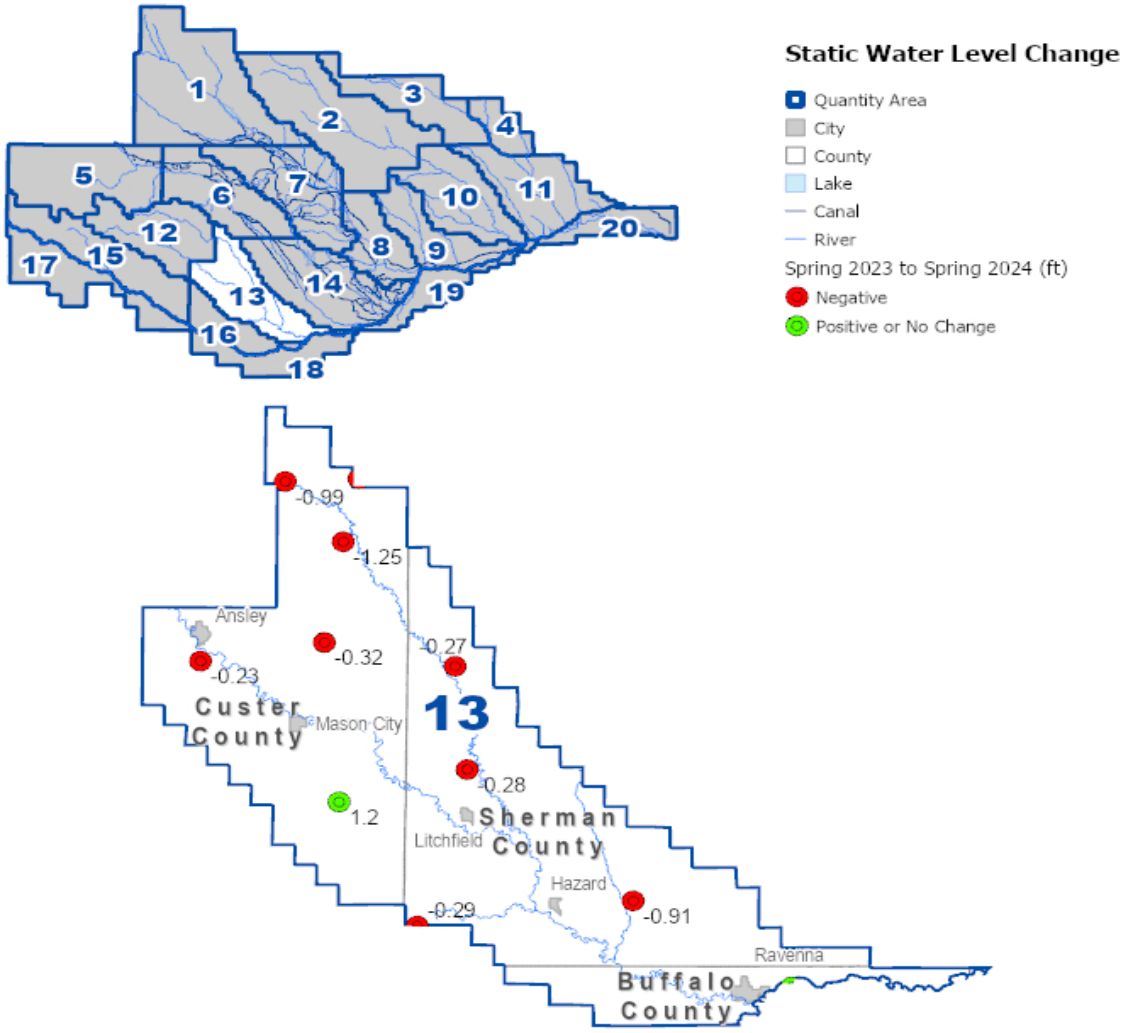


Quantity Area 13 - Spring SWL Change
Lower Loup Natural Resources District

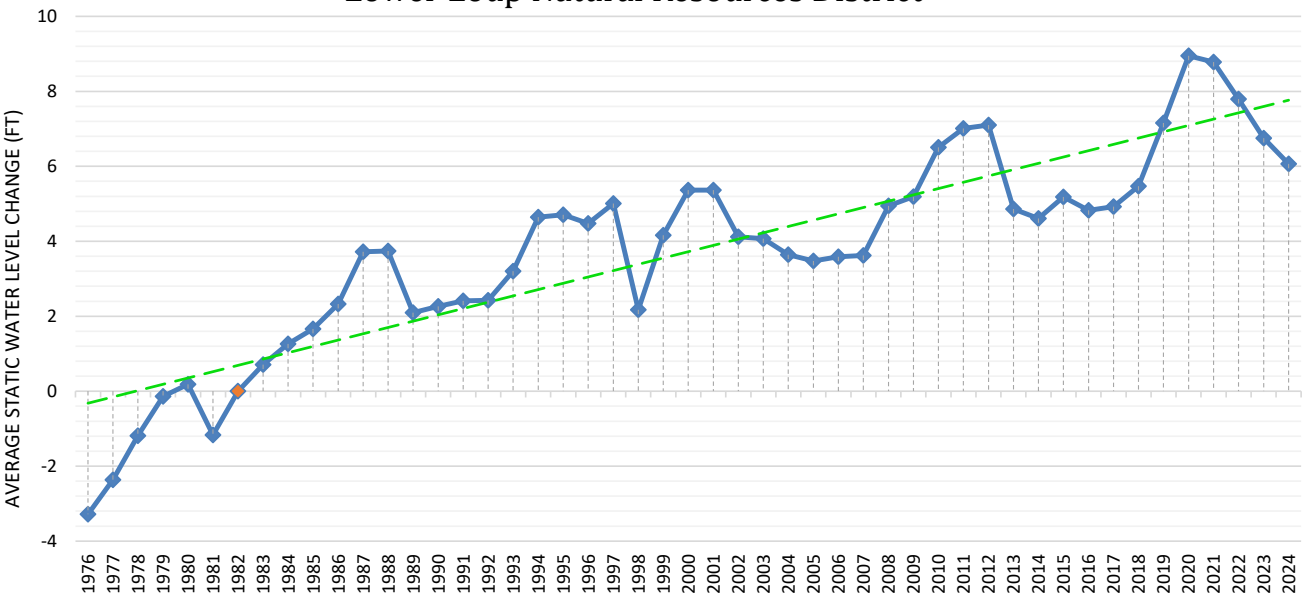


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0204x + 1.1412

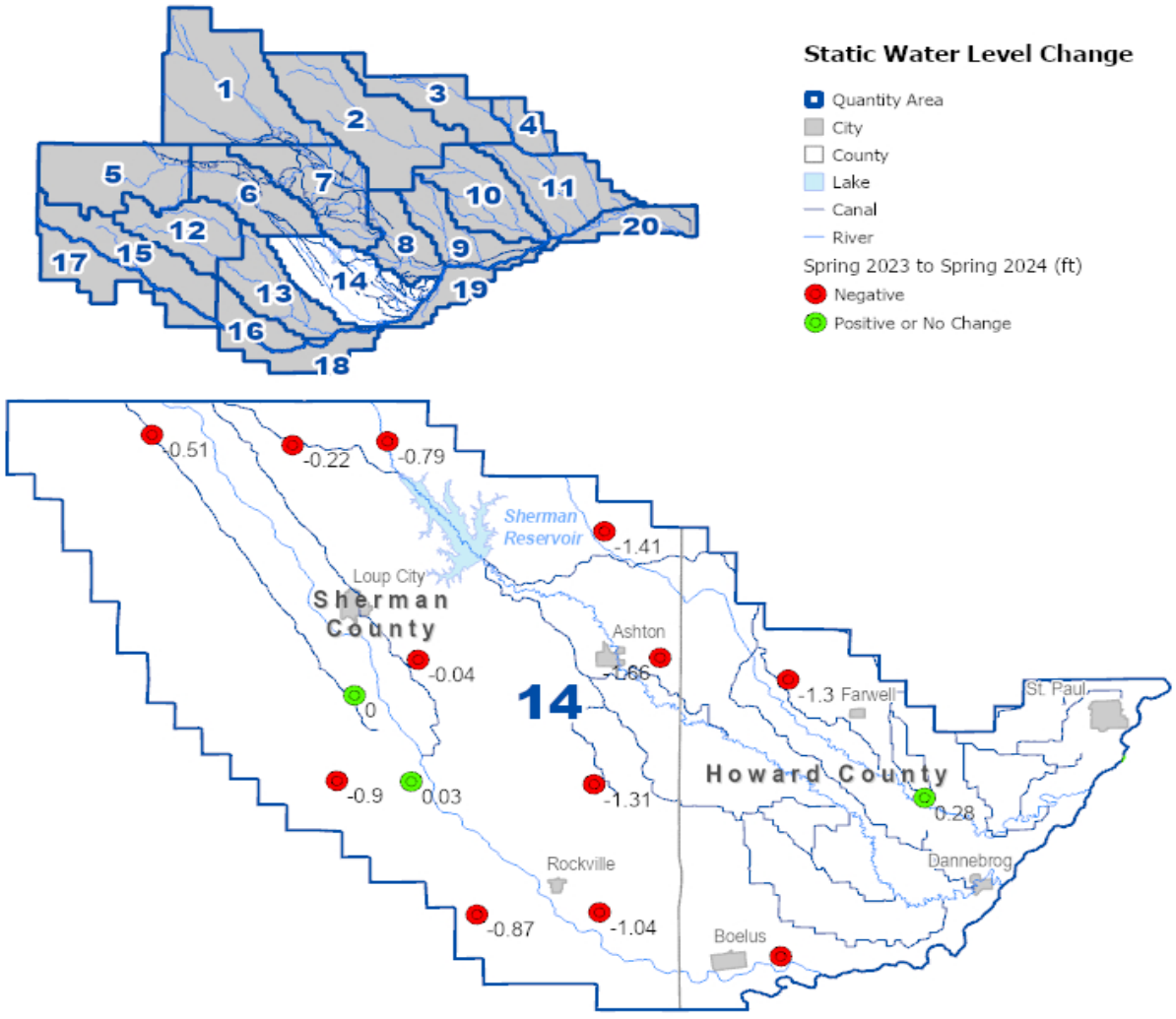


Quantity Area 14 - Spring SWL Change
Lower Loup Natural Resources District

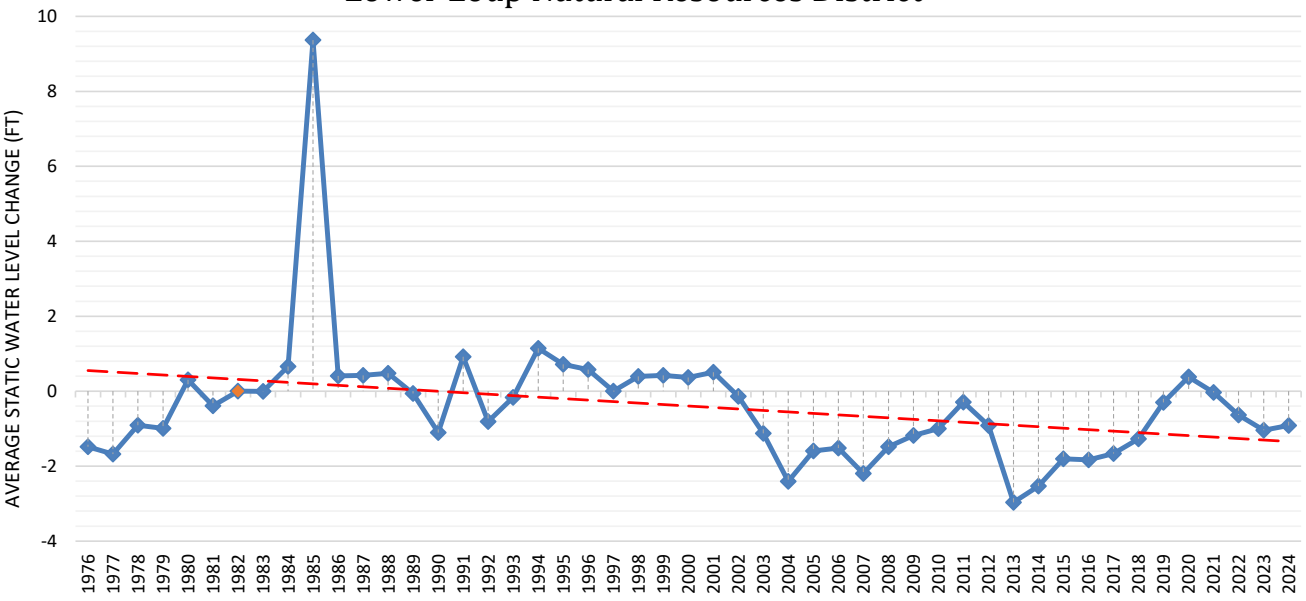


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1684x - 0.489

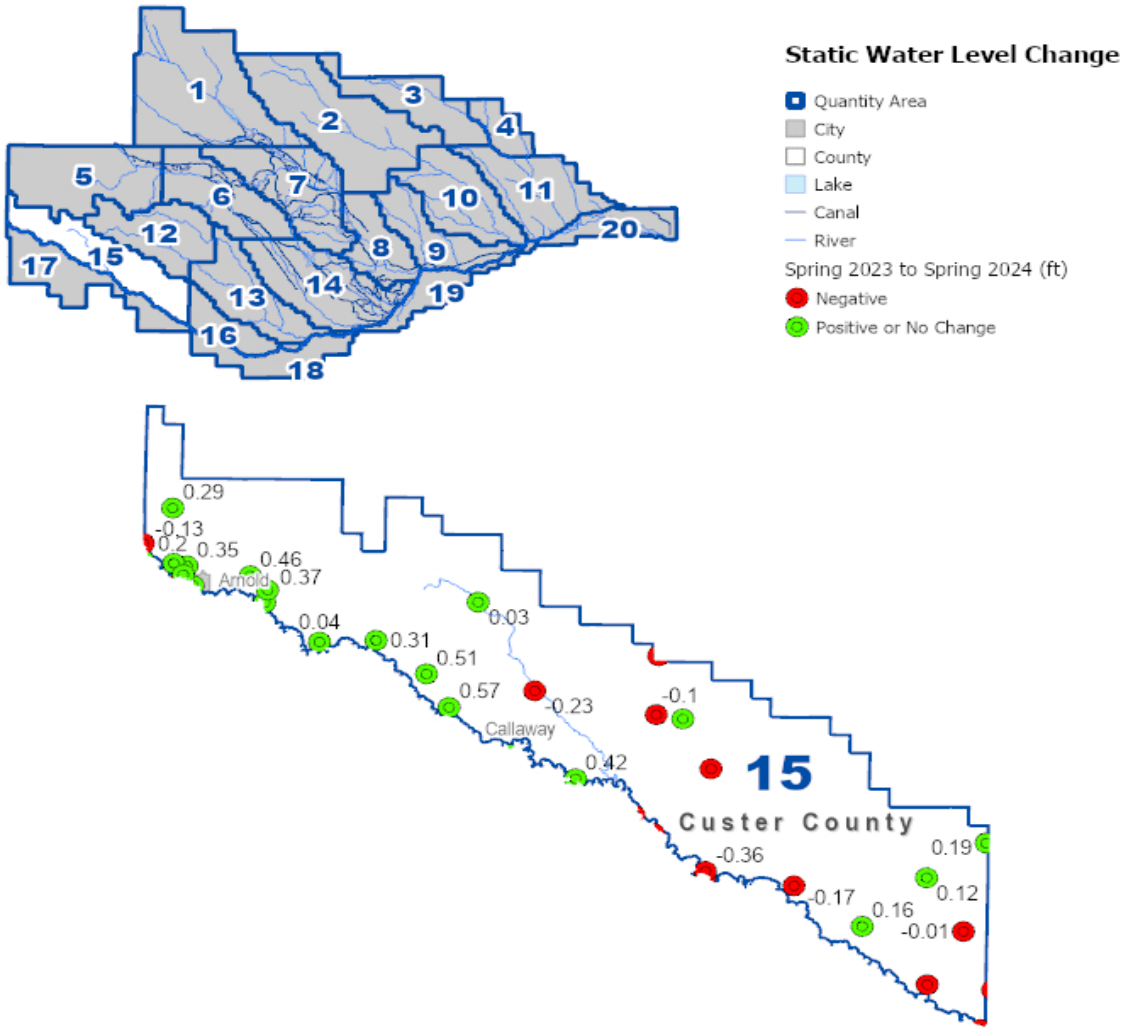


Quantity Area 15 - Spring SWL Change
Lower Loup Natural Resources District

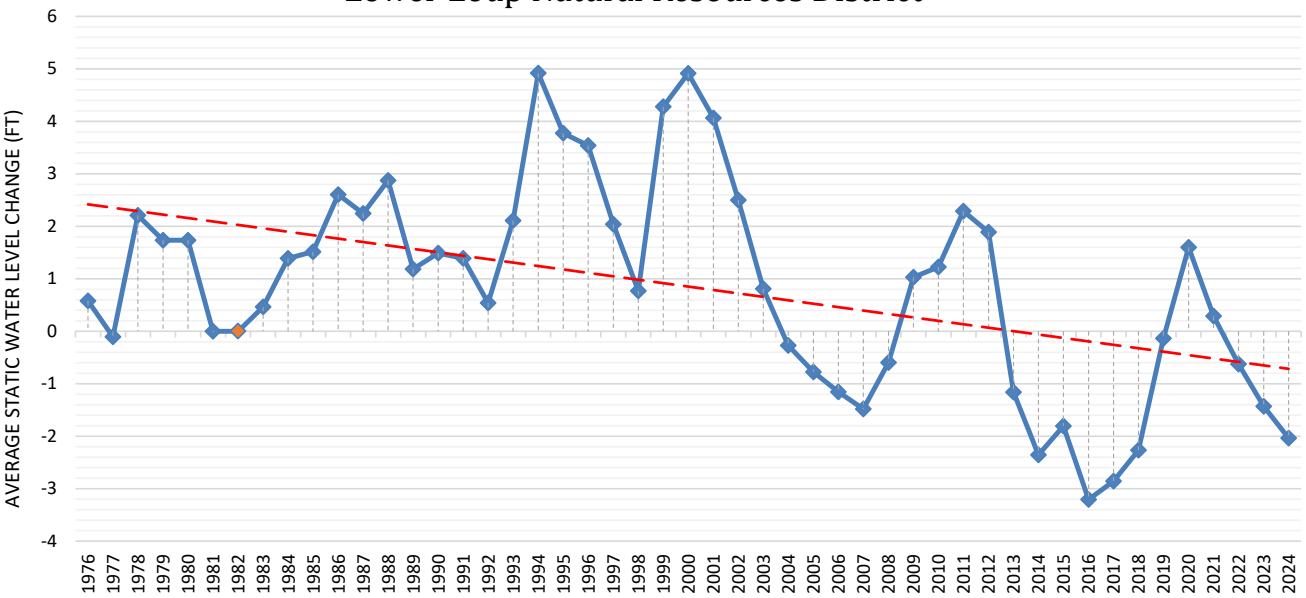


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0394x + 0.5909

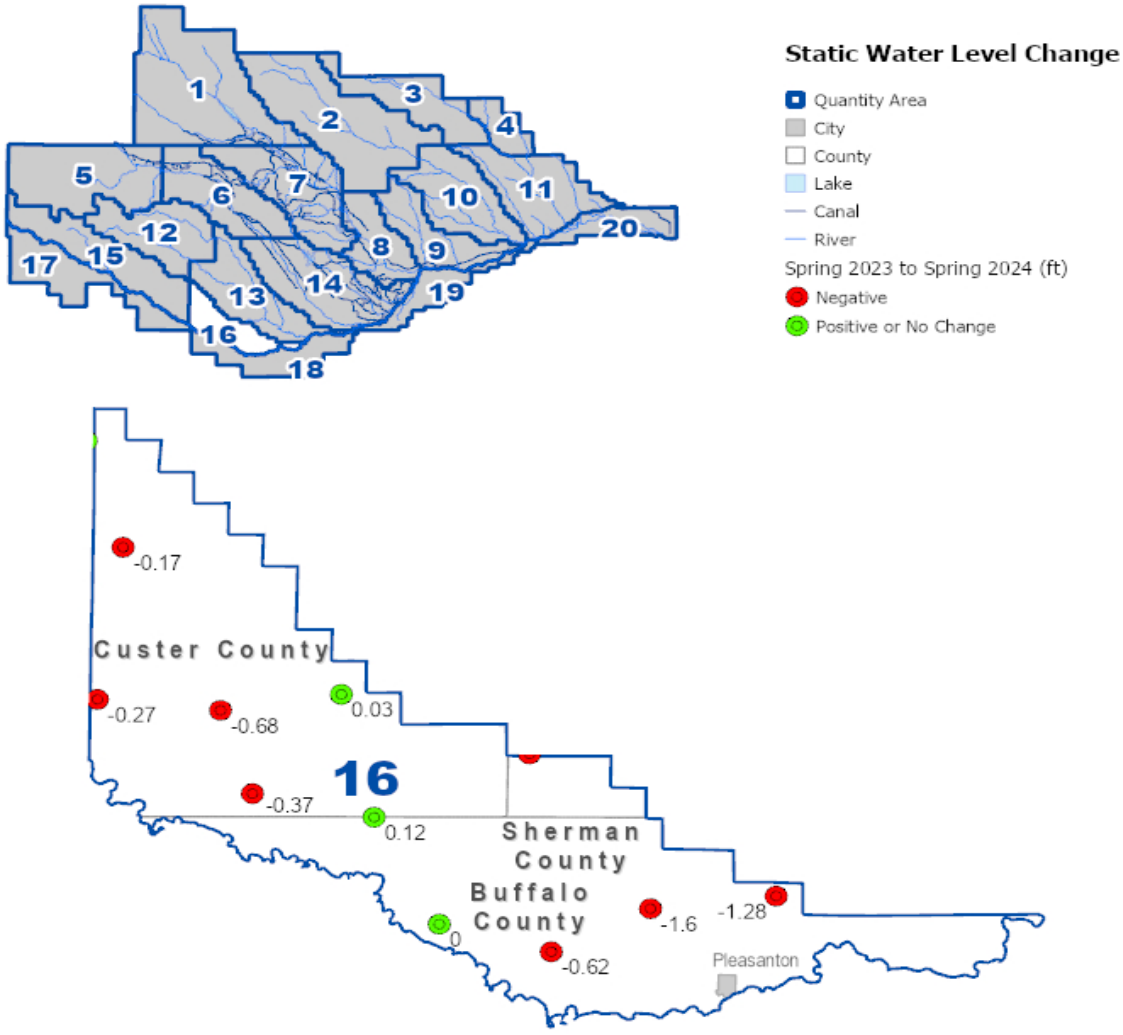


Quantity Area 16 - Spring SWL Change
Lower Loup Natural Resources District

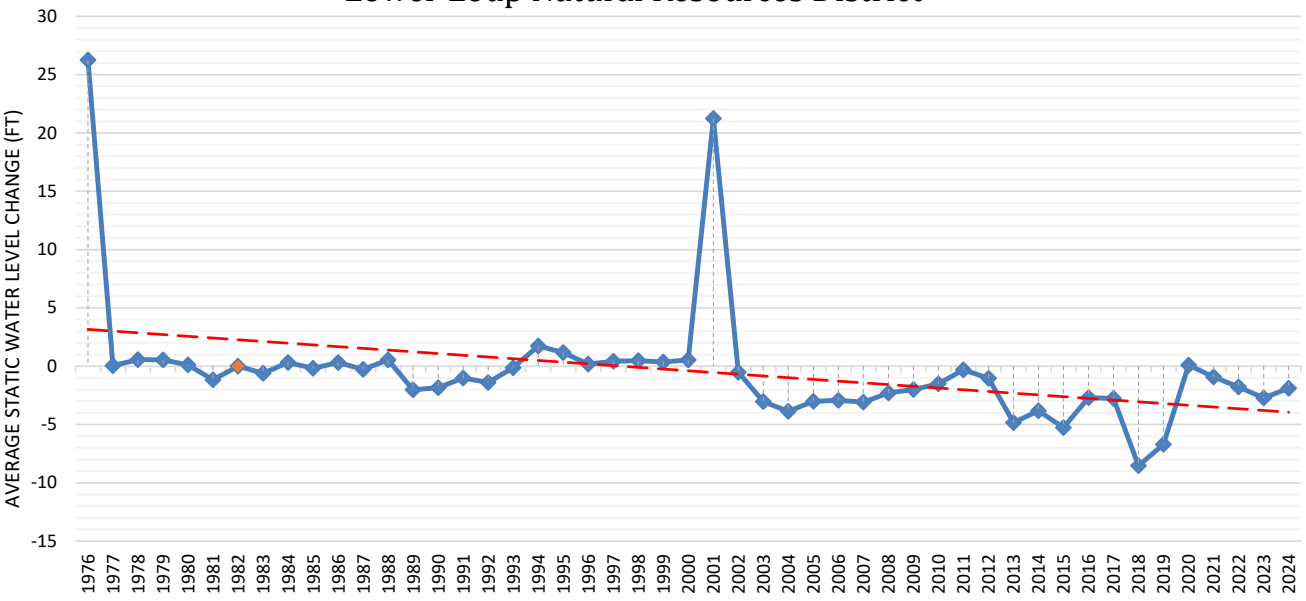


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0653x + 2.4835

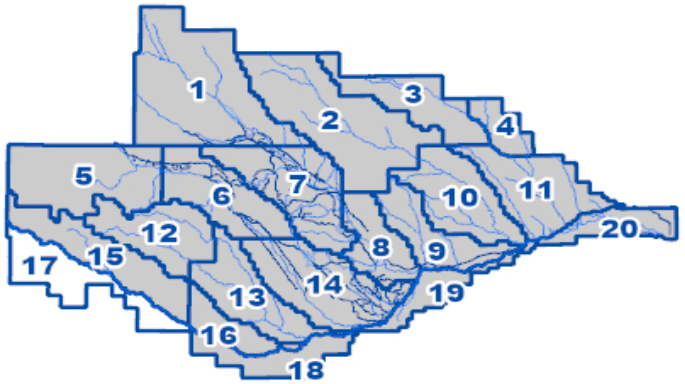


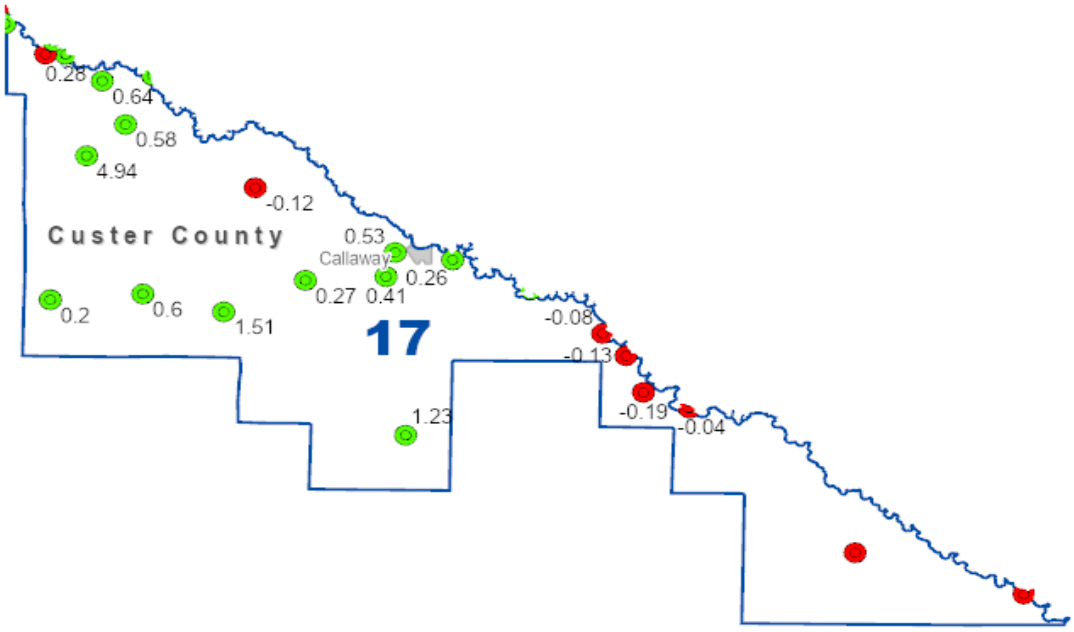
Quantity Area 17 - Spring SWL Change
Lower Loup Natural Resources District



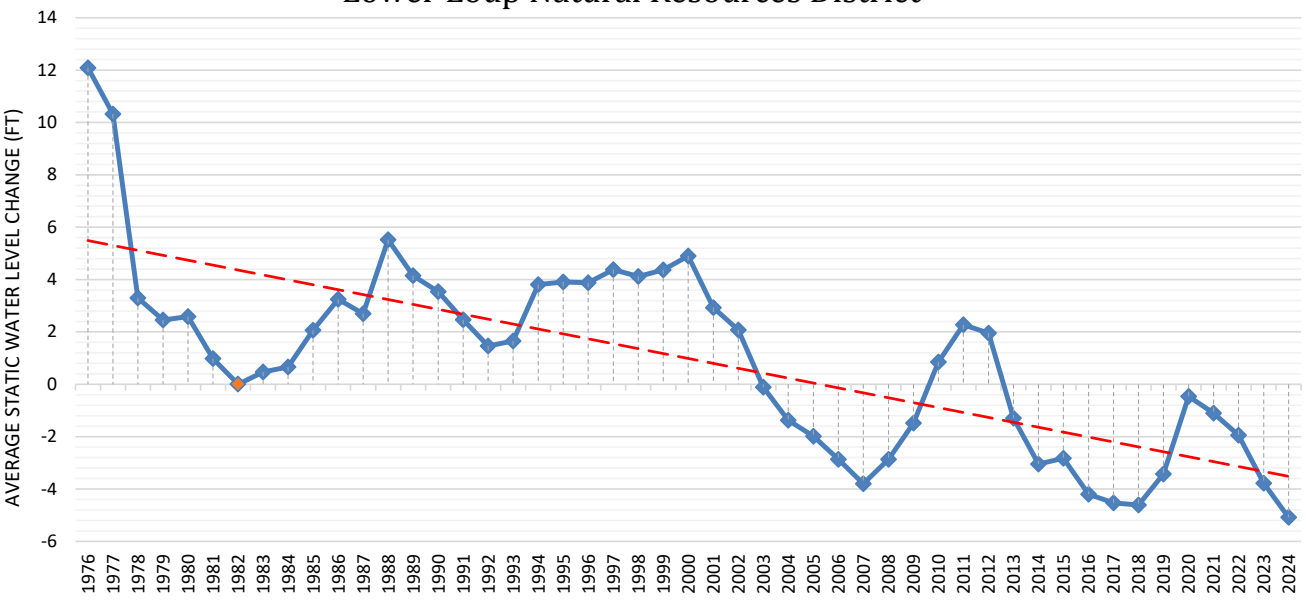
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.1479x + 3.3052



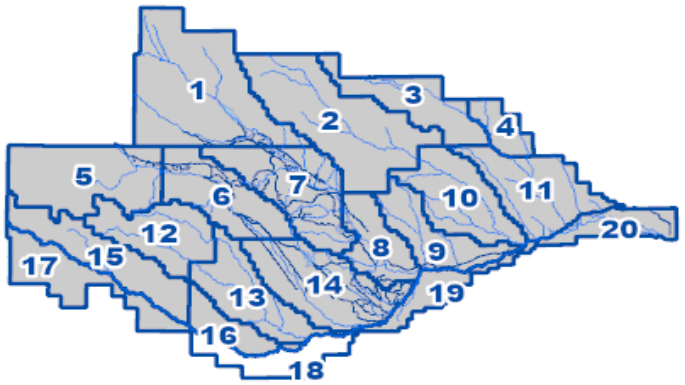


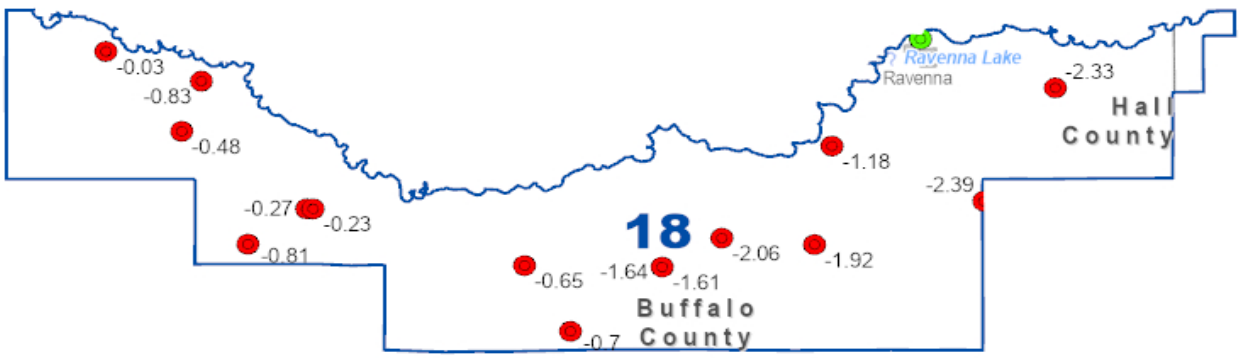
Quantity Area 18 - Spring SWL Change
Lower Loup Natural Resources District



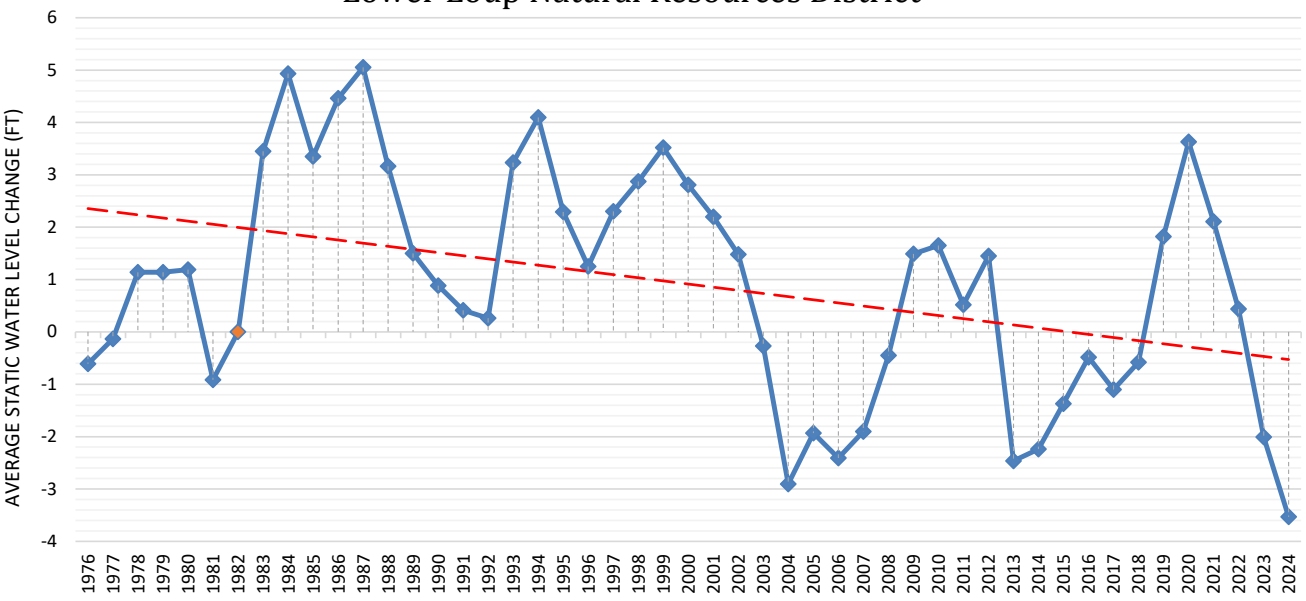
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.1876x + 5.677



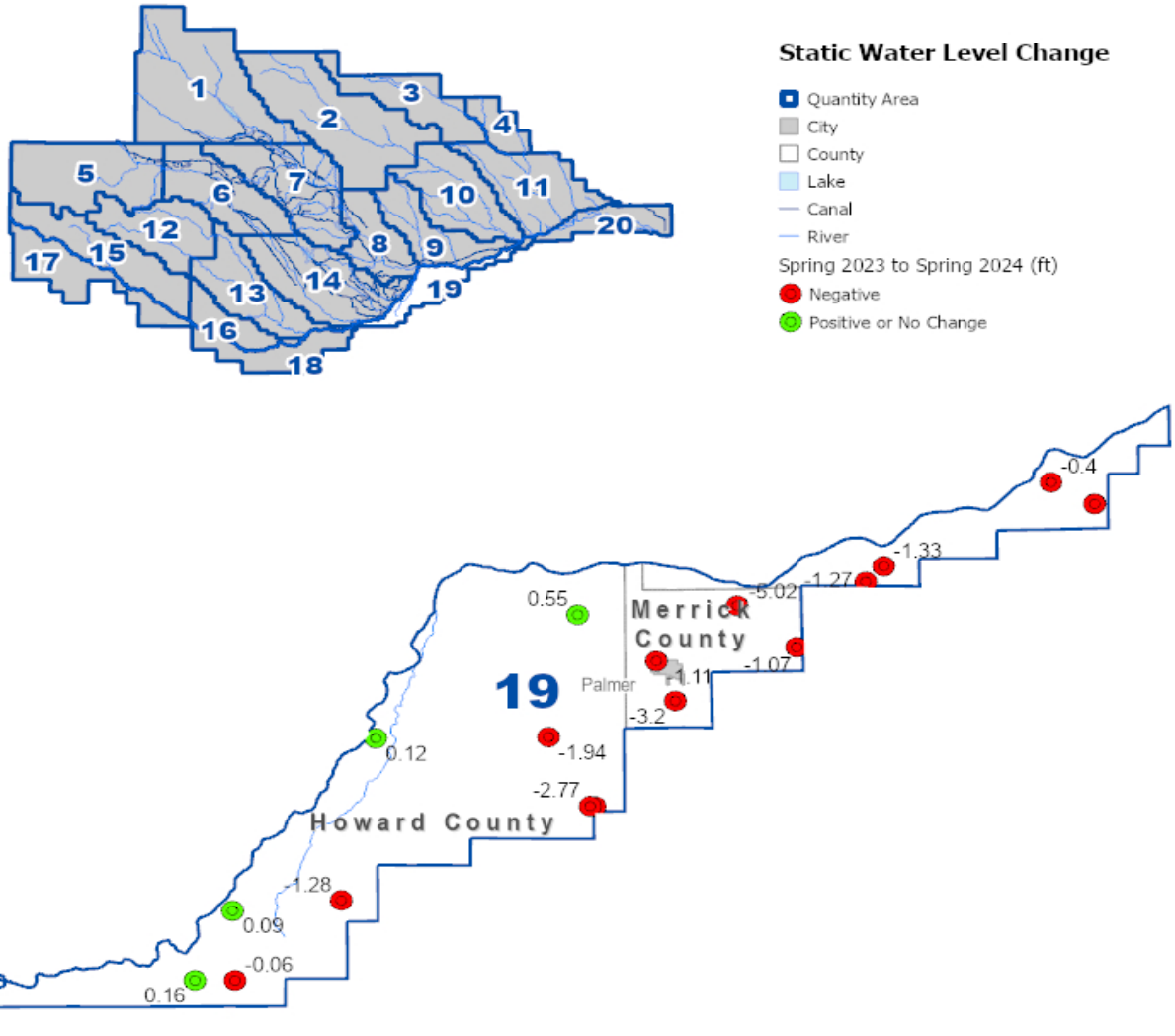


Quantity Area 19 - Spring SWL Change
Lower Loup Natural Resources District

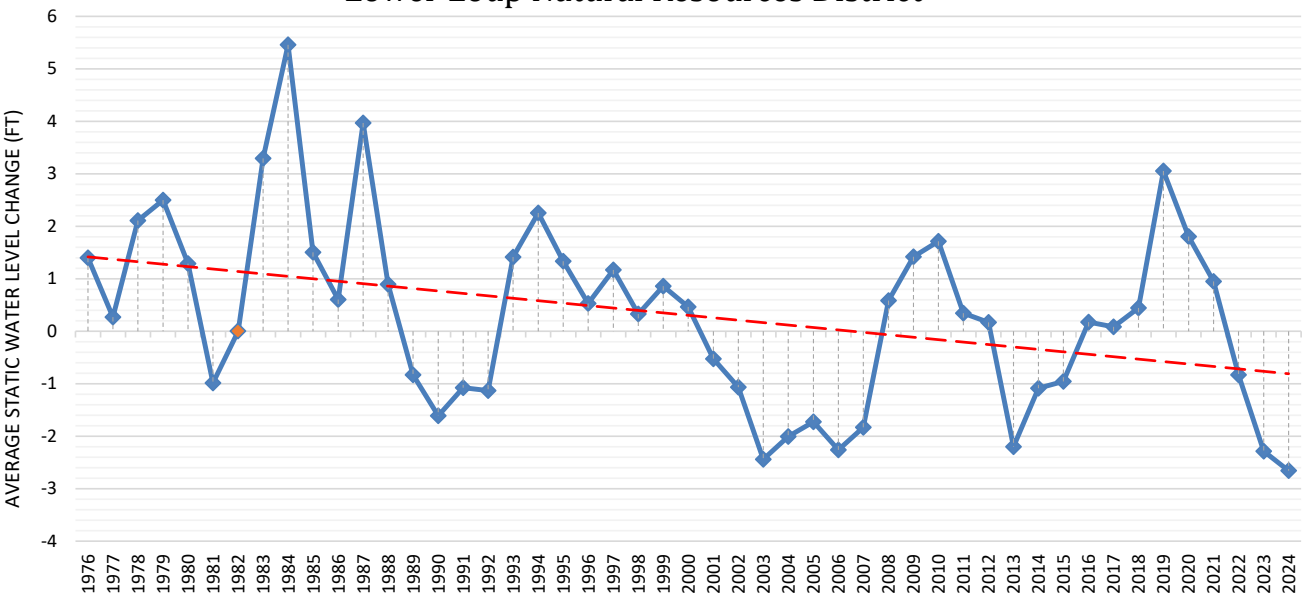


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0601x + 2.4159

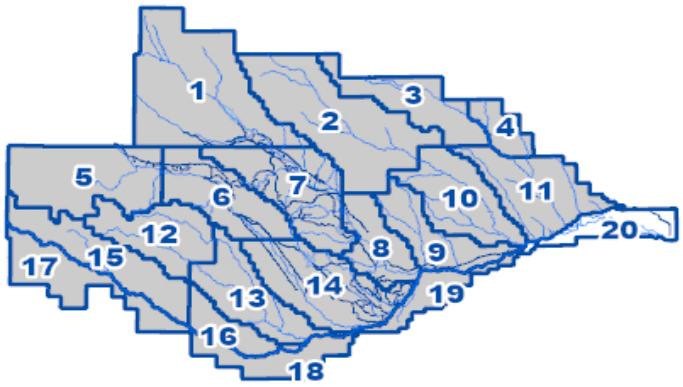


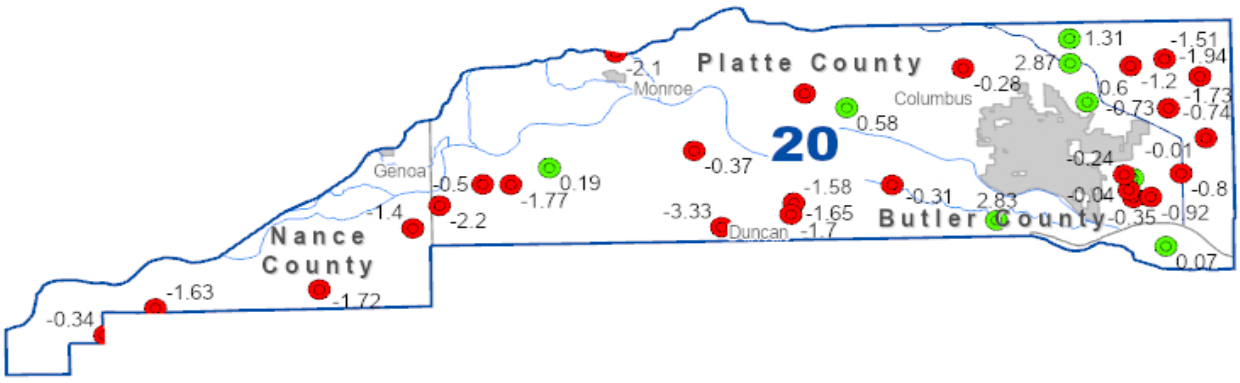
Quantity Area 20 - Spring SWL Change
Lower Loup Natural Resources District

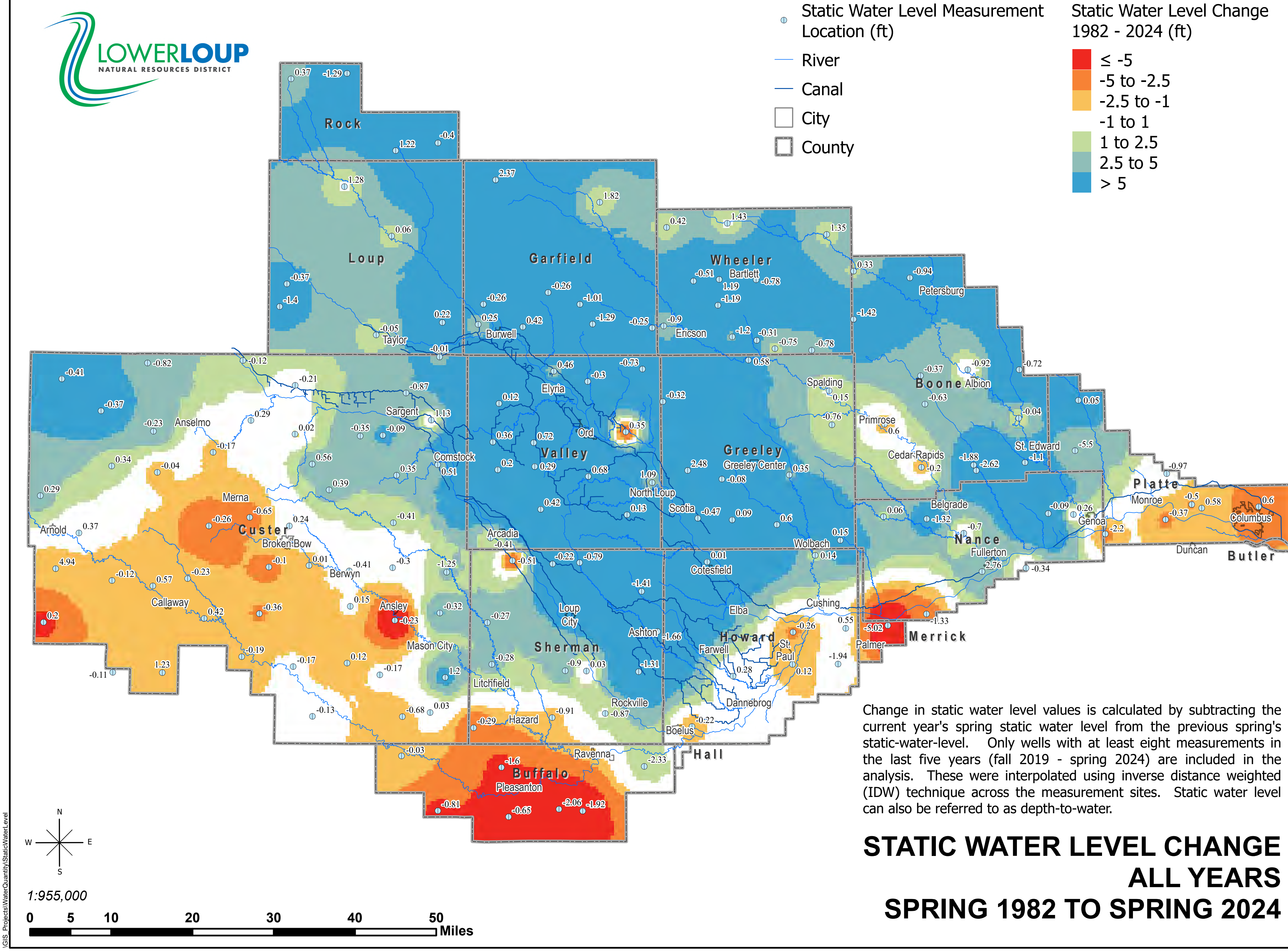


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0464x + 1.4633



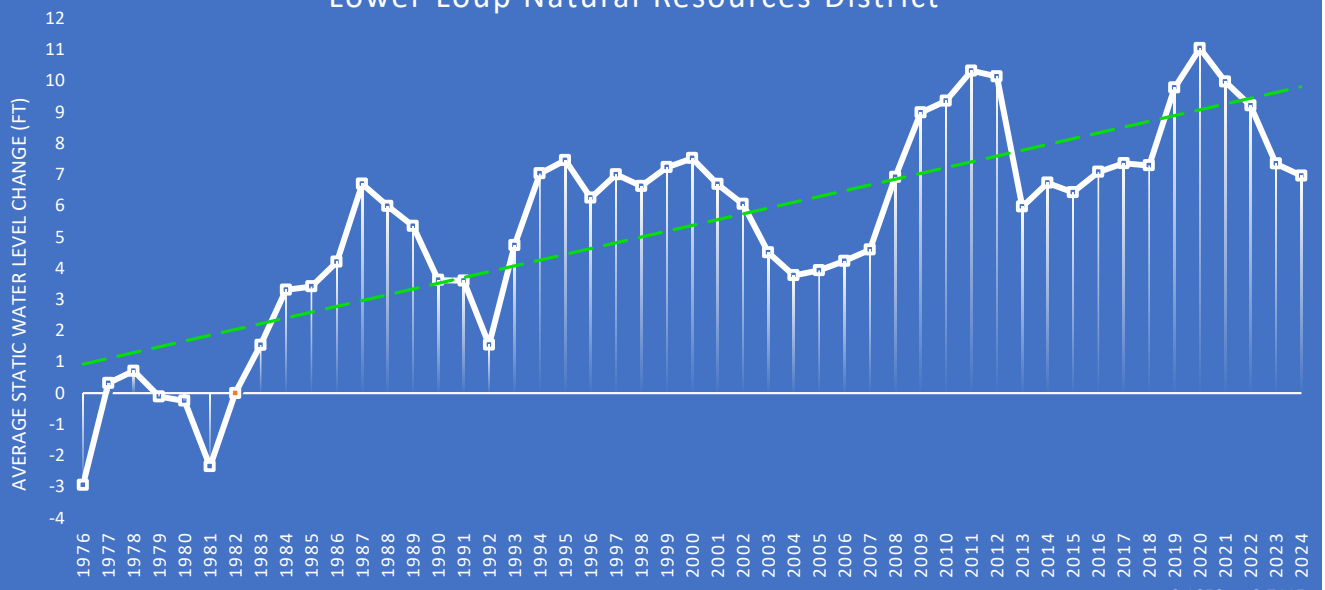




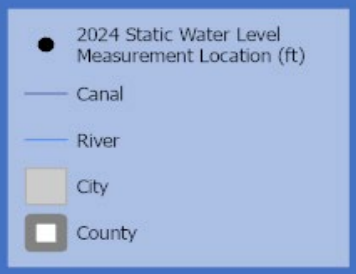
Change in static water level values is calculated by subtracting the current year's spring static water level from the previous spring's static-water-level. Only wells with at least eight measurements in the last five years (fall 2019 - spring 2024) are included in the analysis. These were interpolated using inverse distance weighted (IDW) technique across the measurement sites. Static water level can also be referred to as depth-to-water.

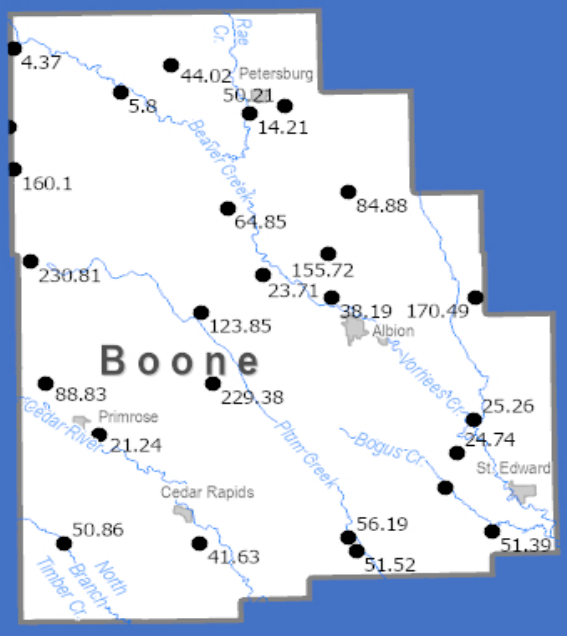
STATIC WATER LEVEL CHANGE ALL YEARS SPRING 1982 TO SPRING 2024

BOONE COUNTY - Spring SWL Change
Lower Loup Natural Resources District

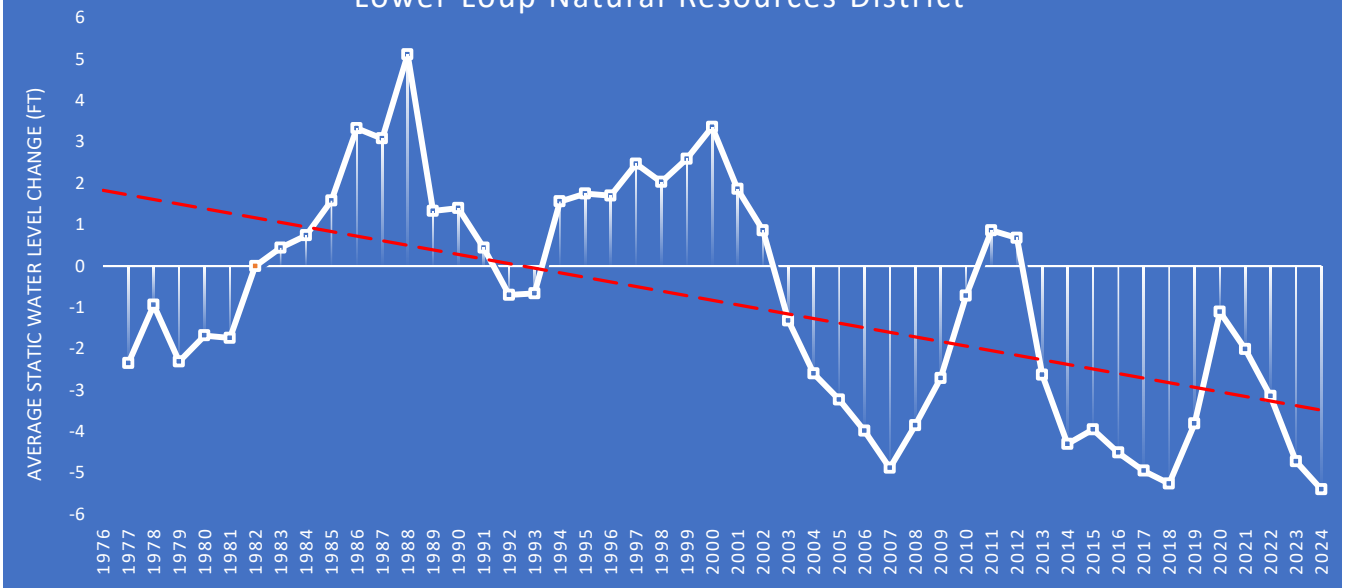


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.



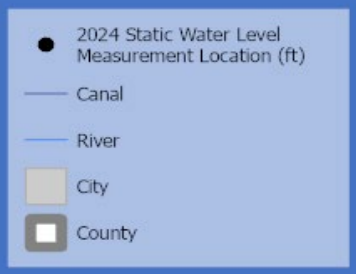


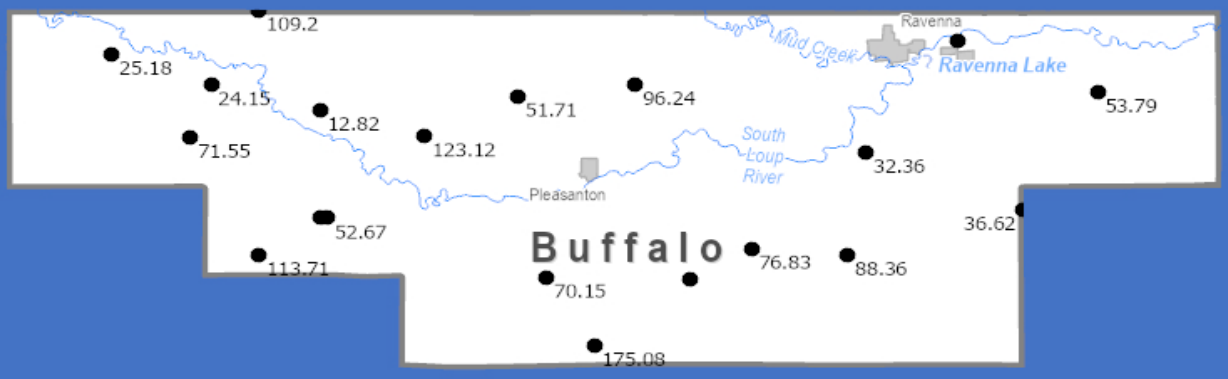
BUFFALO COUNTY - Spring SWL Change
Lower Loup Natural Resources District



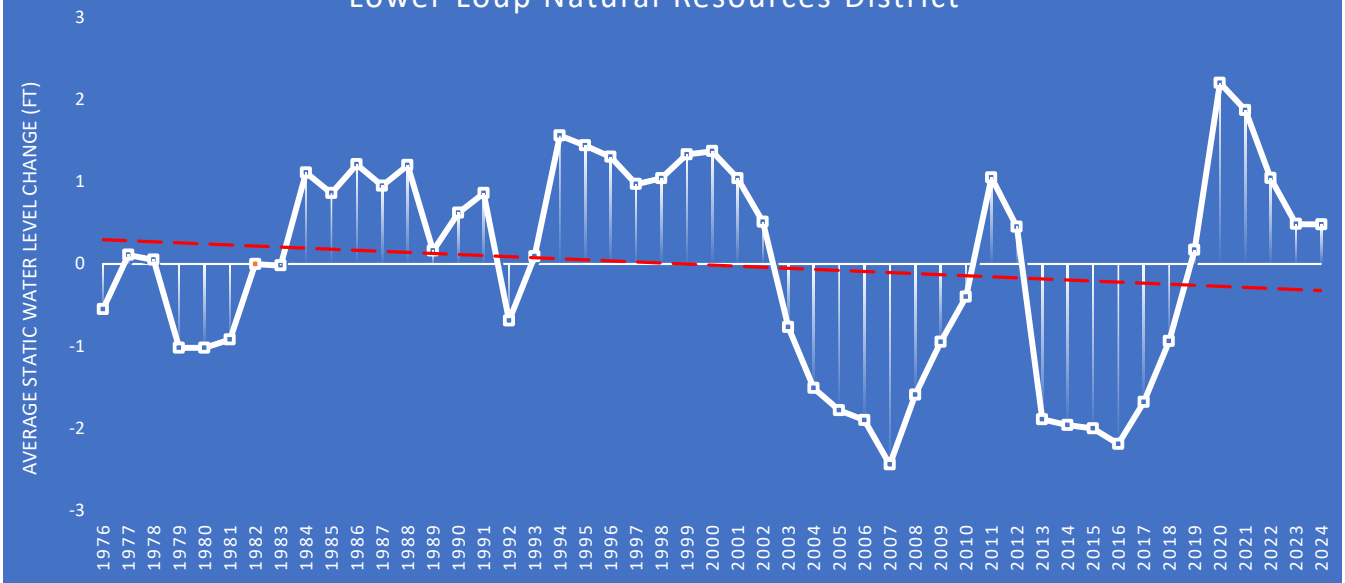
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.1107x + 1.9418



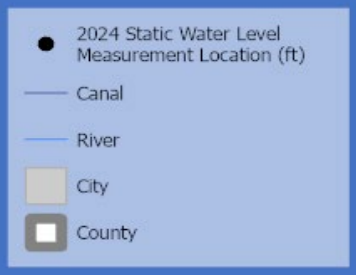


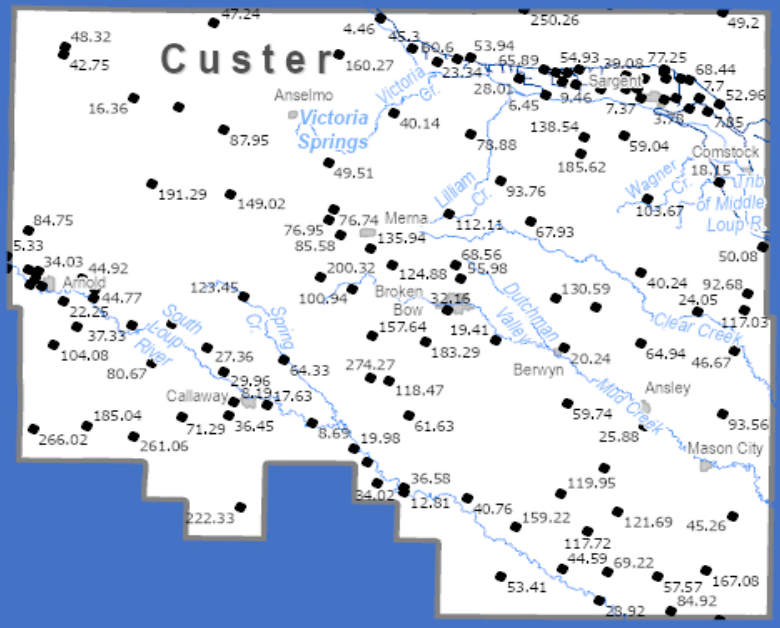
CUSTER COUNTY - Spring SWL Change
Lower Loup Natural Resources District



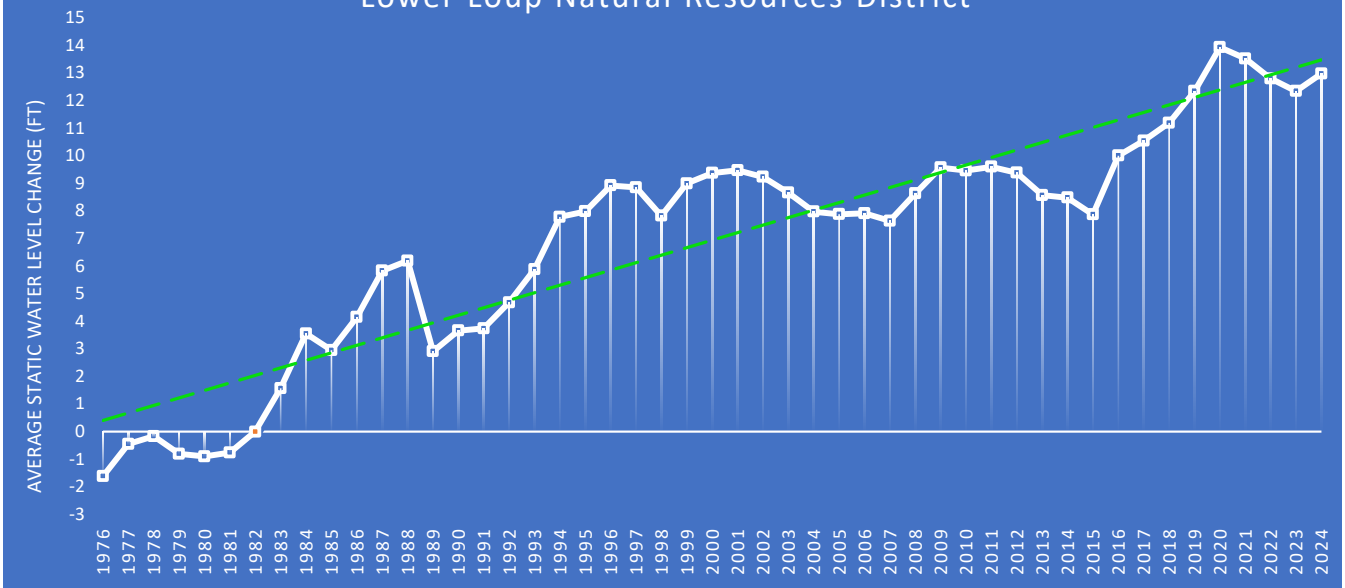
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = -0.0129x + 0.3084



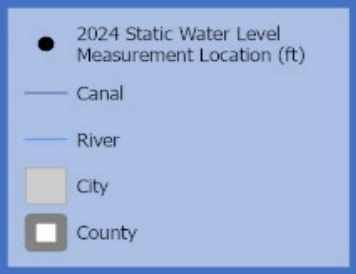


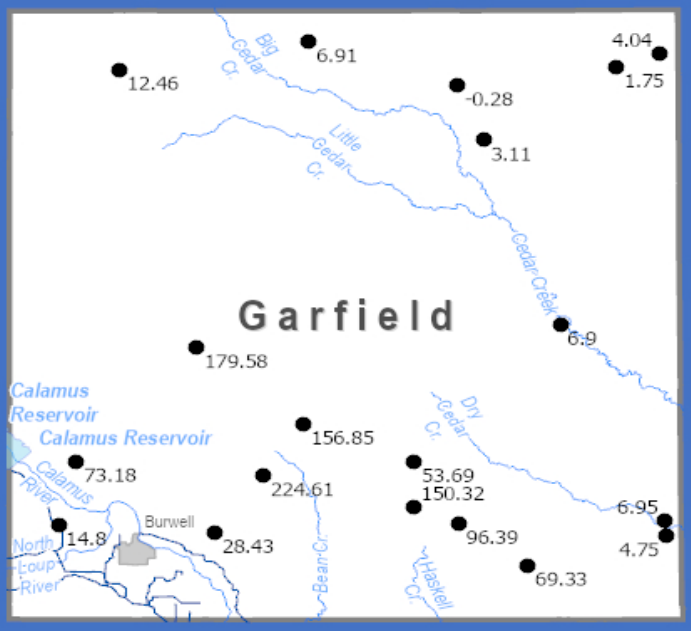
GARFIELD COUNTY - Spring SWL Change
Lower Loup Natural Resources District



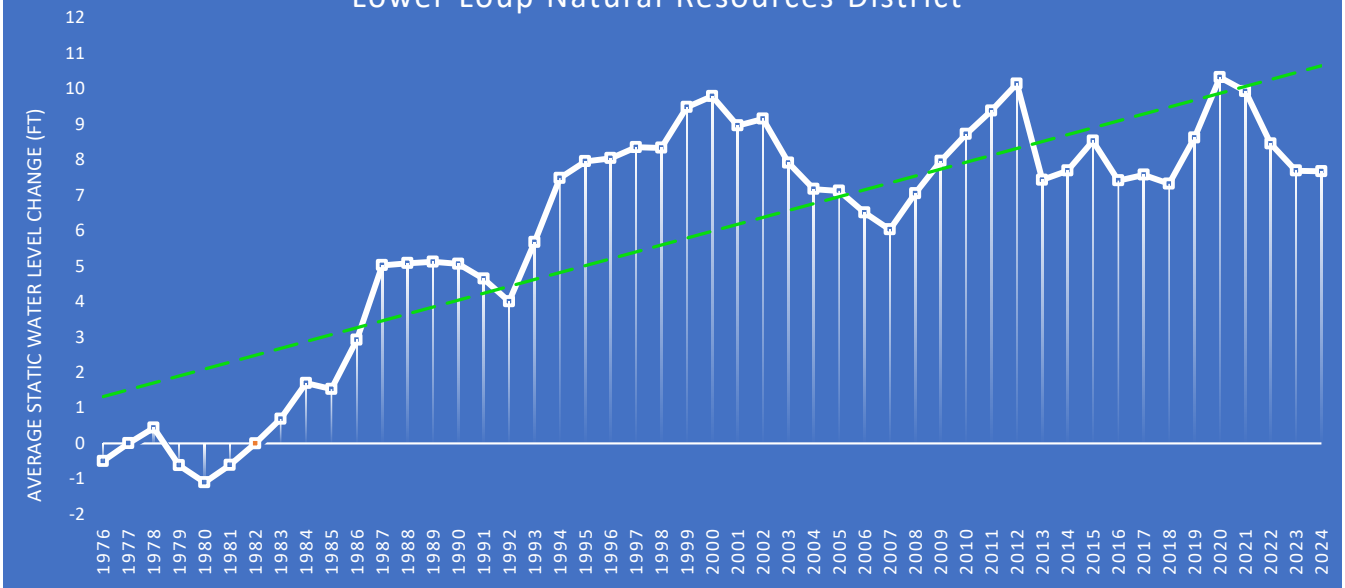
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.2723x + 0.1317



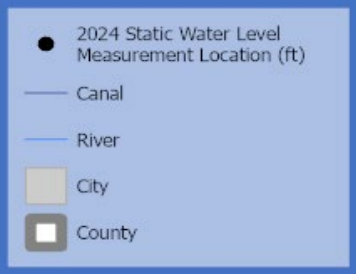


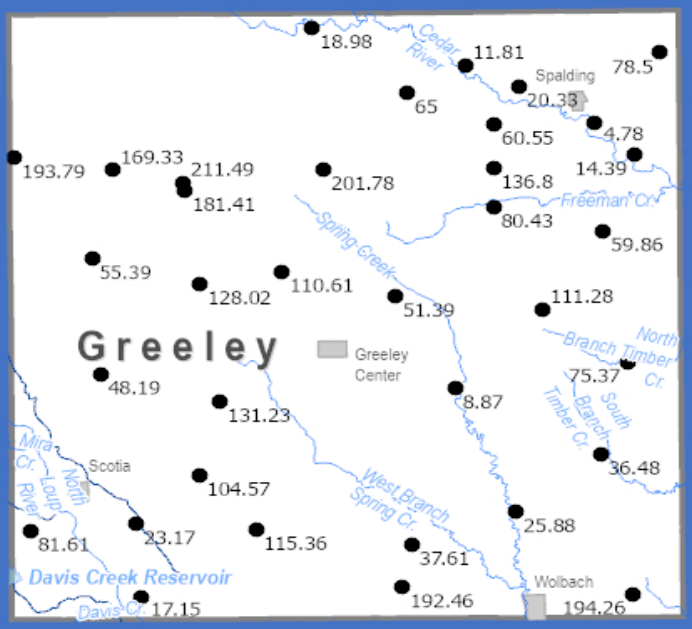
GREELEY COUNTY - Spring SWL Change
Lower Loup Natural Resources District



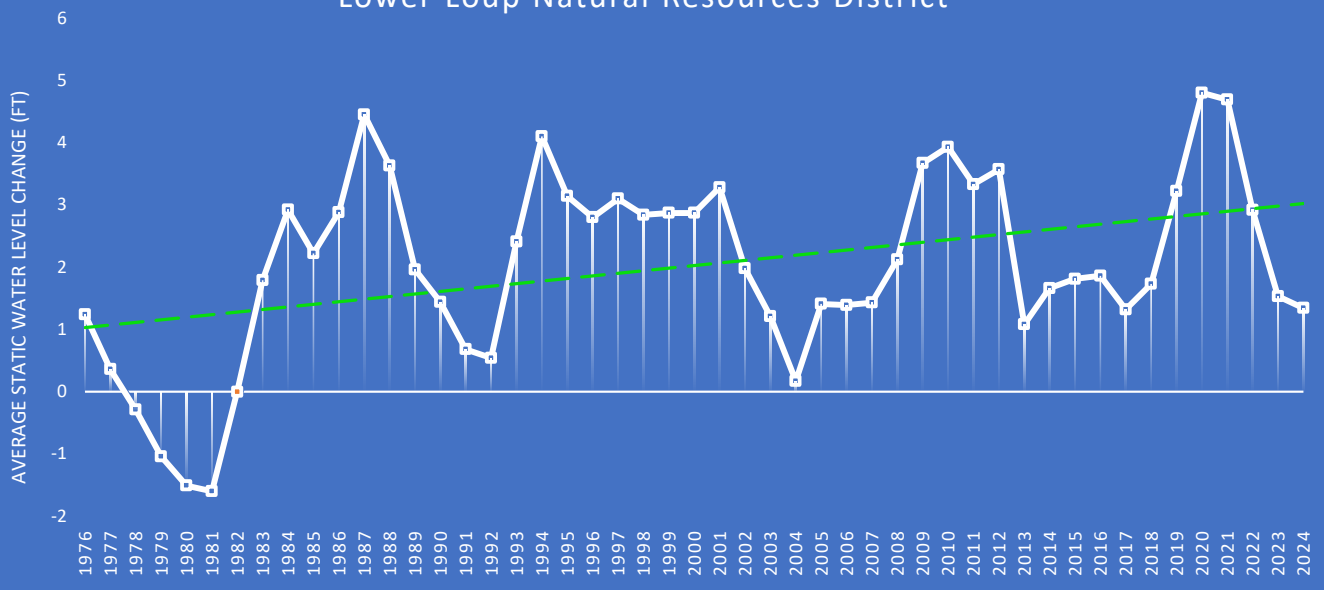
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1944x + 1.1237



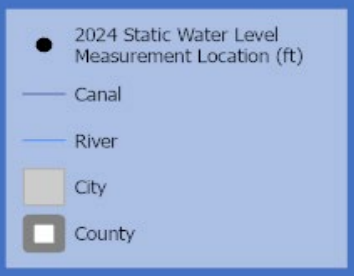


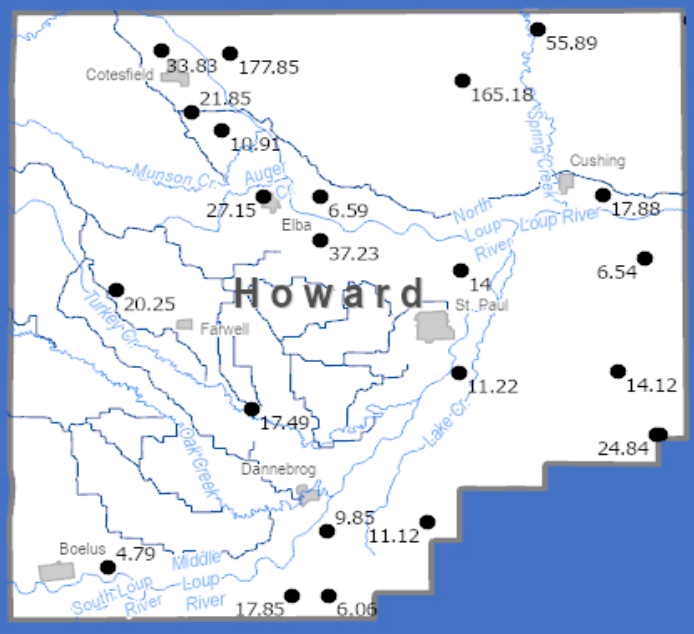
HOWARD COUNTY - Spring SWL Change
Lower Loup Natural Resources District



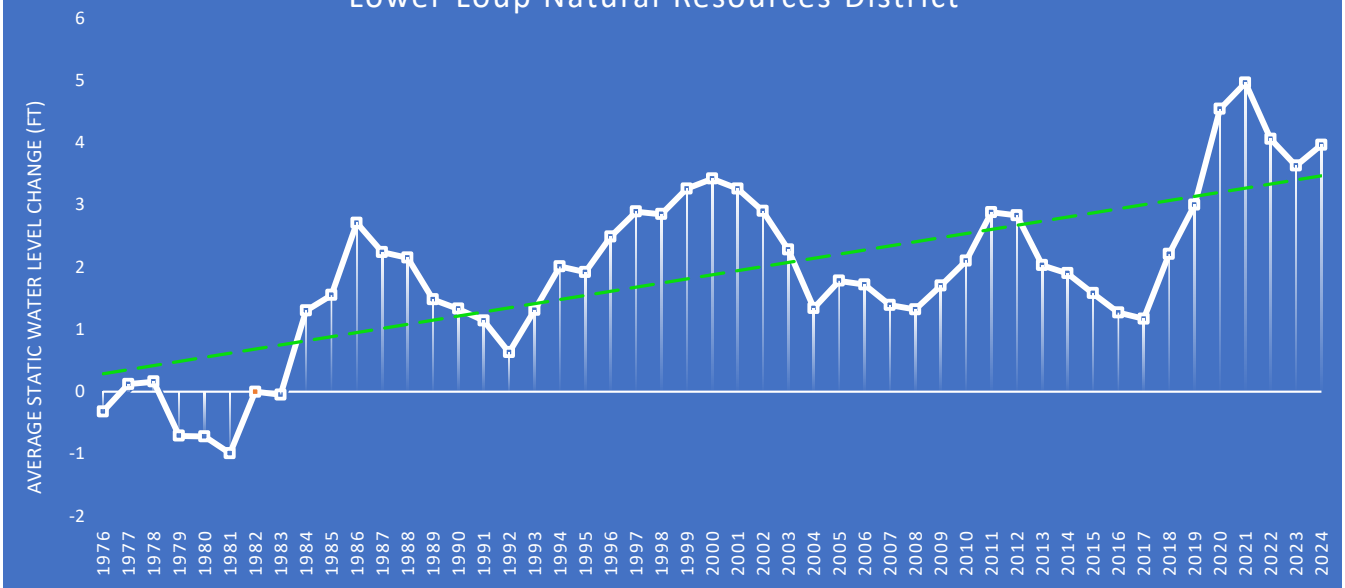
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.0415x + 0.9878



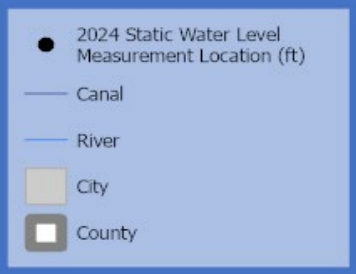


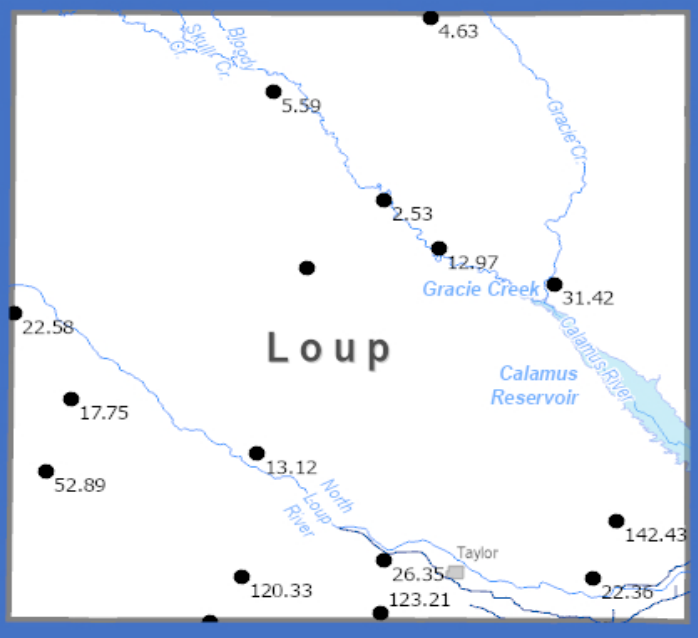
LOUP COUNTY - Spring SWL Change
Lower Loup Natural Resources District



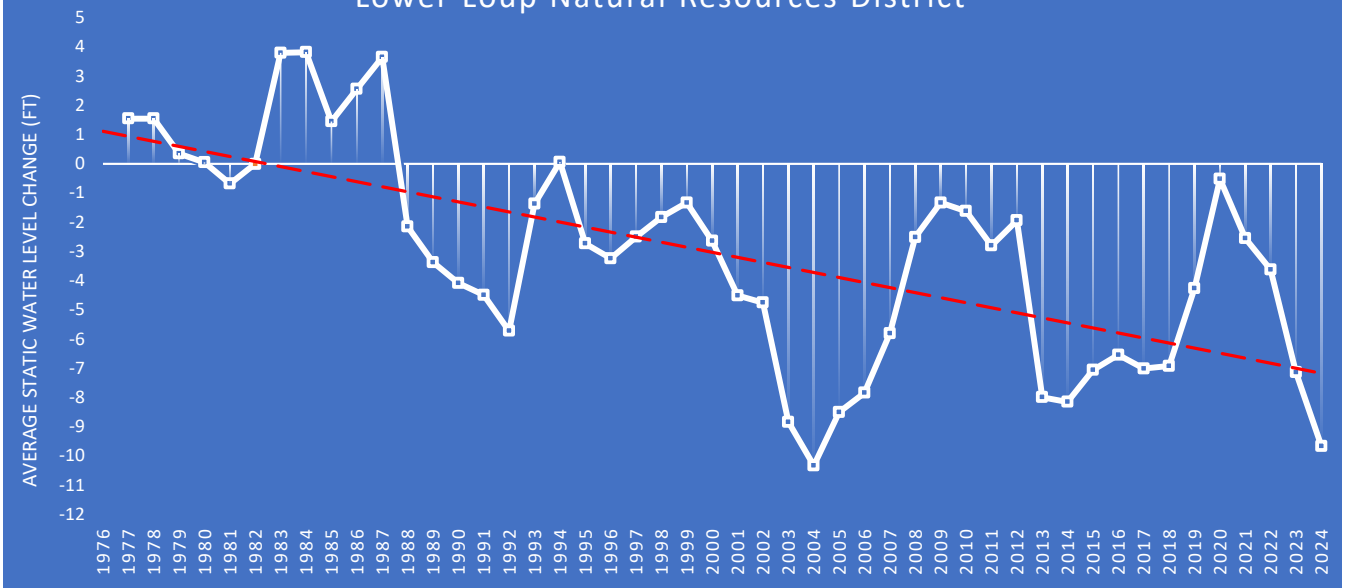
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.0663x + 0.2206



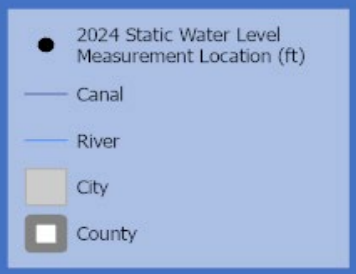


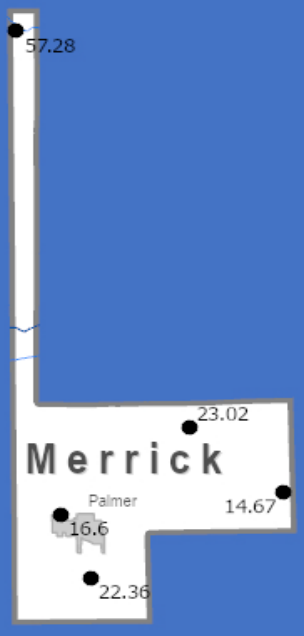
MERRICK COUNTY - Spring SWL Change
Lower Loup Natural Resources District

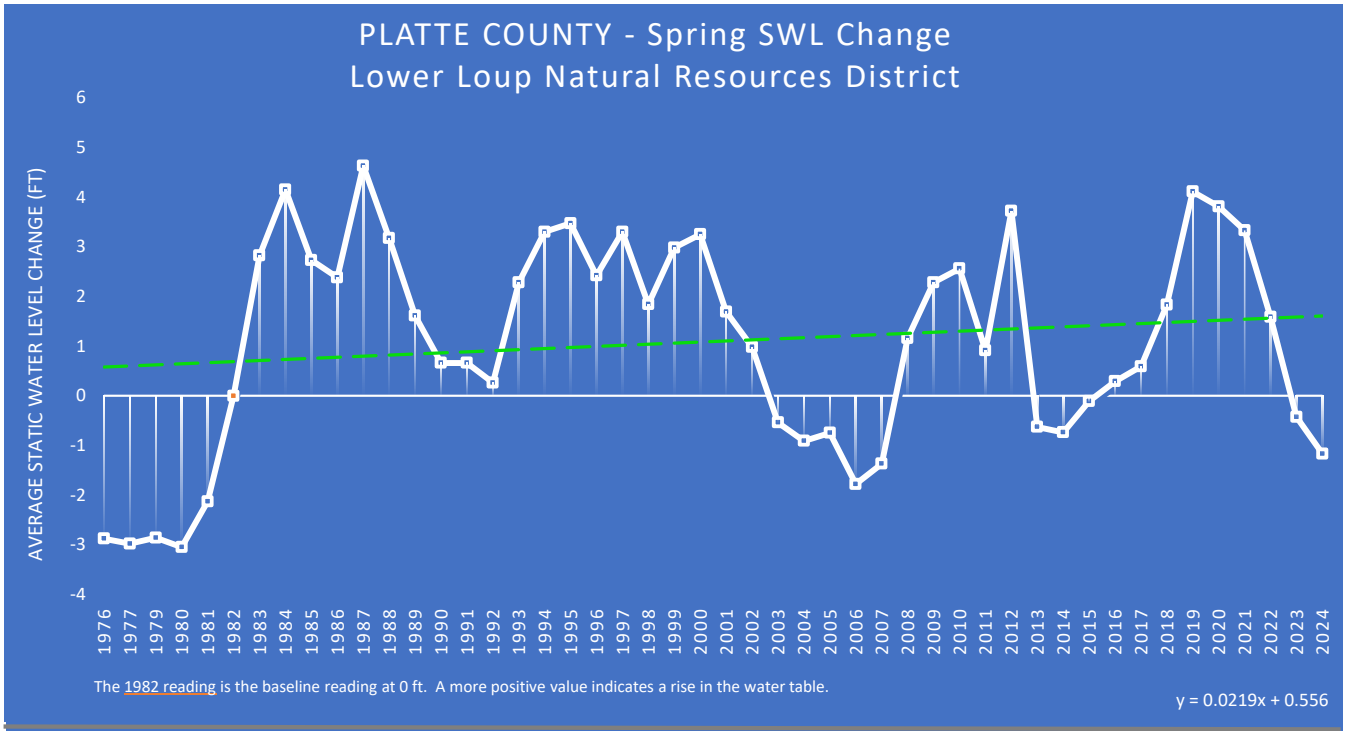


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

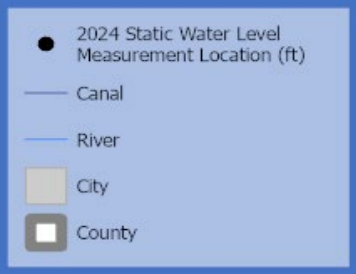
y = -0.1726x + 1.2877

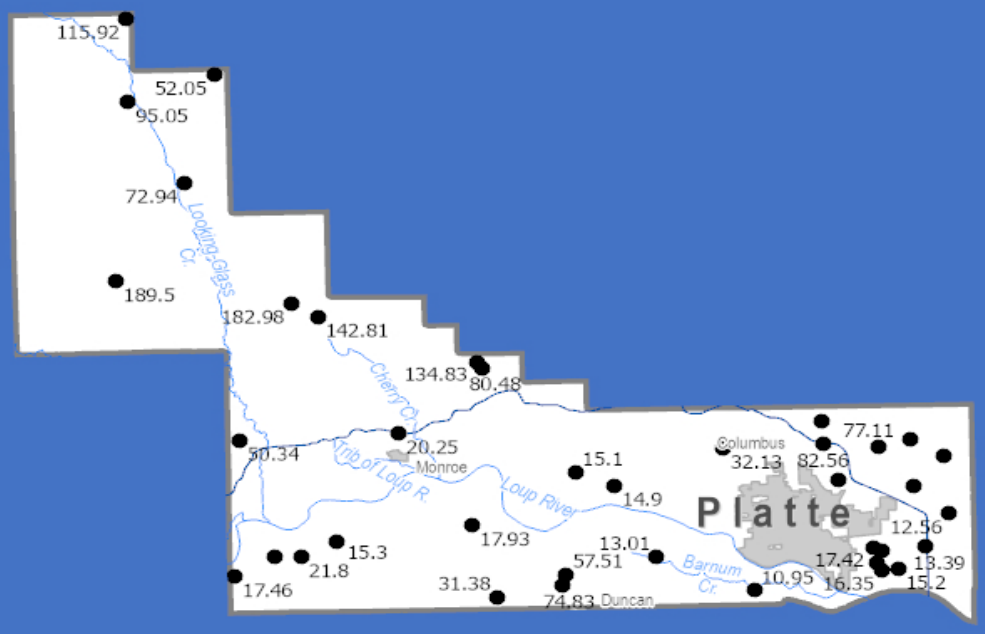


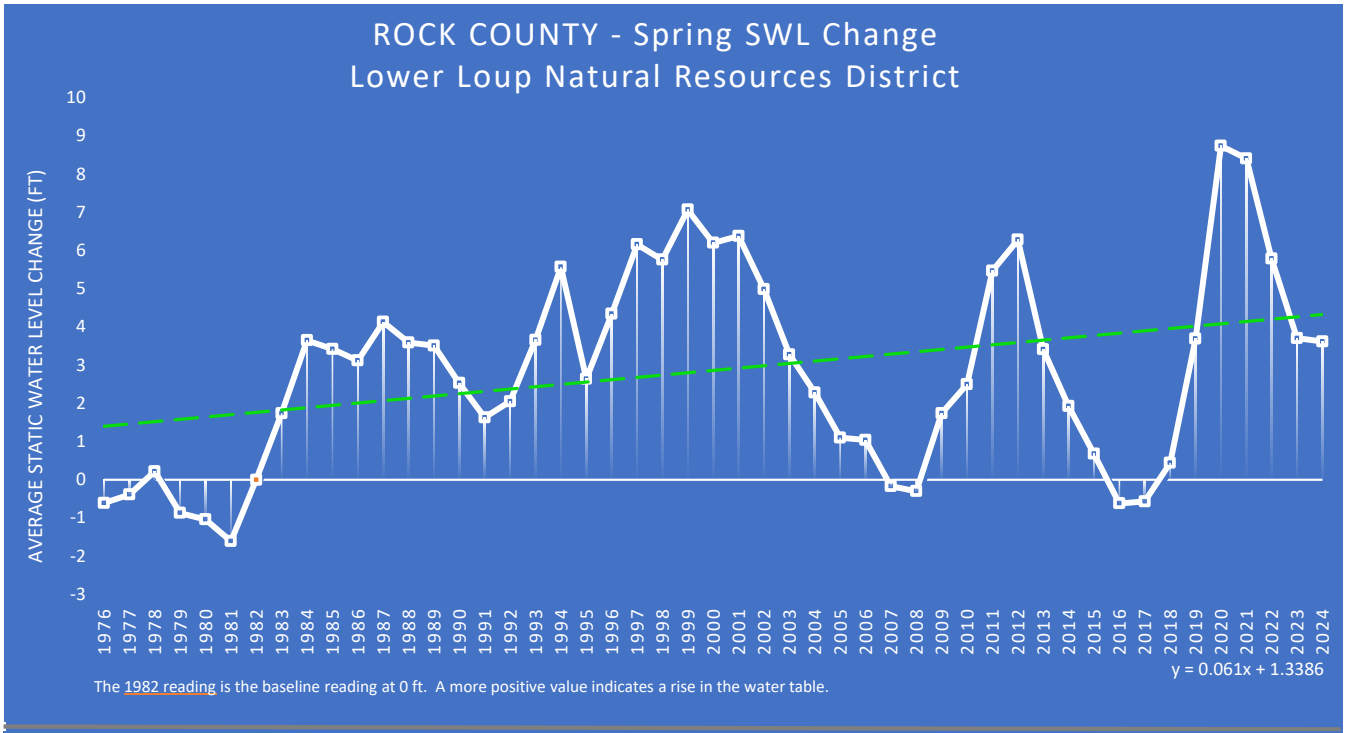



PLATTE COUNTY - Spring SWL Change
Lower Loup Natural Resources District
AVERAGE STATIC WATER LEVEL CHANGE (FT)
6
5
4
3
2
1
0
-1
-2
-3
-4
1976 1977 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.
y = 0.0219x + 0.556

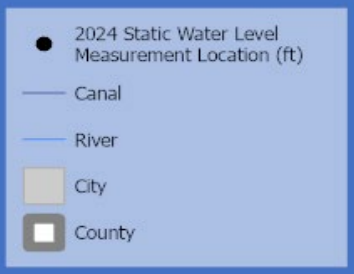

Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall

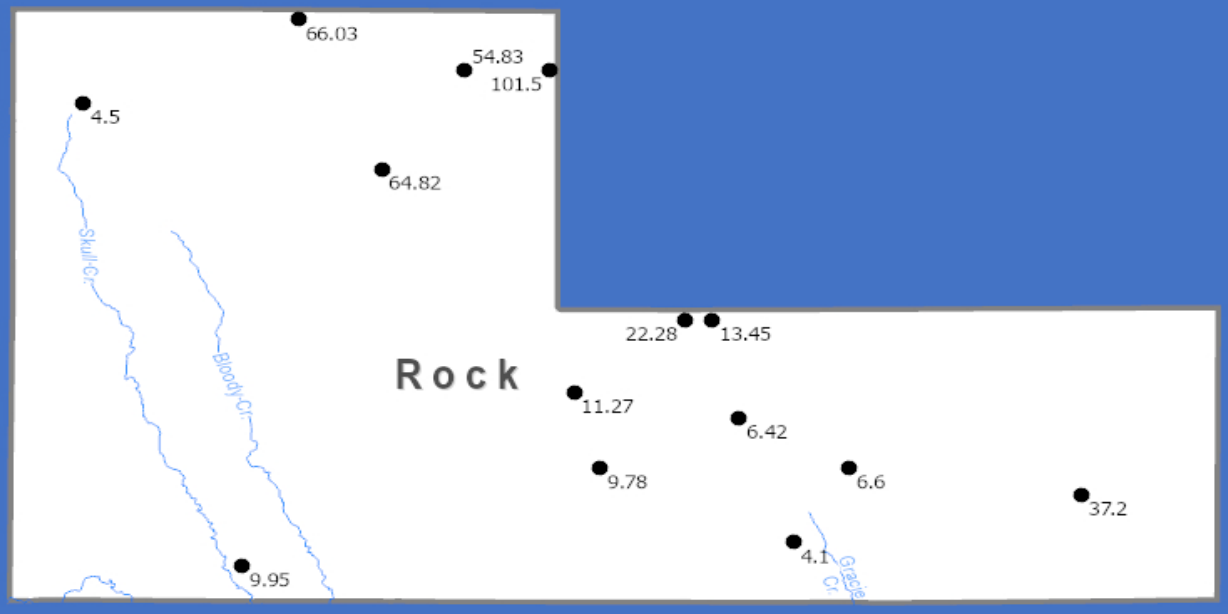

2024 Static Water Level Measurement Location (ft)
Canal
River
City
County


115.92
52.05
95.05
72.94
Looking Glass Cr.
189.5
182.98
142.81
134.83
80.48
Cherry Cr.
50.34
20.25
Monroe
Trib of Loup R.
15.1
14.9
Loup River
Columbus
32.13
77.11
82.56
Platte
12.56
17.93
13.01
57.51
Barnum Cr.
17.42
13.39
15.2
16.35
10.95
15.3
21.8
17.46
31.38
74.83
Duncan

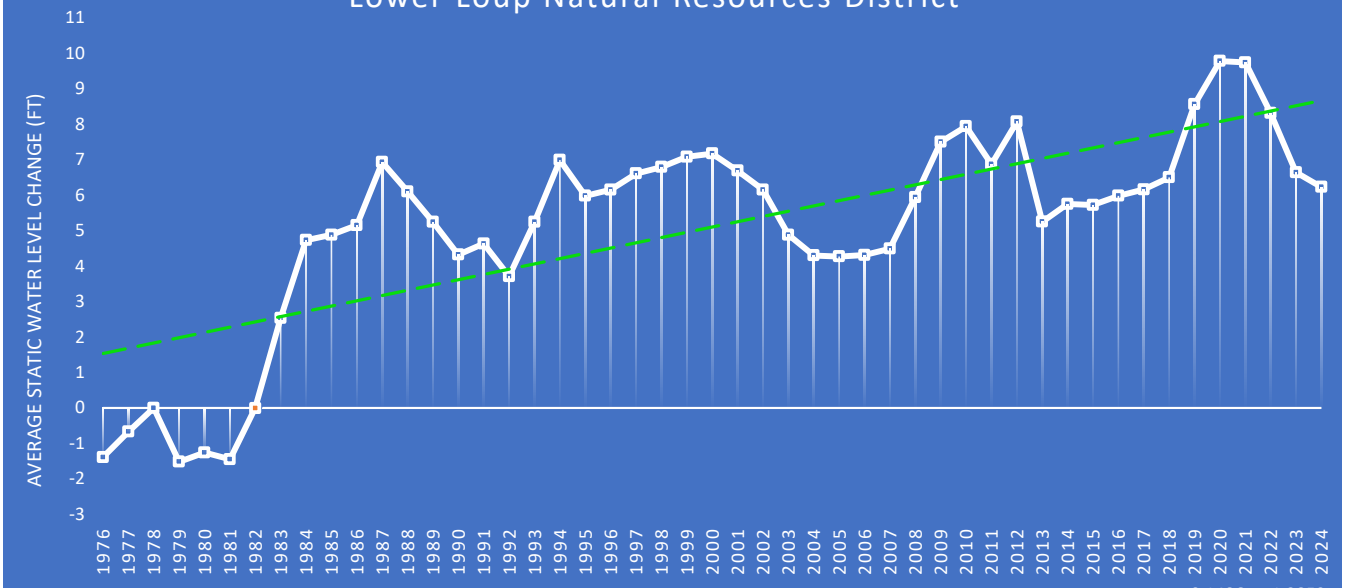


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

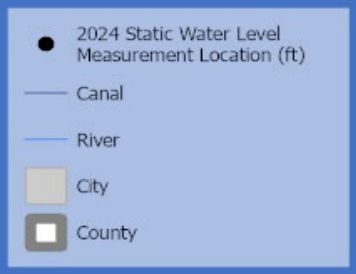


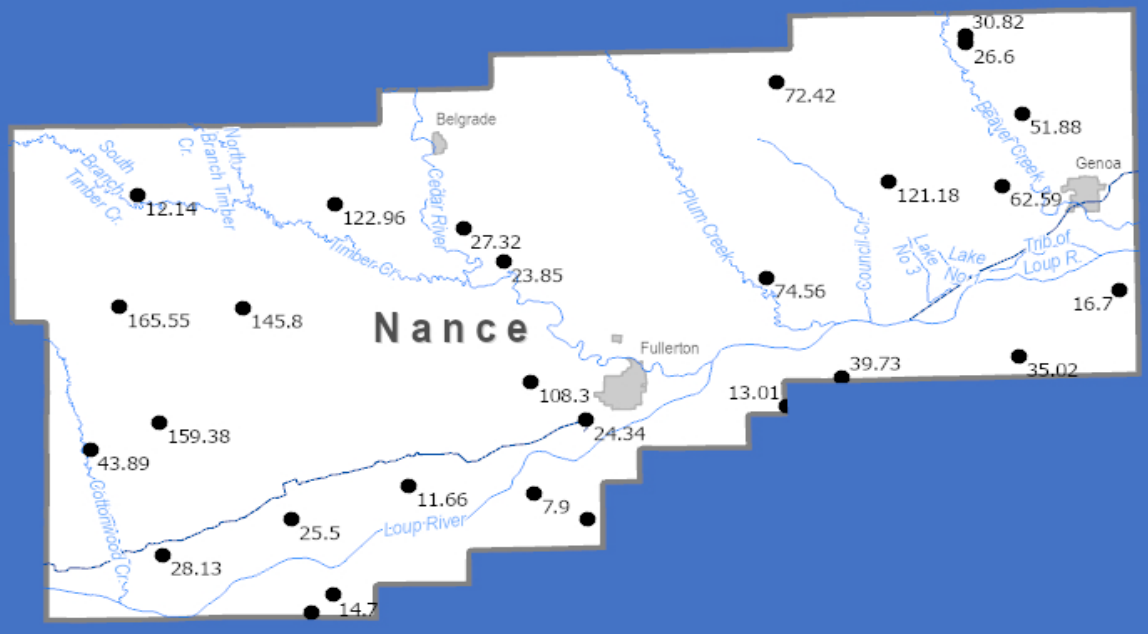


NANCE COUNTY - Spring SWL Change
Lower Loup Natural Resources District

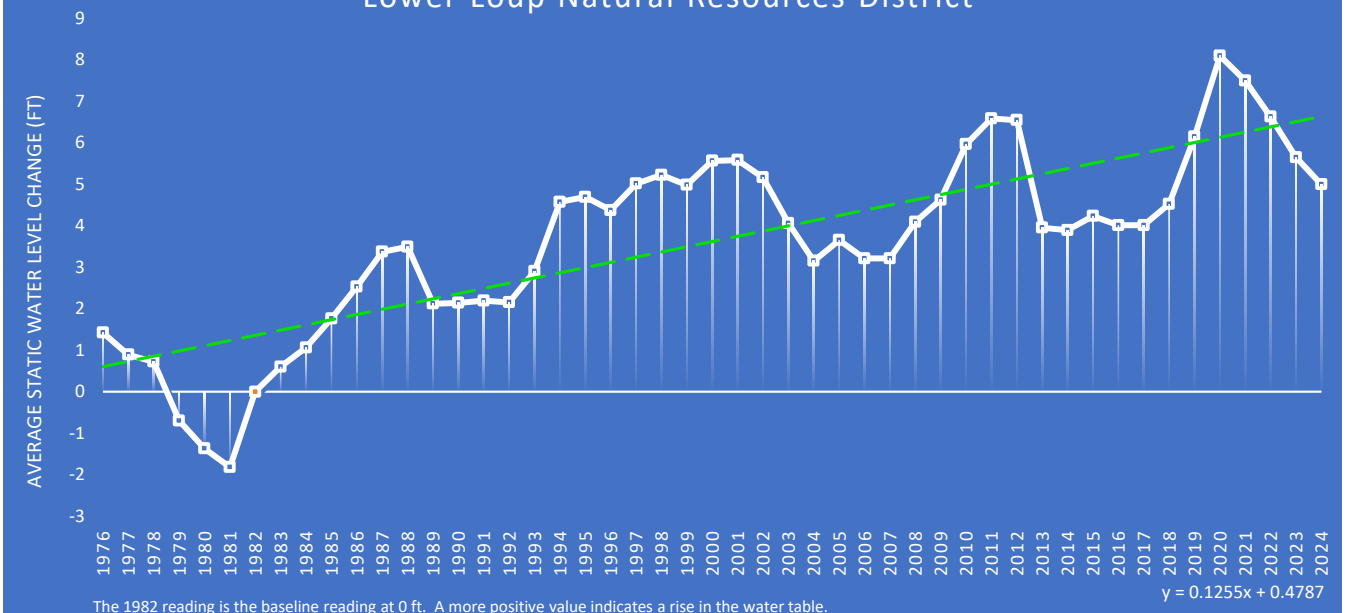


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

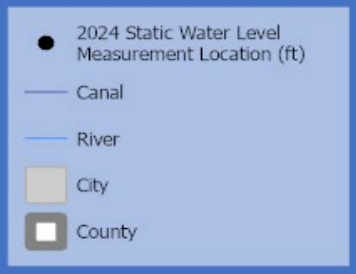


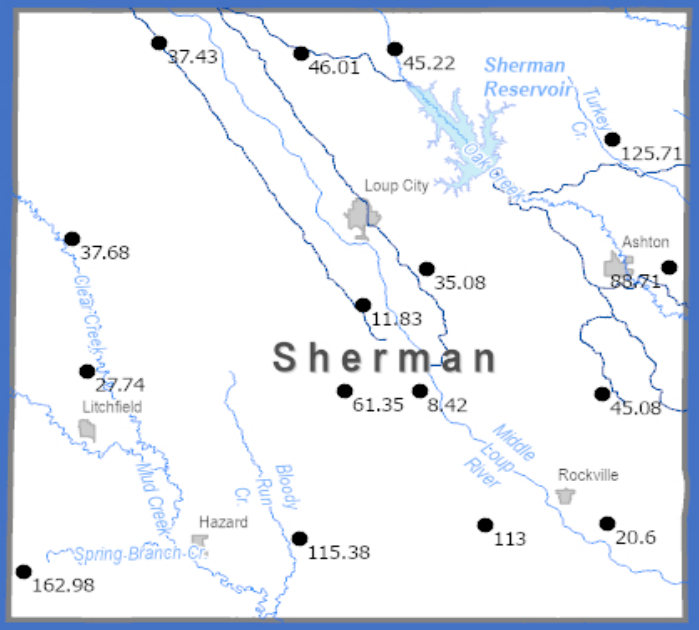


SHERMAN COUNTY - Spring SWL Change
Lower Loup Natural Resources District

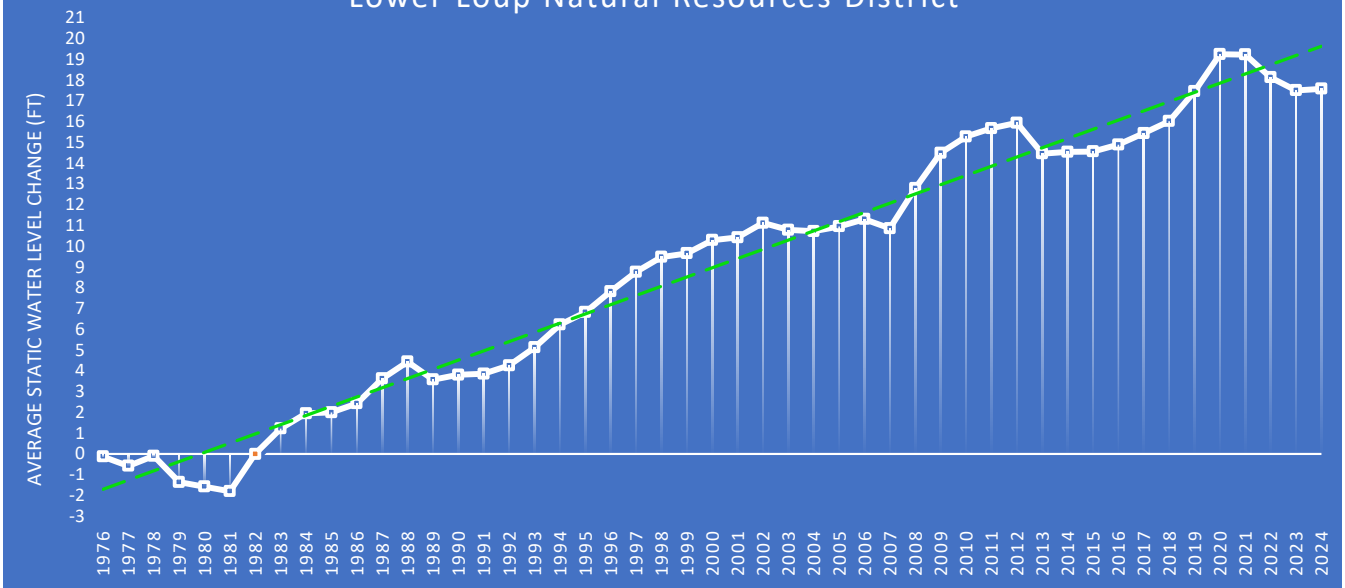


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.



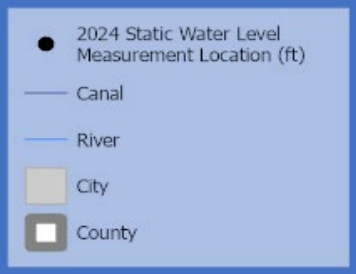


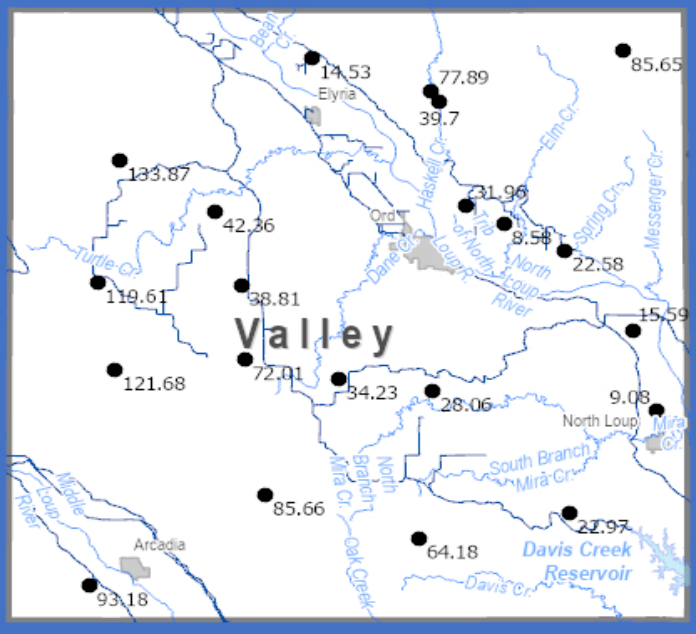
VALLEY COUNTY - Spring SWL Change
Lower Loup Natural Resources District



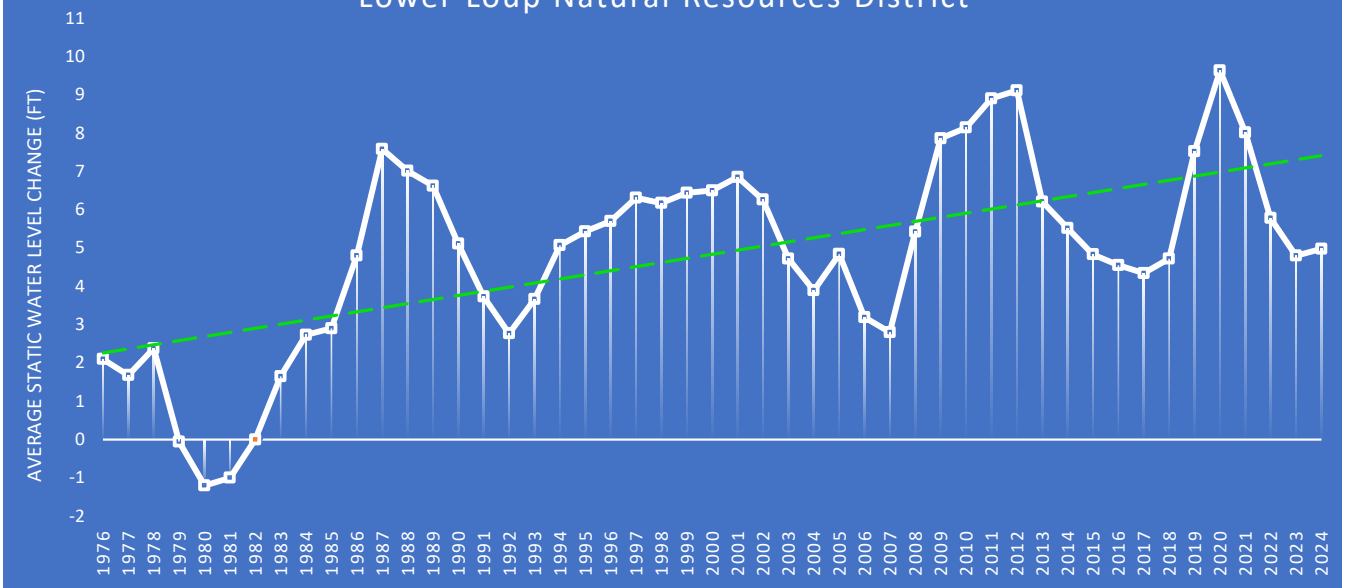
The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.4447x - 2.1489



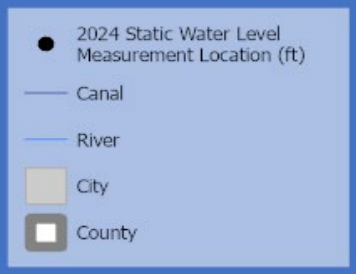


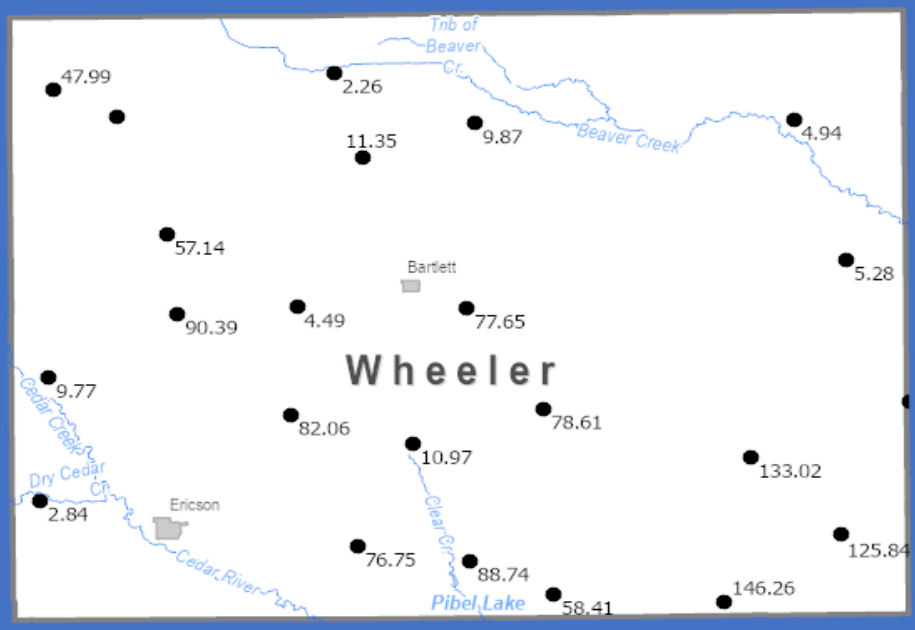
WHEELER COUNTY - Spring SWL Change
Lower Loup Natural Resources District

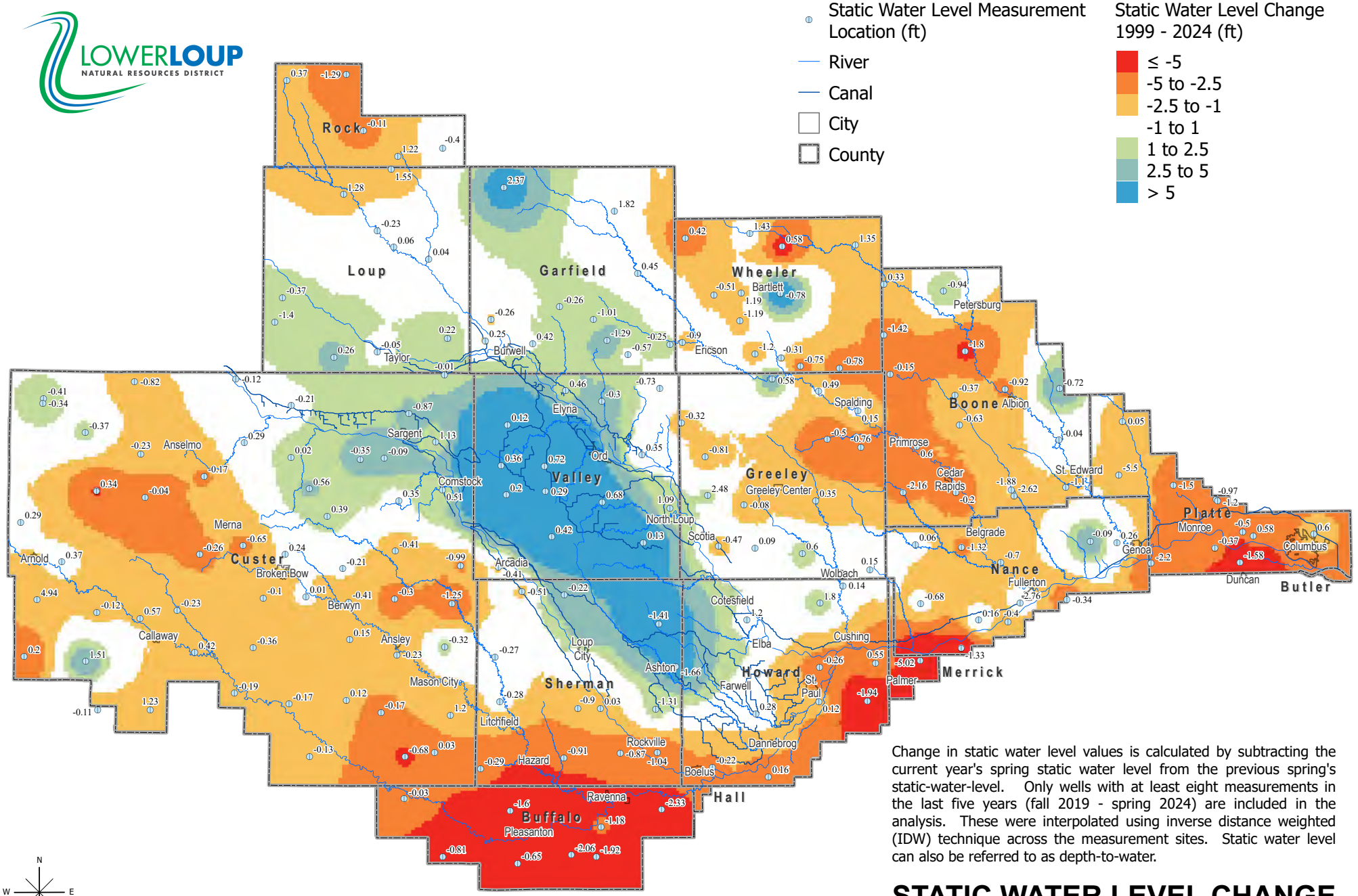


The 1982 reading is the baseline reading at 0 ft. A more positive value indicates a rise in the water table.

y = 0.1073x + 2.1525



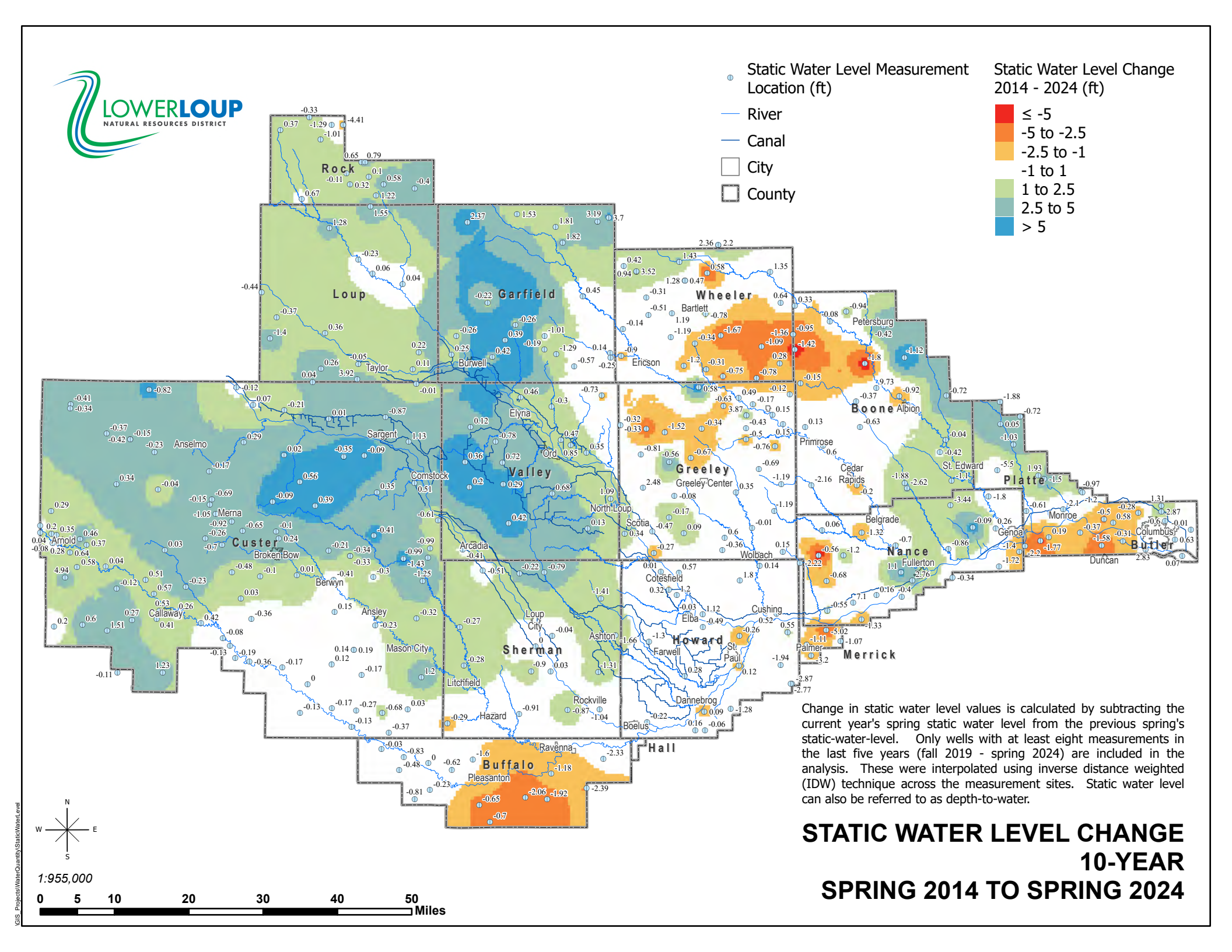




Change in static water level values is calculated by subtracting the current year's spring static water level from the previous spring's static-water-level. Only wells with at least eight measurements in the last five years (fall 2019 - spring 2024) are included in the analysis. These were interpolated using inverse distance weighted (IDW) technique across the measurement sites. Static water level can also be referred to as depth-to-water.

STATIC WATER LEVEL CHANGE 25-YEAR SPRING 1999 TO SPRING 2024

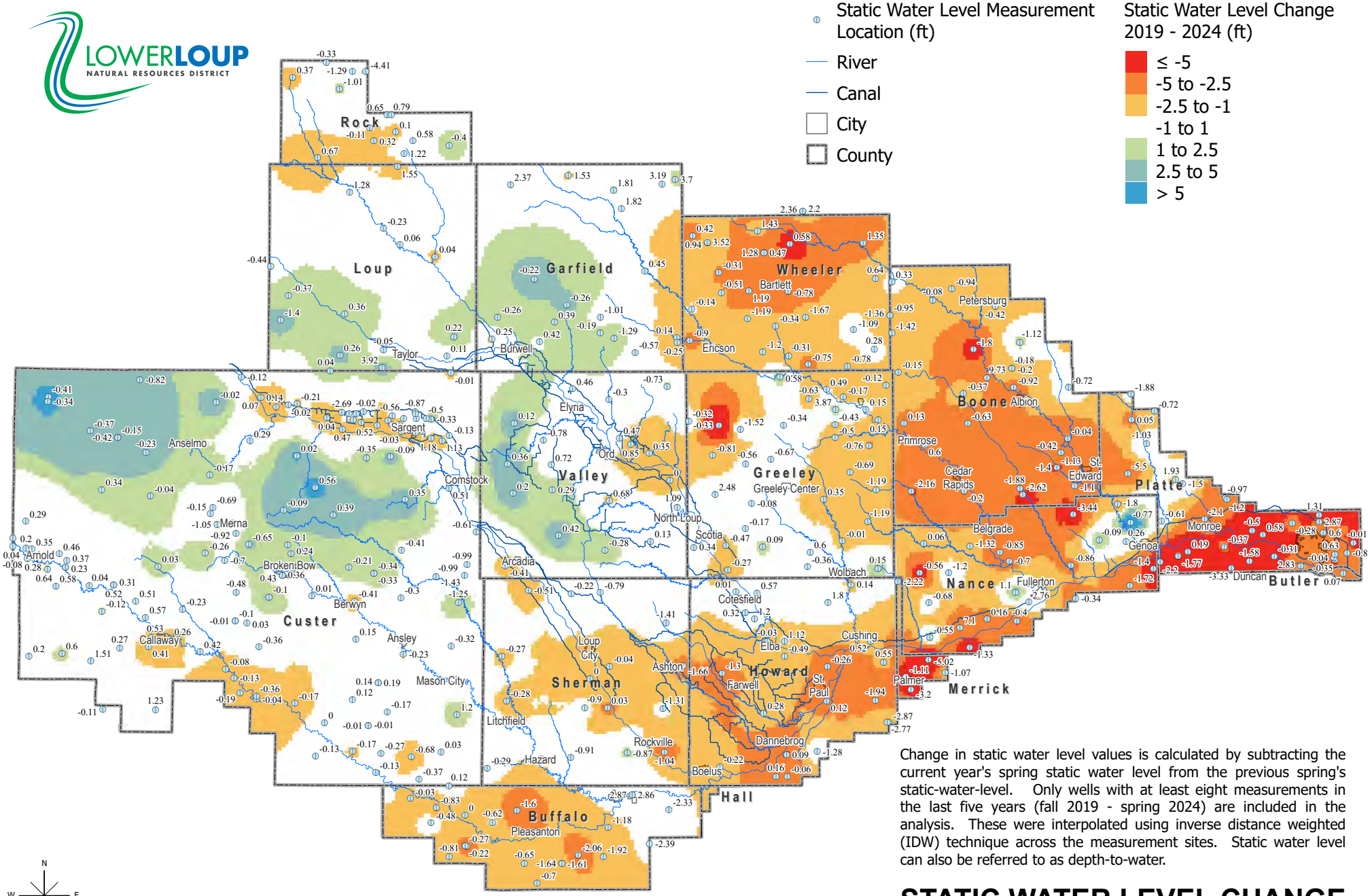
\GIS_Projects\WaterQuantity\StaticWaterLevel



Change in static water level values is calculated by subtracting the current year's spring static water level from the previous spring's static-water-level. Only wells with at least eight measurements in the last five years (fall 2019 - spring 2024) are included in the analysis. These were interpolated using inverse distance weighted (IDW) technique across the measurement sites. Static water level can also be referred to as depth-to-water.

STATIC WATER LEVEL CHANGE 10-YEAR SPRING 2014 TO SPRING 2024

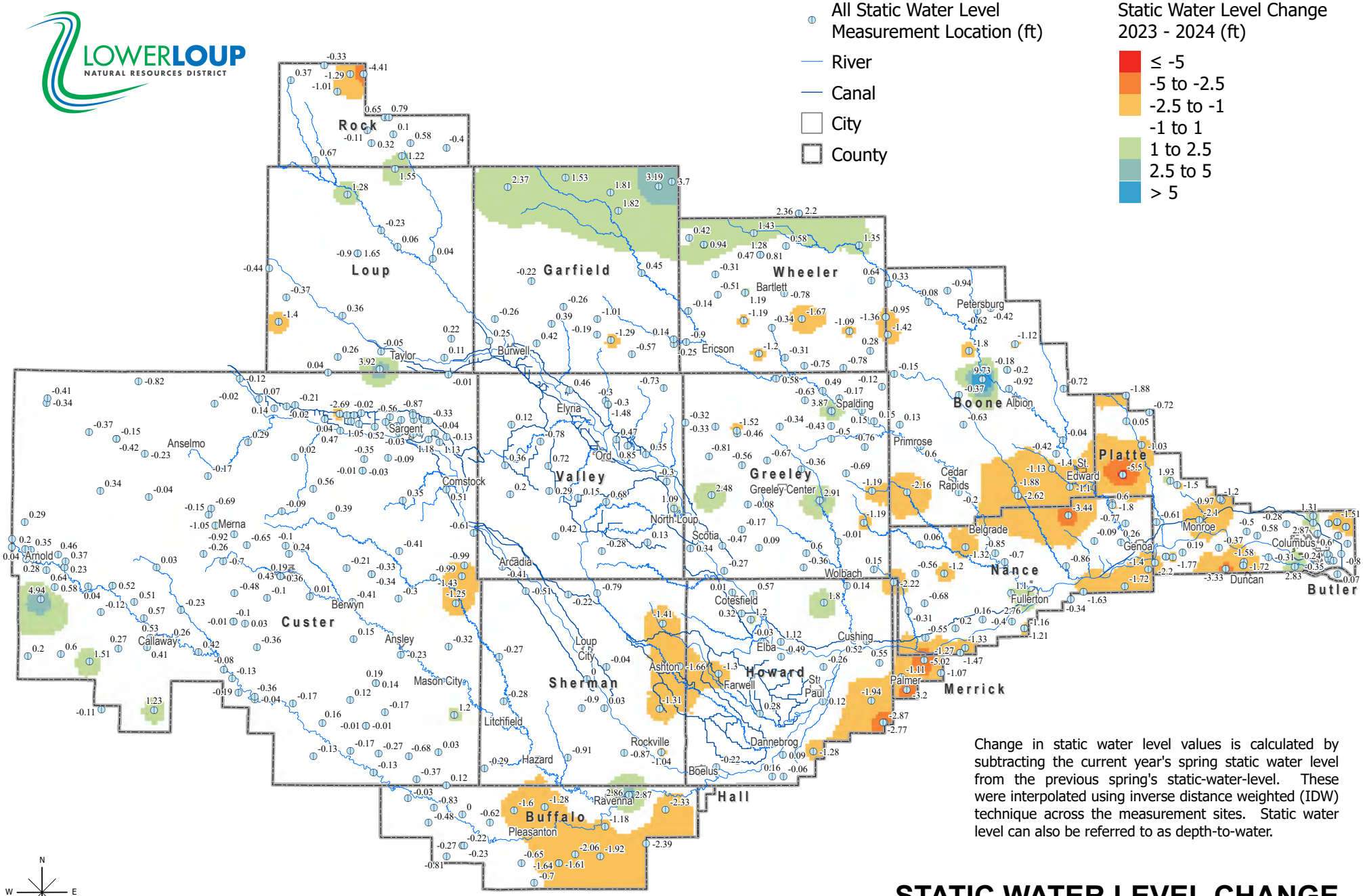
\GIS_Projects\WaterQuantity\StaticWaterLevel



Change in static water level values is calculated by subtracting the current year's spring static water level from the previous spring's static-water-level. Only wells with at least eight measurements in the last five years (fall 2019 - spring 2024) are included in the analysis. These were interpolated using inverse distance weighted (IDW) technique across the measurement sites. Static water level can also be referred to as depth-to-water.

STATIC WATER LEVEL CHANGE 5-YEAR SPRING 2019 TO SPRING 2024

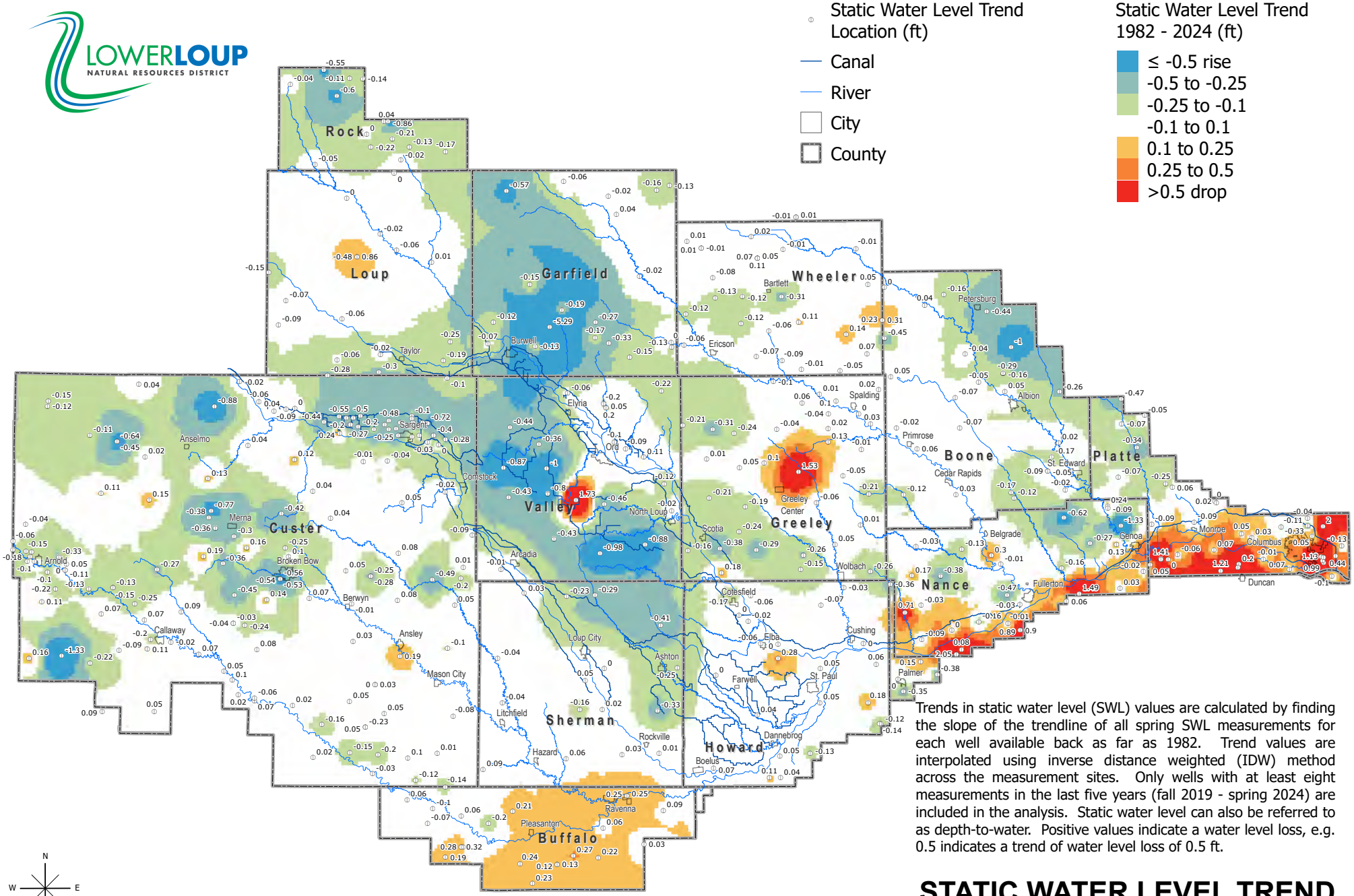
\GIS_Projects\WaterQuantity\StaticWaterLevel



Change in static water level values is calculated by subtracting the current year's spring static water level from the previous spring's static-water-level. These were interpolated using inverse distance weighted (IDW) technique across the measurement sites. Static water level can also be referred to as depth-to-water.

STATIC WATER LEVEL CHANGE 1-YEAR SPRING 2023 TO SPRING 2024

\GIS_Projects\WaterQuantity\StaticWaterLevel



Trends in static water level (SWL) values are calculated by finding the slope of the trendline of all spring SWL measurements for each well available back as far as 1982. Trend values are interpolated using inverse distance weighted (IDW) method across the measurement sites. Only wells with at least eight measurements in the last five years (fall 2019 - spring 2024) are included in the analysis. Static water level can also be referred to as depth-to-water. Positive values indicate a water level loss, e.g. 0.5 indicates a trend of water level loss of 0.5 ft.

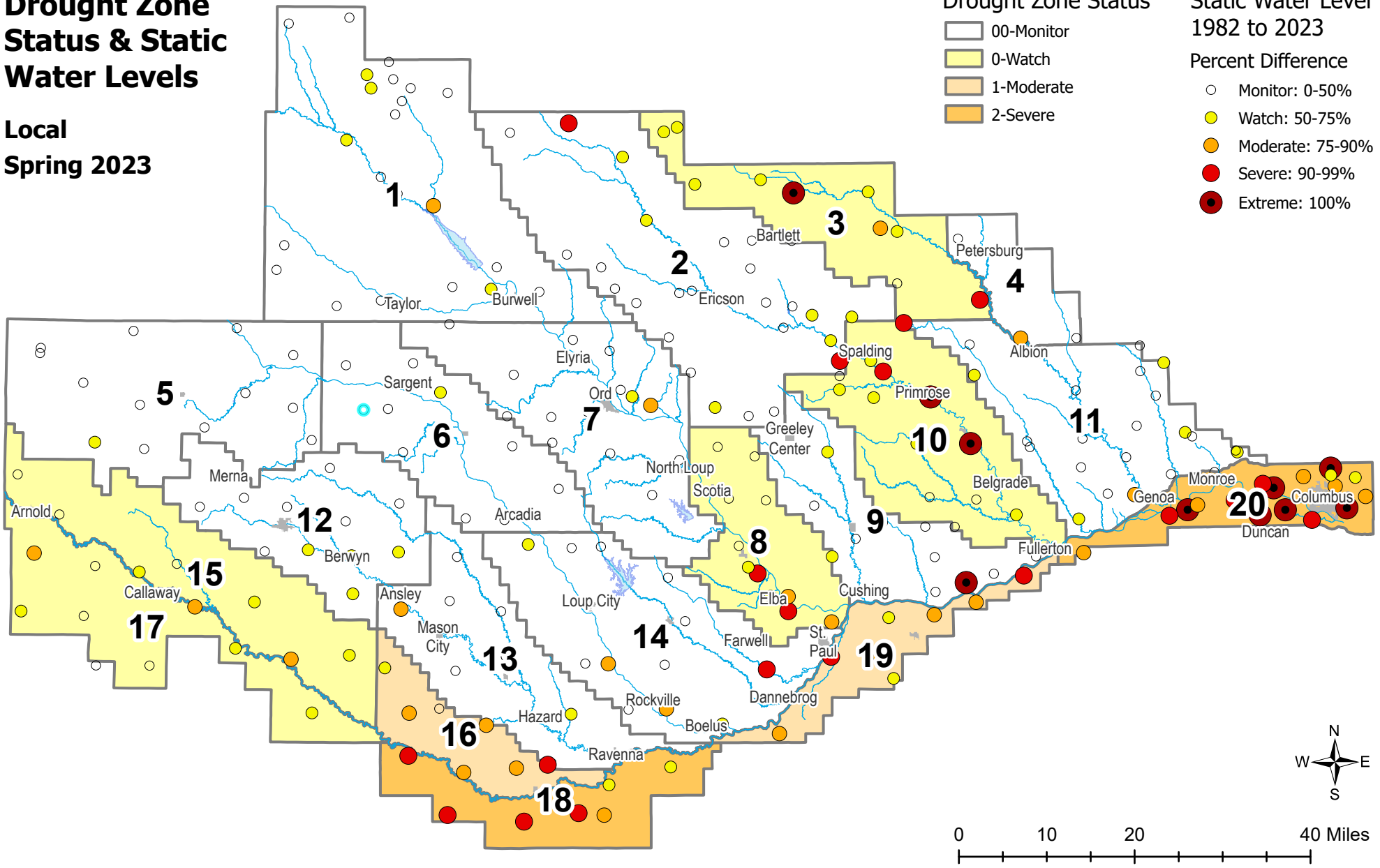
STATIC WATER LEVEL TREND ALL YEARS SPRING 1982 TO SPRING 2024

\GIS_Projects\WaterQuantity\StaticWaterLevel

Drought Zone Status & Static Water Levels

Local

Spring 2023



Updated 4/21/2023

LOWER LOUP NATURAL RESOURCES DISTRICT

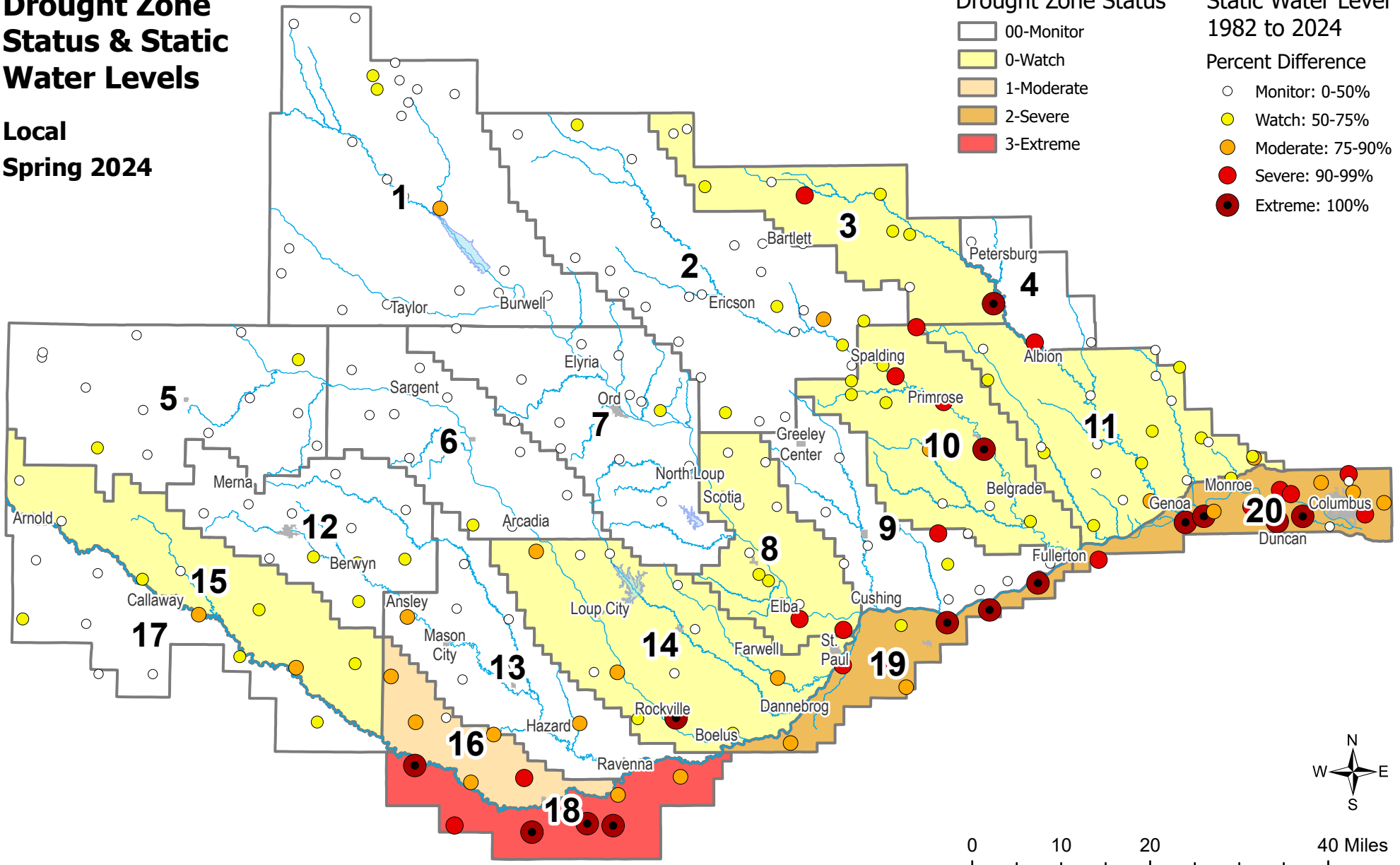
Percentage Difference is calculated as: The difference in the current year spring Static Water Level (SWL) minus the minimum spring SWL the well has on record divided by the difference in the spring maximum and minimum SWLs the well has on record.

Local Status of Drought Zones are classified using criteria outlined in the District's November 2022 Drought Management Plan. It can be found at https://www.llnrd.org/resources/drought-management-plan.

Drought Zone Status & Static Water Levels

Local

Spring 2024



Updated 4/11/2024

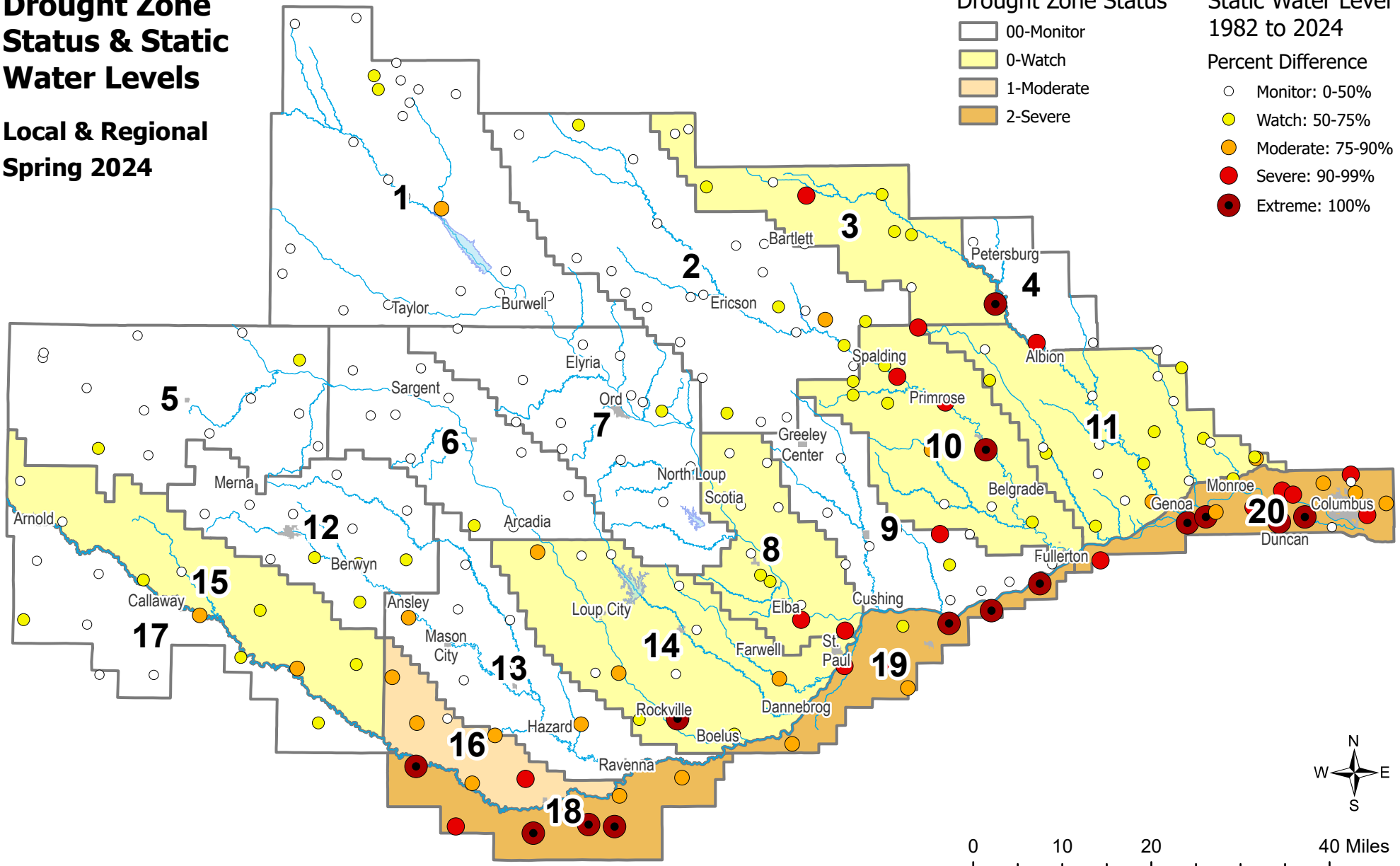
LOWER LOUP NATURAL RESOURCES DISTRICT

Percentage Difference is calculated as: The difference in the current year spring Static Water Level (SWL) minus the minimum spring SWL the well has on record divided by the difference in the spring maximum and minimum SWLs the well has on record.

Local Status of Drought Zones are classified using criteria outlined in the District's November 2022 Drought Management Plan. It can be found at https://www.llnrd.org/resources/drought-management-plan.

Drought Zone Status & Static Water Levels

Local & Regional Spring 2024



Updated 4/11/2024

Percentage Difference is calculated as: The difference in the current year spring Static Water Level (SWL) minus the minimum spring SWL the well has on record divided by the difference in the spring maximum and minimum SWLs the well has on record.

Local Status of Drought Zones are classified using criteria outlined in the District's November 2022 Drought Management Plan. It can be found at https://www.llnrd.org/resources/drought-management-plan. The U.S. Drought Monitor live map is overlaid on the LLNRD Drought Zones to determine which status is most prominent in each zone during SWL measurements. The local and regional statuses are averaged to determine the final combined status.