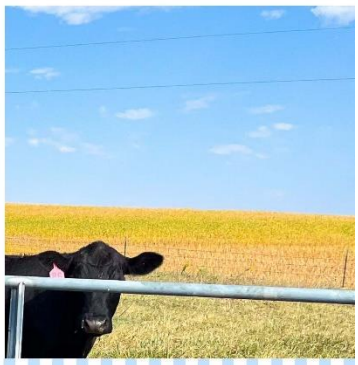
2024

GROUNDWATER MANAGEMENT PLAN ANNUAL REVIEW




LOWER PLATTE SOUTH
natural resources district

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LOWER PLATTE SOUTH NATURAL RESOURCES DISTRICT
2024 GROUNDWATER MANAGEMENT PLAN
ANNUAL REVIEW

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Foreword

The following report fulfills the Lower Platte South Natural Resources District's responsibility to conduct a review each calendar year assessing the District's actions, activities, and effectiveness under the Rules and Regulations for implementation of the Groundwater Management Plan approved by the Nebraska Department of Water Resources on June 26, 1995. This report is issued in a format which will hopefully make it easy for the reader to gain information about groundwater quality and quantity within the District. The 2024 Annual Review was presented to the Water Resources Subcommittee on March 17, 2025, and to the Board of Directors on March 19, 2025.

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Please Note: This report is organized by major groundwater program areas. The applicable rules and regulations governing those program areas are cited in the text for each area where appropriate. These rules and regulations were substantially revised effective January 15, 2020; the applicable sections cited in this document reflect those updates.

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Appendix A - List of Figures

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List of Acronyms

AEM	Airborne electromagnetic
BMP	Best management practice
CPA	Crete-Princeton-Adams
CWSPA	Community Water System Protection Area; equivalent to Wellhead Protection Area (WHPA)
DV	Dwight-Valparaiso
DVB	Dwight-Valparaiso-Brainard
ENWRA	Eastern Nebraska Water Resources Assessment
gpm	Gallons per minute
GWMA	Groundwater Management Area
GWMP	Groundwater Management Plan
GWR	Groundwater Reservoir
HCA	Hydrologically Connected Area
IMP	Integrated Management Plan
IWMPP	Interrelated Water Management Plan Program
LSC	Lower Salt Creek
MCL	Maximum Contaminant Level
mg/ℓ	Milligrams per liter; equivalent to parts per million (ppm)
MR	Missouri River
MW	Monitoring well
NDEE	Nebraska Department of Environment and Energy (formerly Nebraska Department of Environmental Quality)
NDNR	Nebraska Department of Natural Resources
NDHHS	Nebraska Department of Health and Human Services
ppb	Parts per billion; equivalent to micrograms per liter (ug/ℓ)
ppm	Parts per million; equivalent to milligrams per liter (mg/ℓ)
PR	Platte River
QA/QC	Quality Assurance/Quality Control
RA	Remaining Area
RPD	Relative percent difference
RWD	Rural Water District
SID	Sanitary Improvement District
SMA	Special Management Area
SOP	Standard operating procedure
TDS	Total dissolved solids
ug/ℓ	Micrograms per liter; equivalent to parts per billion (ppb)
UNL	University of Nebraska-Lincoln; these are UNL subdivisions: CSD: Conservation and Survey Division SNR: School of Natural Resources WSL: Water Sciences Laboratory
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHPA	Wellhead Protection Area; equivalent to Community Water System Protection Area (CWSPA)
WQMP	Water Quality Management Plan
WMA	Wildlife Management Area
WSF	Water Sustainability Fund

Phase Determination Criteria

Groundwater Quality Triggers
Phase I: Entire NRD
Phase II: contaminants in ≥50% of network wells are ≥50% of the MCL (5 ppm for nitrate-nitrogen)
Phase III: contaminants in ≥80% of network wells are ≥80% of the MCL (8 ppm for nitrate-nitrogen)
(Note: the MCL for nitrate-nitrogen is 10 ppm)

Groundwater Quantity Triggers
Phase I: Entire NRD

Groundwater Quantity Triggers for CPA, DV, MR, and PR GWRs, and RA
Phase II: saturated thickness in ≥30% of network wells is ≥8% below average
Phase III: saturated thickness in ≥50% of network wells is ≥15% below average

Groundwater Quantity Triggers for LSC GWR
Phase II: saturated thickness in ≥30% of network wells is ≥15% below average
Phase III: saturated thickness in ≥50% of network wells is ≥30% below average

Equations

Relative Percent Difference (RPD):

$$RPD = \left[\frac{(Sample1 - Sample2)}{(Sample1 + Sample2)/2} \right] \times 100$$

(used to calculate % difference between two samples)

EXECUTIVE SUMMARY

The Lower Platte South NRD (LPSNRD) completes an Annual Review of the District's groundwater activities each year as outlined in the 1995 LPSNRD Groundwater Management Plan and the District's Groundwater Rules and Regulations. Below is a summary of the 2024 Annual Review.

LPSNRD collected groundwater 349 quality samples from 328 wells including monitoring, irrigation, and public water supply wells throughout the District, analyzing for nitrate, pesticides, major ions, arsenic, etc. The Lower Salt Creek Groundwater Reservoir (LSC) (GWR) exceeded the Phase II trigger, but no other GWR exceeded the Phase II or Phase III triggers. No pesticides were detected from the 151 sample locations, and minor arsenic detections were found in areas consistent with naturally occurring amounts due to geology.

Of the current designated Phase II Community Watershed Protection Areas (CWSPA's), results indicated that two areas (Hickman and Union) fell below the Phase II trigger, while three areas (Davey, Pleasant Dale, and Valparaiso) remained above the Phase II trigger. Weeping Water/Otoe County RWD #3 exceeded the Phase III trigger. The only currently designated Phase III area (Elmwood) showed results that would exceed the Phase III trigger. The CWSPA of Sprague results exceeded the Phase II trigger and LPSNRD will review this information to decide on declaring it a Phase II CWSPA.

Groundwater quantity information was reviewed from 299 water level measurements collected twice a year in the fall and spring from 148 different wells. The spring to spring levels which are used for trigger calculations showed that 135 of the 148 wells had a decrease in water level. All GWR's showed a decline last year with the largest decline appearing in the LSC GWR. District-wide, the average spring to spring decline was -1.53 feet.

The LPSNRD established the Dwight-Valparaiso-Brainard Special Management Area (DVB SMA) to combat in-season declines. 2024 was the tenth year of allocation regulations. There were no violations associated with the allocation in 2024.

The LPSNRD collected water meter readings for the 14th consecutive year. Total water used District wide was up slightly but very similar to the prior year. Total gallons pumped by irrigation, commercial, and similar uses totaled 5.1 billion gallons, 66% of which was pumped for irrigation, and which was similar to uses recorded in 2023.

The LPSNRD issued nine well permits, four of which were completed. LPSNRD also issued 36 chemigation renewal permits, inspected 17 chemigation permits, and did not find any violations. The LPSNRD completed seven well decommissioning cost-share applications, two water meter cost-share applications, 19 soil sampling cost-share applications, 10 fertilizer meter cost-share applications, and 25 spring nitrogen application cost-share applications.

Other LPSNRD activities included a variety of public information activities such as classroom presentations, field trips, and test your well nights. LPSNRD continued to partner with the Eastern Nebraska Water Resources Association (ENWRA) including a grant for recharge studies and water table map updates.

Also in 2024, the District began the process of updating its Ground Water Management Plan. LPSNRD completed the 3-D Hydrogeologic Framework and incorporation of Airborne Electromangetic (AEM) and other data into groundwater models. LPSNRD also continued development of the voluntary Integrated Management Plan and participation in the Lower Platte River Coalition.

1. INTRODUCTION

1.1. Background

The Lower Platte South Natural Resources District (LPSNRD or District) is one of 23 Natural Resources Districts in Nebraska. When created in the early 1970s, Nebraska's Natural Resources Districts (NRDs) were delineated according to major surface water drainage boundaries, and were given broad responsibilities in conservation and management of natural resources. The LPSNRD is located in the southern portion of the Lower Platte River Basin, and encompasses slightly more than one million acres or more than 1,500 square miles in parts of Butler, Saunders, Seward, Lancaster, Cass, and Otoe Counties in southeast Nebraska (***Appendix A, Figure 1***).

One of the primary areas of responsibility delegated to NRDs is the management and conservation of groundwater, both in terms of its quality and quantity (see below). In Nebraska, some 85% of the state's population relies on groundwater as the primary source of drinking water. Many of the state's rivers, streams, and wetlands are fed by groundwater discharge, and the aquatic and terrestrial plants and animals associated with them depend on groundwater of adequate quality and quantity. Groundwater for irrigation is also fundamental to the state's agricultural economy, and a wide variety of industries depend on its availability and quality. Clearly, groundwater is one of Nebraska's most precious resources, and the Lower Platte South NRD is committed to implementing protective programs for the good of its citizens.

1.2. Authority for Groundwater Programs

Natural Resources Districts are given a wide variety of responsibilities for the management of groundwater quantity and quality by Nebraska statutes. Those authorities can be found mostly in Chapter 46 of the Nebraska Revised Statutes. As required by law, in 1995 LPSNRD developed and adopted a Groundwater Management Plan (GWMP) to govern its groundwater management programs (LPSNRD, 1995). In addition, LPSNRD has adopted Groundwater Rules and Regulations (Revised Effective Date: March 1, 2023) as per the authority granted in statutes.

1.3. Groundwater Reservoirs

Applicable Regulations: Section B, Rules 2 and 3

As is common in most of eastern Nebraska, the geologic setting of the LPSNRD means that groundwater resources in the District are quite variable from place to place. The District has therefore delineated five major groundwater reservoirs (GWRs) in its jurisdiction. The GWRs represent areas which useable amounts of good quality groundwater are generally available. Typically, the GWRs consist of sand and/or gravel deposits in buried paleovalleys or present-day river valleys. The location of the GWRs can be seen in ***Appendix A, Figure 2***. The remainder of the District has been designated as the Remaining Area (RA), which includes the Dakota Formation aquifer and other small aquifers not designated as part of any GWR. Groundwater in the RA is discontinuous spatially, and variable in both quality and quantity. ***Appendix A, Figure***

2 also shows the location of the RA in LPSNRD (the RA is indicated by the area in white—that is, everything that is not in a GWR).

1.4. Community Water System Protection Areas (CWSPAs)

Applicable Regulations: Section B, Rule 2

Drinking water supplies in LPSNRD come primarily from groundwater sources, just like most of the rest of Nebraska. The Nebraska Department of Environment and Energy (NDEE) delineates Wellhead Protection Areas (WHPAs) for all public water supply systems in the state. These WHPAs generally correspond to the predicted 20-year time-of-travel zone for the supply wells in those systems, although recently some communities have designated their WHPAs based on 50-year time-of-travel zones. In other words, the WHPAs represent the area from which groundwater could be expected to be extracted during 20 to 50 years of normal water use for those public water supplies. NDEE has indicated that eventually the 50 year time-of-travel will be used for WHPA delineation. LPSNRD has adopted the boundaries of the delineated WHPAs as additional areas for groundwater management under the current GWMP. In the LPSNRD, these areas are referred to as Community Water System Protection Areas (CWSPAs); the locations of which are shown in ***Appendix A, Figure 3***.

2. REGISTERED WELLS

Applicable Regulations: N/A

As is the case in most of Nebraska, the majority of water for municipal, domestic, irrigation, and other uses in the District comes from groundwater sources. As already described, availability of groundwater across LPSNRD is highly variable, with some areas containing considerable supplies while others have little or almost no groundwater (for more information, see Section 4.1.1). As a result, the distribution of groundwater wells across the District is also variable. ***Appendix A, Figure 4*** shows the locations of registered domestic and public water supply wells in LPSNRD, while ***Appendix A, Figure 5*** shows the locations of registered irrigation wells. Note that, prior to 1993, domestic wells were not required to be registered in Nebraska, and so ***Appendix A, Figure 4*** is only a partial representation of the location of these types of wells. That is, domestic wells completed prior to 1993 may or may not show up on this map.

3. GROUNDWATER MONITORING NETWORK

Applicable Regulations: Sections F, G

The District's groundwater monitoring networks are designed to provide a grid-like network of monitoring sites for each of the Groundwater Reservoirs and the Remaining Area, and to provide additional information about each CWSPA. LPSNRD's GWMP allows for the designation of various phases to deal with increasing groundwater contamination and/or decreasing groundwater levels. The entire NRD is currently in at least a Phase I Groundwater Management Area (GWMA), and in this phase the District establishes various information and education programs, and requires permits for all new wells which pump more than 50 gallons per minute (gpm) in a GWR or CWSPA, and 20 gpm for non-domestic wells in the RA. Higher levels of

phased management have been implemented in some parts of the District to deal with concerns over groundwater quality and quantity (see below). Progress in developing LPSNRD's monitoring well network is shown in ***Appendix B, Table 1***.

For groundwater quality, if levels of a contaminant exceed 50% of the federal maximum contaminant level (MCL) for that contaminant in 50% of the District's groundwater monitoring network wells for two consecutive years, the NRD can designate a Phase II GWMA, and adopt rules and regulations for management of that contaminant. If contaminant levels exceed 80% of the MCL in 80% of the NRD's network wells, again for two consecutive years, the NRD can designate a Phase III GWMA, and adopt additional, more stringent rules and regulations for dealing with the situation. Currently, the Lower Salt Creek GWR and the Valparaiso, Otoe County RWD #3/Weeping Water, Davey, Hickman, Pleasant Dale, and Union CWSPAs are in Phase II management, and the Elmwood CWSPA is in Phase III management for groundwater concerns due to elevated nitrate levels (see ***Appendix A, Figure 3***).

For groundwater quantity, LPSNRD's GWMP lays out a similar procedure for designating phased management areas to deal with groundwater declines. If spring static water level elevations in 30% of the District's groundwater monitoring network wells have declined from the established upper elevation of the saturated thickness by 8% (15% in the Lower Salt Creek GWR), the NRD can designate a Phase II GWMA, and adopt rules and regulations to manage groundwater declines. If spring static water level elevations in 50% of the District's network monitoring wells decline by 15% (30% in the Lower Salt Creek GWR), the NRD can designate a Phase III GWMA, and again can adopt additional and more stringent rules and regulations for management of groundwater declines. Currently, there are no Phase II or III GWMAs for groundwater quantity in the LPSNRD, but due to concerns over seasonal declines, LPSNRD is implementing management actions in a Special Management Area in the Dwight-Valparaiso-Brainard area (see Section 4.2).

3.1 Groundwater Quality Monitoring Program

Staff collected 349 samples and 92 quality assurance/quality control (QA/QC) samples from 328 different wells in 2024. Samples that were collected were obtained from monitoring network wells, CWSPA wells, irrigation wells, and other wells that the District samples on an annual basis. Samples were analyzed for a variety of parameters, including nitrate-nitrogen, major ions, pH, specific conductance, hardness, alkalinity, and total dissolved solids. Since 2005, pesticide analyses have been rotated annually between different GWRs, and in 2010, the District adopted a similar rotation for major ions. Community water supply wells and CWSPA monitoring wells were tested for arsenic in addition to the basic parameters.

3.1.1 Nitrate-Nitrogen Results

Nitrates in drinking water have been a concern for many years in many parts of Nebraska, the United States, and the world. Nitrate (often expressed by the term "nitrate as nitrogen" or "nitrate-nitrogen") is naturally present in groundwater at low levels, usually less than 2 parts per million (ppm; this is essentially equivalent to milligrams per liter or mg/ℓ), and at such levels typically does not present any health concerns. However, nitrogen fertilizers, manure, or other nitrate-containing material applied to farm ground or lawns and gardens can supply additional

nitrate which can infiltrate with natural recharge and lead to higher than natural levels of nitrate in groundwater. Nitrate in drinking water at elevated levels of several tens of ppm can cause acute health problems especially in infants by causing a condition in which the oxygen-carrying capacity of the blood is inhibited. High nitrate levels have also been associated with health and gestational problems in livestock, and may have long term chronic effects on humans as well. The United States Environmental Protection Agency (USEPA) has established an MCL of 10 ppm for nitrate-nitrogen in drinking water.

All wells sampled by the District in 2024 were analyzed for at least nitrate-nitrogen. Nitrate concentrations were variable across the District (***Appendix A, Figures 6*** and ***7***). Based upon this data, Phase II and Phase III determinations for the GWRs are shown in ***Appendix B, Table 2***. Based on the 2024 sampling results, LSC GWR exceeded the Phase II trigger but no other GWR's exceeded the Phase II or III triggers. The LSC GWR average had been below the Phase II trigger in 2011 through 2021, slightly exceeded in 2022, but again was below in 2023. In some cases during that period, it was only slightly below that trigger. As a result of the nitrate levels being consistently below the Phase II trigger for several years, in its implementation plan for Fiscal Year 2020 LPSNRD included an action item to continue to evaluate whether to suspend Phase II in the LSC GWR; this process is ongoing. More specific information for each GWR can be found in Section 4.

3.1.2 Pesticide Results

Pesticides are compounds that are designed to control pests. Most common of these are herbicides (used to control undesirable plants) and insecticides (use to control undesirable insects). Other commonly used pesticides include fungicides, algicides, rodenticides, and grain fumigants. Residues from pesticides applied to crop ground, buildings, or lawns and gardens, or concentrated amounts from leaks and spills can move into the ground with infiltration and may eventually find their way to groundwater. The possible health effects of pesticides vary widely depending upon the compound and concentration, but as a general rule it is obviously desirable to keep such compounds out of groundwater and drinking water altogether, or at least to keep the levels of pesticides below any applicable health limits.

The District analyzes samples for 30 separate pesticide compounds on a rotating basis; in some cases existing agreements with public water suppliers specify annual pesticide sampling. In 2024, samples were collected from 152 wells and analyzed for these compounds. Of the wells sampled in 2024, no wells had any detections of a pesticide. ***Appendix A, Figure 8*** shows the locations of the wells that were sampled in 2024.

3.1.3 Other Parameter Results

Although nitrate and pesticides are often cited as groundwater concerns, LPSNRD also monitors groundwater for additional parameters. In 2024, District staff collected additional groundwater samples which were analyzed for major ions and arsenic.

3.1.3.1 Major Ions

Analysis of major ionic species in groundwater gives a general indication of water chemistry and hydrogeologic conditions. In 2024, LPSNRD had 154 groundwater samples analyzed for the following ions: calcium, iron, magnesium, manganese, potassium, silicon, sodium, chloride, fluoride, and sulfate. Alkalinity and hardness expressed as calcium carbonate were also included, as was measurement of total dissolved solids (TDS). Based on previous years' monitoring, LPSNRD began a rotational system for monitoring major ions in 2011; in 2024 samples from the Remaining Area as well as several public water supplies (depending upon the NRD's agreement with those municipalities) were analyzed for these compounds. Samples from the other GWRs and the Remaining Area will be analyzed on this rotational basis in coming years, and those from all PWS wells will continue to be analyzed.

For the most part, analysis of major ions provides information regarding general water quality, and can also be used to evaluate changing groundwater conditions or to help identify concerns. For example, groundwater influenced by animal waste or septic tank effluent may exhibit elevated levels of sodium and/or chloride. In parts of the District, groundwater contained in lower portions of the Dakota Formation may also be elevated in sodium, chloride, and TDS, and pumping of shallow groundwater or various natural conditions may cause saline water to move toward the surface. Monitoring of major ions can give important information on situations such as these.

3.1.3.2 Arsenic

Arsenic is a semi-metallic element that can be found naturally in various kinds of rock and sediment, and can also be produced in agricultural and industrial processes. Acute effects from arsenic can occur at high levels of ingestion, and long-term exposure to arsenic has been linked to various forms of cancer. The USEPA has established an MCL for arsenic in drinking water of 10 parts per billion (ppb), which is equivalent to 0.01 ppm. LPSNRD collects groundwater samples for arsenic analysis as a service to several community water suppliers in the District. Although arsenic is a regulated contaminant for public water supplies, in Nebraska its occurrence is most commonly as a result of naturally-occurring sources, and as such is beyond the NRDs' regulatory authority to manage.

In 2024, LPSNRD staff collected 155 samples from that number of different wells in the District. The results of that sampling are shown in ***Appendix A, Figure 9***. All but seven of the samples had arsenic results at either non-detectable levels or levels below the MCL; this number is comparable to past years. District personnel communicated the results to all cooperators, and will continue to provide information as requested.

3.1.3.3 Radon

Radon is a colorless, tasteless, odorless gas that is produced by the natural breakdown of uranium in rocks and sediments. The main health concern from radon is exposure through inhalation, as high levels of radon in indoor air have been linked with lung cancer. Most radon in indoor air comes from the soil and rock surrounding buildings, but a small amount can be

released from water used indoors. In addition, there is some possibility that concentrations of radon in drinking water might increase the likelihood of stomach and other digestive cancers. However, the USEPA has not established an MCL for radon in drinking water. LPSNRD staff did not collect any radon samples in 2024 but will consider such sampling on a case-by-case basis as needed.

3.1.4 Quality Assurance/Quality Control (QA/QC)

The District continued to implement its QA/QC program in 2024. The QA/QC results are used to monitor the performance of a laboratory's analyses. There were four types of QA/QC checks performed by District staff-- inter-lab comparability, precision, accuracy, and cross-contamination. The relative percent difference (RPD) is computed for each of the first three types of QA/QC sample, and the results are averaged for each type of QA/QC check. Ideally, the RPD should be 0% for each of the QA/QC checks. Generally, an average difference of 10% or less is acceptable, but 5% or less is preferred.

The inter-lab comparability was checked by 'splitting' some samples into two different bottles. The 'split' samples are analyzed by separate laboratories. One sample was sent to Midwest Labs (which is the primary lab for District sample analysis) and the other to the Nebraska Health and Human Services (NHHS) Lab. In 2024, 25 split samples were taken. On average, there was a -1.1% RPD in the results reported by these two labs; in other words, results from Midwest Labs were, on average, 1.1% lower than those of the NHHS Lab. This is well within LPSNRD's ±5% preferred range for RPD, and indicates excellent inter-lab comparability.

The precision, or ability to reproduce similar results, was checked by taking 'duplicate' samples for analysis by Midwest Labs. Duplicates are similar to split samples, but both samples are sent to the same lab – Midwest Labs. Twenty-eight samples were duplicated in 2024. The results of this QA/QC check averaged -0.06%. Again, this number is well within the District's preferred range, and indicates excellent precision.

In order to demonstrate the accuracy of results from the main contract lab (Midwest Labs), District staff employed analysis of documented reference samples. Reference samples are samples with a predetermined concentration of a certain constituent, prepared beforehand, and sent to the lab concerned to see if that lab can accurately determine that documented concentration. LPSNRD contracted with the University of Nebraska-Lincoln Water Sciences Laboratory (UNL-WSL) to produce nitrate samples of four documented nitrate-nitrogen concentrations, unpreserved: low (2mg/ℓ), medium (5 mg/ℓ), high (10 mg/ℓ), and very high (20 mg/ℓ). UNL-WSL staff prepared these samples using standard laboratory methods, and documented the concentrations of each sample by analyzing them in duplicate via autoanalysis employing the cadmium-reduction method. LPSNRD sent 12 total reference samples (three of each of the concentrations listed above) to Midwest Labs. On average, Midwest Lab's results showed a 1.9% RPD from the UNL documented concentration. These results are again well within the preferred ±5% range, and as a result, LPSNRD considers these results to document excellent accuracy from the primary contract lab.

The final type of QA/QC check utilized by the District is the employment of field blanks. A field blank is a sample of distilled or deionized water which is prepared in the field using the same techniques as all other samples. These blanks are then sent to the primary contract lab. The expected result is that all parameters will come back with non-detectable results. If any parameters are detected in any field blank, this is an indication that some operation in sampling, transport, processing, and/or analysis is introducing some sort of outside contamination into the sample. However, in all blank samples taken in 2024 as in almost all years preceding, there were no detections of any contaminant. This is an indication of proper sampling, transport, processing, and analysis.

The results of the calculations for the QA/QC samples with returned detections are summarized in ***Appendix B, Table 3***. Given the median values for those RPDs are well within LPSNRD's preferred range of values, the District considers the results for 2024 to be acceptable. LPSNRD will continue to work with all labs in coming years to maintain and where necessary improve this high level of QA/QC and to improve procedures if necessary.

3.2 Groundwater Quantity Monitoring Program

District staff measured a total of 299 water levels in 148 different wells in 2024. The results have been reported to the U.S. Geological Survey and the District's cooperators. Water levels are measured in the spring (usually March and April) and fall (usually October and November). For purposes of this report and as specified in the District's Groundwater Management Plan, levels are compared from spring to spring measurements, as the spring measurement is considered to be more indicative of static aquifer conditions. Fall measurements are taken within a few months of the cessation of the irrigation season, and some aquifer units are likely still affected by that activity. Spring measurements represent aquifer conditions after the units have had several months to equilibrate, and are used for the purpose of annual comparison. However, in specific cases, comparison of spring to fall water levels can give an indication of how aquifer units are responding to comparatively intense use over the summer months.

Groundwater levels were lower across the District (***Appendix A, Figure 10***). From spring 2023 to 2024, water level decreases were observed in most measured quantity network wells, with 135 wells showing a decrease while only 13 wells recorded an increase. The maximum decline in an individual well's water level was 5.55 feet, while the maximum increase was 3.66 feet between spring 2023 and 2024. The majority of water level changes in the NRD's monitoring wells are on the order of a few hundredths of a foot to a few feet (see ***Appendix A, Figure 10***). District-wide, no Phase II or III triggers were exceeded in any of the District's GWRs (see ***Appendix B, Table 4***). Taken as a whole, the average static water level across the District decreased by 1.53 feet from spring 2023 to spring 2024; individual GWR changes can be seen in ***Appendix B, Table 4***. It's important to realize that this number is only provided for a general comparison from year to year, and doesn't apply to any individual well. As can be seen from ***Appendix A, Figure 10***, water level changes in any well or GWR are quite variable, so a District-wide average does not accurately represent actual changes in groundwater levels.

The District continues to monitor long-term groundwater level trends from representative wells from each GWR (***Appendix A, Figures 11*** and ***12***). Some areas of the District have experienced

a decrease in groundwater levels since the early 1980s, even though trigger levels as reflected in LPSNRD's GWMP have not been exceeded. As already mentioned, the difference in spring water levels serves as the trigger for management actions in the District's current GWMP. ***Appendix A, Figure 11*** provides a general sense for how these spring levels have varied over time. Given the unusual drought conditions that prevailed for much of the summer in 2012 and the latter portion of the summer in 2013 (see below), the District paid special attention to groundwater levels late in the summer and throughout the fall and winter of 2012 and 2013. ***Appendix A, Figure 12*** shows the changes in fall water levels for the representative wells depicted in ***Appendix A, Figure 11***. Note that, even with the drought of 2012 and 2013, water levels in both the spring and fall were not below some of the corresponding measurements from earlier years, particularly in the mid-1990s and mid-2000s. In addition, given the return to more normal precipitation patterns since 2014, water levels in most of these wells show anywhere from a few inches to several feet of recovery. In most cases, these wells show declines from 2021 to 2024, but given the recent dry conditions, this is not surprising. However, increasing concern over seasonal water level declines in the northwestern portion of the District has prompted the initiation of a Special Management Area to deal with well interference concerns in that portion of LPSNRD (see Section 4.2). The District has taken additional water level measurements in the past few years to gain more data regarding changes in groundwater levels, and has deployed several continuous water level measuring devices in selected dedicated monitoring wells to provide additional information. All of this data will be considered carefully as the District evaluates management actions in the future.

3.3 Data Management

In 2024, the District continued to utilize the groundwater database, the public information site, and the mobile database collection tools that were created in prior years with a contractor.

The groundwater database stores collected data and aids in the dissemination of information to District landowners and the public. The public information site allows cooperators to view existing data for their wells and to enter new meter information based upon a preassigned login. The mobile database enables staff to utilize tablet computers for many aspects of data collection including water level data, water meter inspections, and retrieval of historical sampling information while in the field. These tools have aided staff in ensuring quality data entry and providing tools to better communicate with landowners while in the field.

4. DESIGNATED AREAS OF MANAGEMENT

Applicable Regulations: Sections B, E, F, G, I, J, K, L

The District's 1995 GWMP specifies three types of areas in which LPSNRD can pursue various management activities to deal with concerns in groundwater quality and quantity. These three types of areas are Groundwater Reservoirs (GWRs), the Remaining Area (RA), and Community Water Supply Protection Areas (CWSPAs). The following sections highlight NRD activities in each area in regard to both groundwater quality and quantity.

4.1 Groundwater Quality

4.1.1 Groundwater Reservoirs

Note: for more information on LPSNRD's Groundwater Reservoirs, see Druliner and Mason, 2001.

4.1.1.1 Crete-Princeton-Adams

The Crete-Princeton-Adams (CPA) GWR is located in the southwestern portion of LPSNRD (see ***Appendix A, Figure 2***). The aquifer in CPA is generally semi-confined to confined, and consists of a complex sequence of glacial till, loess, sand, and gravel. Saturated thickness of sediments ranges from 50 to 250 feet, and depth to groundwater ranges widely from a few feet to about 250 feet below the land surface. Results of groundwater monitoring for nitrate, pesticides, and other components in the CPA GWR are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***. In addition to this routine monitoring, several important actions in CPA were undertaken as part of the Eastern Nebraska Water Resources Assessment (ENWRA). These activities are described in Section 17. Also, in addition to these activities, the District is continuing administration of a Phase II nitrate management area in the Hickman CWSPA (see ***Appendix A, Figure 3***). Activities for the Hickman CWSPA in 2024 are described in Section 4.1.2.16.

4.1.1.2 Dwight-Valparaiso

The Dwight-Valparaiso (DV) GWR occupies the northwestern portion of the District (see ***Appendix A, Figure 2***). The DV aquifer is mostly semi-confined to confined, and is made up of sand and gravel deposits underlying thick glacial till and loess. Saturated thickness of these sands and gravels is about 40-100 feet, and depth to water again ranges from a few feet to about 250 feet below the land surface. Due to the confining units present, significant variations in water levels can result from changes in head pressure due to groundwater withdrawals, and as a result in 2014 the District established the Dwight-Valparaiso-Brainard Special Management Area to help address these in-season declines. Further information about this activity can be found in Section 4.2. Results of groundwater quality monitoring for nitrate, pesticides, and other components in the DV GWR are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***. In addition to this routine monitoring, the District continues to administer a Phase II nitrate management area in the Valparaiso CWSPA (see ***Appendix A, Figure 3***). Activities for the Valparaiso CWSPA in 2024 are described in Section 4.1.3.28.

4.1.1.3 Lower Salt Creek

Applicable Regulations: Section K(1)

The Lower Salt Creek (LSC) GWR is located in the north-central portion of the LPSNRD, roughly between Lincoln and Ashland (see ***Appendix A, Figure 2***). The LSC aquifer is semi-confined to confined, and consists mostly of sand and gravel deposits overlying older bedrock units. Saturated thickness of these sand and gravel deposits is about 40 to 65 feet, and depth to water ranges from a few feet to about 50 feet below the land surface. Results of groundwater

monitoring for nitrate, pesticides, and other components in the LSC GWR are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***.

In 2002, the LSC GWR was designated as a Phase II management area in response to nitrate levels which were determined to be above the NRD's trigger levels for that phase. As a result of this designation, a local advisory committee was formed to advise the District on adoption of rules and regulations to deal with the nitrate issue. The regulations subsequently adopted by the District required nitrogen certification training for those who apply nitrogen fertilizer to agricultural fields in the GWR, and established cost-share programs to implement Best Management Practices (BMPs) aimed at reducing nitrate in groundwater. Practices for which cost-share is available (in addition to the District-wide cost-share items) include fertilizer meters and manifolds, and soil sampling and analysis for fertilizer carryover credits. More information on District cost-share in the LSC GWR as well as the remainder of the NRD can be found in Sections 6-10.
However, as described above, nitrate levels in groundwater in the LSC GWR have been below the Phase II trigger for the past several years. Thus, it's apparent that nitrate levels in the Lower Salt Creek GWR appear to be decreasing at least somewhat over time. In recent revisions of the District's Groundwater Rules and Regulations , a procedure was included for suspending Phase II and moving back to Phase I if nitrate levels dropped below appropriate triggers for a period of not less than three years. In 2024, LPSNRD continued to evaluate steps to suspend the Phase II designation for the LSC GWR, but as noted the nitrate levels in groundwater samples in 2024 slightly exceeded the Phase II trigger, after being slightly below that trigger for several years. LPSNRD will continue to consult with landowners and other interested parties in LSC to get their input on future directions for the GWR. In addition, recent data suggests that nitrate levels within the Waverly, Greenwood, and Ashland CWSPAs, each of which is partially contained within the LSC GWR, have exceeded the Phase II trigger. LPSNRD is cooperating with the City of Waverly, NDEE, and UNL-WSL to implement a comprehensive drinking water protection plan to protect the City's water supply for the foreseeable future. In 2021, LPSNRD worked with Waverly to install dedicated pumps in five preexisting monitoring wells in the vicinity of the City's south wellfield, and with UNL to install one more dedicated monitoring well on the eastern margin of the CWSPA. Part of this project includes determination as to whether the nitrate levels in the Waverly CWSPA meet LPSNRD's criteria for a Phase II GWMA; upon completion of this project the NRD will determine whether to designate the Waverly CWSPA as a Phase II area. Similarly, in 2018 LPSNRD initiated a Phase II Verification Study for the Greenwood CWSPA also to determine if it should be designated as a Phase II GWMA, and these study activities were completed in 2020. In 2021, LPSNRD initiated the public input phase of this study to advise the District on future actions by meeting with the Village of Greenwood, and this process is ongoing. In addition, the District retained a private consulting firm to begin Phase II verification study activities in Ashland, and soil sampling was completed in 2020. One dedicated monitoring well in the CWSPA was completed in 2021, and the District is working with landowners to complete the additional two dedicated monitoring wells typically associated with Verification Studies. More detail on activities in these CWSPAs can be found in Section 4.1.2 below. Finally, several vadose zone samples have been taken from sites within the LSC GWR to further evaluate the likelihood of groundwater quality concerns. These efforts are also described in Section 4.1.2 below.

4.1.1.4 Missouri River Valley

The Missouri River Valley (MRV) GWR is located along the Missouri River at the eastern margin of the District (see ***Appendix A, Figure 2***). The MRV aquifer is mostly unconfined, and consists of fluvial sand, gravel, and silt deposits with some local clay lenses, all overlying older bedrock formations. Aquifer thickness is on the order of 80 feet, and depth to water is generally around 5 to 10 feet below the land surface. Results of groundwater monitoring for nitrate, pesticides, and other components in the MRV GWR are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***.

4.1.1.5 Platte River Valley

The Platte River Valley (PRV) GWR is located in the northeastern portion of the District, along the southern edge of the Platte River (see ***Appendix A, Figure 2***). The PRV aquifer is an unconfined alluvial aquifer that consists of fluvial sand, gravel, and silt overlying older bedrock. The aquifer is on the order of 70 feet thick, and depth to water also ranges from about 5 to 10 feet below the surface. Results of groundwater monitoring for nitrate, pesticides, and other components in the PRV GWR are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***.

4.1.1.6 Remaining Area

The Remaining Area (RA) includes all the land in the District which is not included in a GWR (see ***Appendix A, Figure 2***). In the RA, the occurrence of groundwater bearing units is highly variable; in some portions, practically no groundwater is available. As a result of this variability, no specific GWRs are identified within the RA. In those areas where groundwater does occur, it usually comes from small, intermittent sand bodies within silt and clay deposits, or from underlying bedrock units such as the Dakota Formation, or even older limestone units. Groundwater from these sand units may be of acceptable quality, but the small quantity available limits its use. Conversely, significant amounts of groundwater may occur within the Dakota Formation, but salinity and mineral content of this water increases rapidly with depth, and thus the quality is a limiting factor. Groundwater from limestone bedrock is usually limited to small quantities, and this water is also highly mineralized, therefore these older bedrock units are not generally considered as significant aquifers. Results of groundwater monitoring for nitrate, pesticides, and other components in the RA are summarized in ***Appendix A, Figures 6-9*** and ***Appendix B, Table 2***.

In addition to this routine monitoring, the District continues to administer Phase II management areas in the Davey, Hickman, Pleasant Dale, Otoe County RWD #3/Weeping Water, Valparaiso, and Union CWSPAs and a Phase III management area in the Elmwood CWSPA (see ***Appendix A, Figure 3***). However, recent data suggests that the Hickman, Union, and Valparaiso CWSPA nitrate levels have dropped below the Phase II trigger, so LPSNRD is evaluating if and when these Phase II areas should be suspended. However, the data from Pleasant Dale suggests that nitrate levels might have exceeded the Phase III trigger, so in 2018 LPSNRD undertook additional studies in that CWSPA to determine if Phase III designation is necessary. Additional shallow and deep soil sampling toward this end was conducted in 2019, and the District has completed these studies with installation of one additional dedicated monitoring well in 2020. In

2021, the District determined that the Phase III trigger had not been exceeded for Pleasant Dale, and so after meeting with the Village has continued its Phase II implementation. Also in 2018, LPSNRD initiated a Phase II Verification Study for the Raymond CWSPA, as District groundwater sampling indicated that this trigger may have been exceeded. In 2021, three additional dedicated monitoring wells in the CWSPA were installed and sampled. The final report with recommendations was completed in early 2022. Ongoing sampling has indicated that the Raymond CWSPA is not currently above the Phase II trigger, and NRD personnel reported on those results to Raymond in 2022. Finally, nitrate levels in the Sprague CWSPA, which had been very near the Phase II trigger for the past several years, have increased to the point where they are consistently above the trigger., LPSNRD will consider initiating designation of that CWSPA as a Phase II area as part of the Groundwater Quality Management Plan Update (see Section 21). More detail on the activities in these CWSPAs can be found under the section for each in Section 4.1.2 below.

4.1.2 Community Water System Protection Areas (CWSPAs)

LPSNRD focuses a great deal of effort on groundwater which is used for public drinking water supply. This concern has led the District to delineate Community Water Supply Protection Areas around the groundwater supply wells for the 30 public water supplies (PWSs) within its jurisdiction (see ***Appendix A, Figure 3***). CWSPA boundaries correspond with Wellhead Protection Area boundaries as delineated by the NDEE, and are defined as the area which encompasses the 20-year time-of-travel zone around a given wellfield. In other words, the CWSPA is the area around a well or wellfield from which groundwater can be expected to travel in a period of 20 years. NDEE determines these boundaries by entering information on geology, aquifer characteristics, water levels, and well pumping data into a computer model, which then predicts the 20-year time-of-travel zone. Over the past several years, NDEE has begun the process of implementing comprehensive Drinking Water Protection Programs for various WHPAs around the state. An important additional step in this program is that the capture zones of the wellfields are modeled to a 50-year time-of-travel, and more sophisticated modeling techniques are utilized. The City of Waverly project is proceeding under this program structure. Regardless of the individual circumstances, LPSNRD staff continues to work with NDEE staff to ensure that they have the best available geological and groundwater data for this modeling effort, so the boundaries of the CWSPAs are as accurate and defensible as possible.

In 2022, LPSNRD applied for and received funding for three years from the Nebraska Department of Environment and Energy (NDEE) under Section 319 of the federal Clean Water Act to create a Drinking Water Protection Specialist position. This position was filled in June 2023 to work specifically with the District's approximately 30 public water suppliers on issues involving management and protection of drinking water, establishment of best management practices, public education, and all other aspects of drinking water protection. The initial focus is with the City of Waverly, as they are proceeding with implementation of a full-scale Drinking Water Protection Plan (see Section 4.1.2.29 for more information). In addition, the Specialist will work with the seven public water suppliers currently in Phase II or III management areas to address their concerns, and will eventually contact and cooperate with the remainder of the public water suppliers in the NRD. Following the three-year grant period, LPSNRD intends to fund this position permanently to work with drinking water issues over the entire District.

In general, LPSNRD samples each cooperating PWS well at least annually, and has these samples analyzed for the following components: nitrate-nitrogen, major ions, arsenic, and pesticides. Some of the systems have specific agreements with LPSNRD to perform additional analysis. Also, in 2024, District staff continued implementation of a program to collect unsaturated or vadose zone nitrate data within the confines of the NRD's CWSPAs (as well as locations outside of CWSPAs). This information, which will be similar to that collected during the various verification studies for the Phase II and Phase III delineations, consists of taking soil/sediment samples at approximately 5-foot increments from the land surface downward to the water table, or as deep as the sampling equipment will allow. These samples are analyzed for nitrate-nitrogen content (and any other constituents of concern), and a nitrate profile for the entire vadose zone is constructed. Individual sampling sites will then be re-sampled every few years (the re-sampling may vary depending upon individual results), and the nitrate profiles for each site will be compared over time. In this way, LPSNRD hopes to gain at least some qualitative data to indicate the overall amount of nitrate loading as well as estimates of transport times for various vadose zone settings. Ultimately, this data will help the District evaluate the effectiveness of its management activities, as well as provide some early indication of possible groundwater nitrate problems.

Since 2014, LPSNRD has contacted different entities to provide vadose zone sampling services, but for the past several years has utilized the University of Nebraska-Lincoln Water Sciences Laboratory (UNL-WSL) for vadose zone and analytical services. The locations of sites sampled since the inception of the program is shown in ***Appendix A, Figure 13***.

Vadose zone samples are obtained from shallower depths down to about 75' below the land surface using a small, track-mounted GeoProbe® unit which uses a "direct push" pressure to advance the sampling equipment to the desired depth. For depths greater than about 75', it is necessary to use a more powerful, truck-mounted rotary drilling rig. Both of these units are designed to return continuous core samples of the vadose zone sediments encountered; these samples are in turn analyzed for various compounds such as nitrate-nitrogen, ammonia, and arsenic.

In addition, in 2016, LPSNRD began a cooperative effort with UNL-WSL to develop a more comprehensive set of standard operating procedures (SOPs) for vadose zone data collection. This project will aim to address everything from the most basic sample and data collection (e.g. the nitrate-nitrogen and arsenic characterization described above) to more advanced techniques like soil pore-water extraction and analysis, and higher level research parameter collection such as age-dating. In addition, this project and actions of other NRDs have provided the foundation for establishment of a statewide database or "clearinghouse" for vadose zone data collected by the NRDs, UNL, and other resources agencies. LPSNRD continues to cooperate with UNL-WSL to develop SOPs for vadose zone sampling as well as to help establish the statewide "clearinghouse for vadose zone data. In 2024 staff budgeted for shallow vadose zone sampling equipment capable of taking samples down to about 15', which would allow for rapid sampling of multiple sites and give greater indication of movement of contaminants below the root zone. This item was not funded in 2024 (FY 2025), but NRD staff will continue to include this equipment in its

future budgets and implement a widespread program of shallow vadose zone sampling across the District, with particular emphasis on CWSPAs.

The following sections provide an overview of the District's activities in each of the CWSPAs in 2024. The maps for each PWS show the wells sampled along with the results for nitrate sampling. Other parameters (typically major ions and pesticides) are described only if they have indicated a cause for concern, otherwise the remaining sample information is communicated to the system for their use.

4.1.2.1 Alvo

The Village of Alvo's CWSPA occupies slightly less than one square mile to the east and north of the village in east-central Cass County. District staff sample two PWS wells for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 14***.

4.1.2.2 Ashland

The City of Ashland's CWSPA encompasses about 4 ½ square miles along the northern edge of the city, located along the Platte River in southeastern Saunders County. This area straddles the boundary between the Lower Platte South and Lower Platte North NRDs; about 1 ½ square miles are located within the LPSNRD. At present, all of Ashland's PWS wells are located in LPSNRD. District staff sample four PWS wells for the City and one monitoring well. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 15*** (Note that the LPSRND portion of the Ashland CWSPA is contained within the larger Lower Salt Creek GWR Phase II GWMA). Sampling results from 2018 indicated that nitrate levels in the Ashland CWSPA exceeded the Phase II trigger, and so in 2019 LPSNRD retained a consultant to initiate a verification study for this area. Shallow and deep soil sampling was completed in 2020, and installation of one new dedicated groundwater monitoring well was completed in 2021. Two additional monitoring well sites are planned within the CWSPA and will be completed once land access is obtained. Finally, the District amended its interlocal agreement with the Lower Platte North NRD in 2019 to coordinate study efforts and any future Phase implementation.

4.1.2.3 Brainard

The CWSPA for the Village of Brainard occupies slightly less than two square miles west of the village in southeastern Butler County. The area straddles the boundary between the Lower Platte South and Upper Big Blue NRDs; about 1 ½ square miles are located in LPSNRD. All of the Village's wells are located in LPSNRD, and the District has taken annual water samples from these wells. District staff sample three PWS wells for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 16***.

4.1.2.4 Cass County RWD #1/SID #1 (Lake Waconda)

Cass County Rural Water District (RWD) #1 and Sanitary Improvement District (SID) #1 (which serves the Lake Waconda community) are located within about one mile of each other in eastern Cass County, and the CWSPAs overlap each other. The combined area of the two CWSPAs is about 2 ¾ square miles. District staff sample two PWS wells each for the RWD and SID. The

results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 17***. Also, in 2015, Cass County RWD #1 completed a new well along the Platte River near the existing wells for Cass County SID #5/Buccaneer Bay. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 19***.

4.1.2.5 Cass County RWD #2

The CWSPA for the Cass County Rural Water District #2 takes up about three square miles, just southwest of the Village of Alvo in east-central Cass County. The CWSPAs for the Village of Alvo and the RWD do not overlap each other. District staff sample four PWS wells for the RWD. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 18***.

4.1.2.6 Cass County SID #1

See Cass County Rural Water District #1

4.1.2.7 Cass County SID #5/Buccaneer Bay

The Cass County SID #5/Buccaneer Bay development's CWSPA occupies about one square mile northwest of Plattsmouth in northeastern Cass County. The CWSPAs for the SID and Plattsmouth do not overlap. District staff sample two PWS wells for the SID. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 19***.

4.1.2.8 Ceresco

The Village of Ceresco's CWSPA takes in slightly more than nine square miles north and west of the community in southern Saunders County. In 1997, the District signed an Interlocal Agreement with Ceresco to provide structure for ongoing monitoring and water quality management activities. As a result of this agreement, six dedicated monitoring wells have been installed in the CWSPA. District staff sample three PWS wells for the Village and six monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 20***. In addition, Ceresco has completed a contaminant source inventory for the CWSPA detailing the locations of possible sources of contamination.

4.1.2.9 Davey

Applicable Regulations: Section K(1)

The CWSPA for the Village of Davey occupies slightly less than ½ square mile west and north of the village in northern Lancaster County. In 2006, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded in the CWSPA. As a result, a Phase II Verification Study was initiated and was completed in 2008. This study resulted in the installation of four dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2008a). District staff sample three PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 21***. As a result of the verification study and subsequent sampling, the LPSNRD designated the Davey CWSPA as a Phase II

GWMA in December 2009. In 2012, the NRD began assembling an advisory committee of stakeholders from Davey to advise the District as it develops rules and regulations for the implementation of Phase II, and held the first meeting of that advisory group. Regulations for the Davey Phase II area were adopted in 2013, and became effective in March 2014. As in other Phase II areas, these regulations center on requirement for nitrogen certification for those who apply nitrogen fertilizer, as well as additional promotion of cost-share programs for nitrogen management BMPs. In 2018, the Village began the process of exploring for a possible additional well site to help mitigate the high nitrate levels in the public water supply. In 2022, the Village brought a new well online to replace the existing two older wells. In addition, Davey worked with local water well contractors to accomplish an advanced water well decommissioning process to help mitigate the introduction of contaminants from the surface down to the shallow aquifer units. This process involves piercing the well casing and pressure-injecting grout into the gravel pack surrounding the casing, thus stopping the flow of contaminants through that gravel pack. LPSNRD provided 50% cost share for this procedure, and will continue to monitor the new public supply well as well as existing monitoring wells to document any changes in water quality.

4.1.2.10 Denton

The Village of Denton's CWSPA takes up about 1 ¾ square miles around and to the south of the village in west-central Lancaster County. District staff sample two PWS wells for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 22***.

4.1.2.11 Eagle

The CWSPA for the Village of Eagle takes in about 1 ½ square miles northeast of the village in southwestern Cass County. As a result of a1998 Interlocal Agreement with Eagle, 11 dedicated monitoring wells have been installed in the CWSPA, and these wells as well as the two PWS wells are monitored by the District. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 23***.

4.1.2.12 Elmwood

Applicable Regulations: Section L(1)

The CWSPA for the Village of Elmwood occupies slightly more than 1 ½ square miles west and south of the village in central Cass County. In 2006, District sampling results indicated that the triggers for a Phase III groundwater management area had been exceeded in the CWSPA. As a result, a Phase III Verification Study was initiated and was completed in 2008. This study resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, & Technology, 2008b). District staff sample three PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 24***. As a result of the verification study and subsequent sampling, the LPSNRD designated the Elmwood CWSPA as a Phase III GWMA in December 2009. In 2010, the NRD assembled an advisory group for the GWMA composed of local residents and officials from the Elmwood area, and held two meetings with that group. In 2012 the District began implementation of rules and regulations

for the Phase III area, including requirements for nitrogen certification, fall fertilization, and soil sampling, and increased cost-share for best management practices. The District has held nitrogen certification classes and certified six nitrogen applicators from the Elmwood CWSPA. As part of the Phase III rules and regulations, any producer that intends to apply nitrogen has to conduct soil sampling and must report those results to the LPSNRD. Nitrogen fertilizer can then be applied after March 1st and after the results of the soil sampling have been considered by the landowner. LPSNRD will continue to work with these and all operators within the Phase III area to ensure that its regulations are implemented successfully.

4.1.2.13 Garland

The Village of Garland's CWSPA takes up slightly less than one square mile around and to the west of the village in northwestern Seward County. District staff sample two PWS wells for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 25***.

4.1.2.14 Greenwood

The CWSPA for Greenwood occupies about one square mile around and to the east and southeast of the village in western Cass County. District staff sample two PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 26***. This data as well as sample results from past years indicates that the nitrate levels in the CWSPA have exceeded the Phase II (and perhaps the Phase III) trigger, but the majority of Greenwood's CWSPA is already contained within the larger Lower Salt Creek GWR Phase II GWMA. The District has considered suspending the Phase II designation for the LSC GWR and will continue to evaluate whether or not to do so. However, in 2018, the NRD began a two-year Verification Study for the Greenwood CWSPA to see if it merits designation as a Phase II GWMA. Shallow and deep soil sampling have been completed and three dedicated monitoring wells were installed in and around Greenwood in 2019, and the study report was completed in 2020. That report concluded that NPS groundwater contamination is occurring in the CWSPA. In 2021, LPSNRD met with Greenwood to determine future actions regarding Phase II implementation; if the CWSPA is designated as a Phase II area it would add a small area to the south of the Village to Phase II activities.

4.1.2.15 Hallam

The Village of Hallam's CWSPA takes up about ¾ square mile around and to the north of the village in southern Lancaster County. District staff sample two PWS wells for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 27***.

4.1.2.16 Hickman

Applicable Regulations: Section K(1)

The City of Hickman's CWSPA takes in slightly more than 3 ½ square miles south of the city in southern Lancaster County. The CWSPA for Hickman straddles the boundary between the Lower Platte South and Nemaha NRDs; about 2 ½ square miles are in LPSNRD, and the remaining one square mile is in NNRD. In 2006, District sampling results indicated that the

triggers for a Phase II groundwater management area had been exceeded in the CWSPA. As a result, a Phase II Verification Study was initiated and was completed in 2009. This study resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2009a). District staff sample four PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 28***. As a result of the verification study and subsequent sampling, the LPSNRD designated the Hickman CWSPA as a Phase II GWMA in December 2009. In 2012, the NRD began assembling an advisory committee of stakeholders from Hickman to advise the District as it develops rules and regulations for the implementation of Phase II, and the District developed and adopted the Phase II regulations as of November 1, 2013. As already described, these regulations include a requirement for nitrogen certification training and additional promotion of BMP cost-share. In addition, in 2013, LPSNRD signed an addendum to its Interlocal Agreement with the Nemaha NRD to allow LPSNRD to provide BMP cost-share to producers in NNRD's portion of the CWSPA, as long as any of those producers who desire the cost-share first complete LPSNRD's nitrogen certification training requirements. For 2011 through 2024, Hickman's nitrate levels in the NRD's monitoring wells continued to stay below the Phase II trigger. In recent revisions of the District's Groundwater Rules and Regulations, a procedure was included for suspending Phase II and moving back to Phase I if nitrate levels dropped below appropriate triggers for a period of not less than three years. Hickman's levels have stayed around the Phase II trigger and some variation in one or more of the wells could result in an exceedance of that trigger. As a result, in 2025 LPSNRD will continue to consider the process of suspending the Phase II requirements for the Hickman CWSPA.

4.1.2.17 Lancaster County SID #6/Emerald

The process of installing a new public water system for the community of Emerald in west-central Lancaster County stretches back for several years. After considerable effort, the system was completed and came online in 2010. In 2011, NDEE completed delineation of the wellhead protection area boundary for the new wellfield, and in 2013 LPSNRD arranged a sampling agreement for it. District staff sample two PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 29***. Note that the wells in the eastern portion of the CWSPA are backup wells and are not typically sampled in a given year. Also, the sample results for 2016-2018 indicate that the Phase II trigger had been exceeded for Emerald. In 2018, the District initiated a Phase II verification study to determine if the Emerald CWSPA should be delineated as a Phase II GWMA. Shallow soil sampling was completed in 2018; deep soil sampling and installation of one monitoring well were completed in 2019, and the remaining two monitoring wells were completed in 2020. Study activities are complete, and a report was issued in late 2020. With the installation of the dedicated monitoring wells, it appears that the Phase II trigger has not been exceeded, and so Phase II designation is not warranted at this time. In 2021, LPSNRD consulted with the SID to that effect, and both entities agreed to continue monitoring water quality in the SID supply wells and monitoring wells to determine whether additional action will be necessary in the future.

4.1.2.18 Lincoln

The City of Lincoln operates a large public water system along the north side of the Platte River near Ashland. The extent of Lincoln's CWSPA is shown in ***Appendix A, Figure 3***. At present, LPSNRD does not sample any of Lincoln's wells as the majority of them are located outside of District boundaries, and the City performs extensive monitoring of its own. However, LPSNRD frequently cooperates with Lincoln on matters related to groundwater quality and quantity, drought management, etc. In 2022, Lincoln initiated a process to identify an additional water source to account for projected growth of the City as well as provide redundancy should the current wellfield near Ashland encounter any major problems. The recommendations of the consultants and advisory committee included establishing a new wellfield in the Missouri River Valley between Plattsmouth and Nebraska City. Preliminary design and planning is underway, and it is anticipated that the new wellfield would be installed and operational in the next several years or few decades.

4.1.2.19 Louisville

The City of Louisville's CWSPA takes up about1 ¼ square miles to the west of the city along the south side of the Platte River in northern Cass County. District staff sample three PWS wells for the City. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 30***.

4.1.2.20 Malcolm

The Village of Malcolm's CWSPA covers about 5 square miles north and west of the village in west-central Lancaster County. District staff sample three PWS wells for the village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 31***.

4.1.2.21 Metropolitan Utilities District (MUD)

The Metropolitan Utilities District (MUD) serves the greater Omaha area. It gets its water supply from the Missouri River and several wellfields, one of which is the Platte wellfield just northwest of Plattsmouth along the lower reaches of the Platte River. The CWSPA for the MUD Platte wellfield occupies about 12 square miles along the Platte River, most of it on the north side of the river in the Papio-Missouri River NRD. District staff sample one PWS wells for MUD. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 32***.

4.1.2.22 Otoe County RWD #3/Weeping Water

Applicable Regulations: Section K(1))

The CWSPAs for Otoe County Rural Water District #3 (OCRWD#3) and the City of Weeping Water are located within about one mile of each other just northeast of the village of Manley in central Cass County, and the CWSPAs overlap. The total area of the two CWSPAs is slightly over four square miles, and the overlap area is about one square mile. Water from the OCRWD#3 wells is combined with water from other supply wells throughout the system to supply customers in other parts of Cass and Otoe Counties, including the Village of Manley.

Water from the Weeping Water wellfield is used to supply customers in the City of Weeping Water, which is about five miles south of the wellfield.

In 2006, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded in these two CWSPAs. As a result, a Phase II Verification Study was initiated and was completed in 2009. This study resulted in the installation of six dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2009b). Unfortunately, two of the monitoring wells for the Weeping Water investigation (MW-1 and MW-2) were inadvertently installed too close to the county road right-of-way, and had to be decommissioned in mid-2009. As a result of additional investigation, two new wells were installed in 2011-2012 to replace these wells. District staff sample five total PWS wells for the combined area and six monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 33***.

The results of the District nitrate sampling from 2006-2009 indicated that the trigger for Phase II and possibly Phase III had been exceeded. However, conversations with NDEE late in 2009 indicated that the boundaries of the two CWSPAs might need modified based on the additional information gained in the verification study. The District supplied the information to NDEE, and new boundaries for the two CWSPAs were proposed and adopted. LPSNRD then delineated the entire combined area of the two CWSPAs as a joint Phase II GWMA in January 2010. In 2011 the District held a public hearing on, adopted, and began implementation of rules and regulations for the Phase II area, including requirements for nitrogen certification, and increased levels of cost-share for best management practices. In early 2012, the District worked with UNL Extension to hold nitrogen certification classes for those required operators in the CWSPA, and began implementation of enhanced cost-share for BMPs installed in the CWSPA. Re-certification for operators was held in 2017. Also, in 2016, the City of Weeping Water installed a new well to replace an older well that had been showing high nitrate levels, and nitrate in the City's system has decreased considerably since that time. All this information will continue to be incorporated into LPSNRD's management efforts for the CWSPA.

4.1.2.23 Panama

The Village of Panama's CWSPA occupies about one square mile north and east of the village in southeastern Lancaster County; the CWSPA overlaps the boundary between LPSNRD and the Nemaha NRD, and the Village itself is within NNRD. However, the one PWS well for the Village is located within LPSNRD and is sampled by District staff for the Village. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 34***.

4.1.2.24 Plattsmouth

The City of Plattsmouth's CWSPA occupies about 3 ¼ square miles to the northeast of the city along the Platte and Missouri Rivers in northeastern Cass County. District staff historically sampled six PWS wells for the city, but in 2011 widespread flooding along the Missouri River caused extensive damage to Plattsmouth's wellfield. In 2012, the City completed repairs to the system which included installation of one new high-capacity production well and decommissioning of three wells that were damaged. Plattsmouth has indicated recently that in the future it intends to purchase water for some or all of its supply from the Metropolitan

Utilities District (MUD), and so future LPSNRD sampling may be affected by these arrangements. District staff sample any operating PWS wells for the City. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 35***.

4.1.2.25 Pleasant Dale

Applicable Regulations: Section K(1)

The CWSPA for the Village of Pleasant Dale occupies about 2 ½ square miles west and north of the village in eastern Seward County. In 2006, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded in the CWSPA. As a result, a Phase II Verification Study was initiated and was completed in 2009. This study resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2009c). As a result of the verification study and subsequent sampling, the LPSNRD designated the Pleasant Dale CWSPA as a Phase II GWMA in December 2009. The District's Phase II regulations for the CWSPA became effective in 2013.

District staff sample two PWS wells for the Village and four monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 36***. In 2011-2013, District monitoring indicated that nitrate levels in the Pleasant Dale CWSPA had exceeded the Phase III trigger. However, in 2015, the nitrate level in these wells had dropped back below the Phase III trigger. In 2018, the NRD began a 2-year verification study to determine whether the CWSPA merits designation as a Phase III GWMA. In 2019, additional shallow and deep soil sampling was completed, and installation of one additional monitoring well was completed in 2020. The report for this investigation has been completed and shared with Pleasant Dale officials. With sampling results from the new monitoring well, it appears that the Phase III trigger has not been exceeded, so LPSNRD will continue Phase II activities and consult with Pleasant Dale on future activities.

4.1.2.26 Raymond

The Village of Raymond's CWSPA covers a little more than one square mile north and east of the village in northwestern Lancaster County. Sampling results from 2018 indicated that nitrate levels in the Raymond CWSPA exceeded the Phase II trigger, and in 2019 the District retained a private consultant to begin Phase II verification studies for the CWSPA. These studies began in 2020 with shallow and deep soil sampling, which is now complete. Three dedicated monitoring wells were installed in 2021, and the study was completed in 2022. District staff sample three PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 37***.

4.1.2.27 Sprague

The Village of Sprague's CWSPA occupies about 1 ¾ square miles around the village in southwestern Lancaster County. In 2006, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded in the CWSPA. As a result, a Phase II Verification Study was initiated and was completed in 2009. This study resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great

deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2009d). District staff sample two PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 38***. As has been the case for the past few years, these sampling results show that nitrate levels in the Sprague CWSPA are very close to the Phase II trigger (for 2021-2024 they exceeded that trigger). In December 2009, the LPSNRD Board directed the staff to continue to monitor the PWS and monitoring wells in the CWSPA to determine if those levels are in fact being exceeded. Given that the nitrate levels in samples from the Sprague monitoring network have exceeded Phase II triggers for two consecutive years, the LPSNRD will consider designating the Sprague CWSPA as a Phase II GWMA in 2025.

4.1.2.28 Union

Applicable Regulations: Section K(1)

The CWSPA for the Village of Union occupies about one square mile south of the village in southeastern Cass County. In 2006, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded in the CWSPA. As a result, a Phase II Verification Study was initiated and was completed in 2008. This study resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2008c). For several years, LPSNRD had not sampled Union's individual public supply wells, but in 2012 the NRD coordinated with the Village to begin sampling those wells. District staff sample two PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 39***.

As a result of the verification study and subsequent sampling, the LPSNRD designated the Union CWSPA as a Phase II GWMA in December 2009. The District developed and adopted Phase II regulations for the Union CWSPA which became effective on November 1, 2013, and as already mentioned these regulations include nitrogen certification requirements and additional BMP promotion. Over the past several years, nitrate levels in Union's wells have been either slightly above or slightly below the Phase II trigger. As shown in ***Appendix A, Figure 39***, those levels were slightly below the trigger in 2024, just as they were in 2021-2023. LPSNRD will continue to monitor these wells and work with the Village to gain more complete information for evaluation of Union's Phase status.

4.1.2.29 Valparaiso

Applicable Regulations: Section K(1)

The CWSPA for the Village of Valparaiso covers about 5 ¼ square miles surrounding the village in southwestern Saunders County. In 2001, District sampling results indicated that the triggers for a Phase II groundwater management area had been exceeded, and subsequent investigations resulted in the installation of three dedicated monitoring wells in the CWSPA, as well as collection of a great deal of geologic, soil, and other data (EA Engineering, Science, and Technology, 2003). As a result of this study, the Valparaiso CWSPA was designated as a Phase II GWMA in 2004, and implementation of the Phase II area began, and continues to the present.

District staff sample three PWS wells for the Village and three monitoring wells. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 40***. These results are slightly above the 50% level of MCL exceedance for Phase II designation as per the LPSNRD's GWMP. As already noted, in recent revisions of the District's Groundwater Rules and Regulations (Effective Date: January 15, 2020), a procedure was included for suspending Phase II and moving back to Phase I if nitrate levels dropped below appropriate triggers for a period of not less than three years. Given that the nitrate levels in samples from Valparaiso have been alternately slightly above or below that trigger, in 2024 LPSNRD will continue consideration of the process of suspending Phase II requirements for the Valparaiso CWSPA.

4.1.2.30 Waverly

The City of Waverly's CWSPA occupies more than eight square miles around and south of the city in northeastern Lancaster County. District staff sample eight PWS wells and six dedicated monitoring wells for the City. The results of the 2024 nitrate sampling are shown in ***Appendix A, Figure 41***. The results from 2017 through 2020 indicate that the Waverly CWSPA has exceeded the Phase II trigger.

In 2017, LPSNRD signed a cooperative agreement with the City of Waverly to support development of a comprehensive Drinking Water Protection Plan for the City's water supply. The project is also supported by the Nebraska Department of Environment and Energy and the University of Nebraska Water Sciences Laboratory. As shown in ***Appendix A, Figure 41***, the northern portion of the Waverly CWSPA is contained within the current Lower Salt Creek GWR Phase II area. Therefore, the Waverly project will be important to determine whether or not this area should be designated as a Phase II GWMA. In 2025, LPSNRD will continue considering whether the entire Waverly CWSPA should be designated as a Phase II area; since much of Waverly's CWSPA is contained within the Lower Salt Creek GWR Phase II area, most if not all individuals who apply nitrogen fertilizer in this area are already certified according to current NRD rules and regulations. Finally, LPSNRD has cooperated with the City of Waverly, UNL, and NDEE to apply for and receive funding to establish a dedicated Drinking Water Protection Specialist position to work with Waverly as a pilot project, but then branch out into the remaining 30 CWSPAs in LPSNRD. This position was filled in July of 2023, and the Drinking Water Protection Specialist held several meetings with individual farmers and landowners as well as the City of Waverly to discuss ways of implementing Best Management Practices, communicating with landowners and well owners, and other methods of protecting the groundwater resource in Waverly's CWSPA.

In 2024 there was UNL on farm research that was conducted on a local producer's field within the Waverly CWSPA. The research plan was to compare reduced nitrogen application rates vs. normally applied nitrogen application rates with a profitability analysis. The goal was to showcase the yield potential with reduced nitrogen rates by effectively utilizing existing nitrogen credits. The adoption of cover crops has not yet taken off widespread throughout the District but will continue promoting the use of cover crops to help improve overall soil health. The District held an Open House at the Waverly Community Center that included NDEE, UNMC, UNL-Extension, UNL-Water Sciences, NRCS, and Sentinel. Also, multiple educational events have

been held at the Waverly Community Center that were focused on both urban and rural nitrogen fertilizer management. These types of activities plan on being continued in 2025.

4.1.2.31 Weeping Water

See Otoe County Rural Water District #3.

4.2 Groundwater Quantity

Designated areas of management for groundwater quantity follow the same boundaries as those for groundwater quality—that is, Groundwater Reservoirs, the Remaining Area, and Community Water System Protection Areas. Spring 2023 to Spring 2024 water level changes are shown for the entire District in ***Appendix A, Figure 10***, and representative long-term trends are shown in ***Appendix A, Figures 11*** and ***12***. Typically, water levels are measured from irrigation wells and dedicated monitoring wells. Public water supply wells are not usually measured. In 2024, no GWRs or areas in the RA exceeded the trigger levels for advancement to Phase II, and the majority of the wells measured showed a decrease in water levels (***Appendix B, Table 3***).

As has been documented in earlier versions of this report, in late 2013 and early 2014, the District drafted new rules and regulations for the proposed Dwight-Valparaiso-Brainard Special Management Area (DVB SMA—see ***Appendix A, Figure 42***) to respond to seasonal declines in groundwater levels in the northwestern portion of the District. The District adopted new rules and regulations for the DVB SMA which went into effect on March 1, 2014. These regulations included the following:

- A prohibition on new irrigated acres;
- An allocation for all certified irrigated acres as follows:
- Pivot/sprinkler: 21 acre-inches per three years with a maximum of nine inches applied in any one year
- Gravity/flood: 30 acre-inches per three years with a maximum of 12 acre-inches applied in any one year
- Required completion of an irrigation management certification class for all irrigators;
- Establishment of cost-share programs;
- Requirement that new wells be completed to a depth such that they are less likely to be affected by seasonal water declines; and
- Requirement that all new well permits for this area be approved by the Board of Directors.

At the completion of the 2016 growing season, the three-year allocation period described above had been completed. As a result, the District revised its Groundwater Rules and Regulations to account for the expiration of this allocation period. Based upon water use records submitted to the District by water users in the DVB SMA, it appeared that the allocation amounts originally adopted were adequate to maintain irrigation in the area, and so the allocation amounts were adopted for a second three-year allocation period. However, additional hydrogeologic data collected by the NRD, especially via the airborne electromagnetic (AEM) surveys conducted

over the past several years, indicated that the geology of the eastern portion of the SMA is considerably different than that of the western portion. This is mainly due to the more unconfined nature of the aquifers in the eastern portion, which results in much less seasonal decline in groundwater levels. As a result, the District removed the allocation amount for the eastern portion of the SMA (all of the SMA located in T13N, R6E of Saunders County—see ***Appendix A, Figure 42***), but kept the prohibition on new irrigated acres for the entire SMA.

In addition, in 2014 the District formed an advisory group to help evaluate its progress and guide implementation of the SMA in the future. This group, consisting of local irrigators, dryland farmers, well owners, business owners, and representatives of the three villages, met for the first time in December 2014, and subsequently in January 2016, March 2018, and March 2019.The advisory committee recommended that the SMA move to a three-year "rolling" allocation with the same annual amounts, and that there be no separate allocation for flood irrigation. As a result, in 2019 the District revised its Groundwater Rules and Regulations to reflect these recommendations, and those regulations took effect early in 2020.

Appendix A, Figure 43 shows a summary of the historic use information for the area. ***Appendix A, Figures 44*** and ***45*** shows the irrigation used by producers under allocation during the previous year, multiple years, and the remaining allocation available for 2025.

Finally, one of the recommendations of the advisory group was the establishment of a weather station within or near the SMA so farmers in the area could have more local information as far as weather conditions, crop requirements, etc. In 2021, LPSNRD staff contacted UNL to begin the process of establishing this weather station, and the station was installed at Red Cedar Lake in mid-2022. This information will be provided to cooperators and the general public in the DVB SMA area.

As mentioned above, current regulations require that irrigators in the SMA attend an irrigation management certification class. The NRD held its first such class in February 2015, and all 63 irrigators obtained certification by attending this class. Re-certification of these irrigators took place in March 2019 and again last February 2023.

4.2.1 Irrigated Acre Certification

One of the tools used by LPSNRD as well as many other Districts in Nebraska to effectively manage groundwater quantity concerns is the certification of irrigated acres. In an agricultural state like Nebraska, irrigation is a primary use of groundwater. Therefore, accurate data as to the location and number of irrigated acres as well as the water applied to those acres is critical in making management decisions. In the Lower Platte South NRD, certification of irrigated acres is taking place in two phases, one involving what's known as the Hydrologically Connected Area (HCA), and the other involving the remainder of the District.

4.2.1.1 Hydrologically Connected Area

Applicable Regulations: Section Q

The Nebraska Department of Natural Resources (NDNR) has designated areas within Nebraska known as Hydrologically Connected Areas (HCAs). These are defined as areas where ground and surface water resources are directly connected and have relatively immediate and substantial impacts on one another. In LPSNRD, the HCA occupies all or parts of about 70 sections along both sides of Salt Creek between roughly Waverly and Ashland, and then along the south side of the Platte River from Ashland to Plattsmouth. ***Appendix A, Figure 46*** shows the location of the HCA in LPSNRD. NDNR has been working on a groundwater model for the Lower Platte River basin for the past several years, incorporating a variety of additional information to further evaluate the nature of the HCA in LPSNRD and other NRDs in eastern Nebraska. It is anticipated that NDNR will publish these model results and an associated map revision of the HCA in approximately the next five years, so the HCA in LPSNRD may be modified in the future.

Legislation passed in 2009 (LB483) required the Lower Platte South NRD and other Districts in the Lower Platte River Basin to develop regulations limiting the expansion of irrigated acres within the designated HCAs. An important consideration in this process was identification of "historically groundwater irrigated acres," those acres which were under irrigation from a groundwater source before the requirements of this law took effect. As a result of this requirement, the District developed and passed rules and regulations for the certification of historically groundwater irrigated acres and allowing for limited expansion of these acres on an annual basis for a five-year period through 2012. Those regulations were incorporated into the NRD's Groundwater Rules and Regulations in early 2013, and the requirements were extended indefinitely.

As a natural extension of the above activities, the District developed its voluntary Integrated Management Plan (IMP) in conjunction with NDNR. Following approval by both LPSNRD and NDNR, the IMP became effective on May 15, 2014. For more detail regarding the development of the IMP, see LPSNRD-NDNR, 2014.

As part of the effort toward a more comprehensive management strategy, LPSNRD joined six other NRDs and NDNR to form the Lower Platte River Basin Coalition (LPRBC) to jointly develop a water management plan for the entire Lower Platte River basin. As of early 2018, all seven participating NRD Boards and NDNR had approved the Interlocal Agreement that continues the Coalition and adopts the first five-year plan. For more information on the LPRBC, refer to its website at https://lprbc.nebraska.gov/.
In 2020, LPSNRD Board members, management, and staff attended several meetings of the Coalition and the technical committee. At the end of 2021, the first five-year increment for the Coalition expired, and in 2022 LPSNRD worked with the other members and NDNR to adopt the second five-year increment, essentially carrying forward the existing framework and allowable new uses.

The NRD's regulations for the Hydrologically Connected Area state that all acres historically irrigated with groundwater would be certified no later than March 31, 2010. By the deadline, LPSNRD had received and verified 34 separate certifications from 27 landowners in the HCA for a total of 2,964.48 acres. Currently, the NRD can approve allowable expansion of irrigated acres in accordance with the allowable new depletions in each five-year increment as agreed

upon by the Lower Platte River Basin Water Management Plan Coalition. At the beginning of the second five-year increment, LPSNRD had a total allowable new depletion amount of 2,098 acre-feet. At the start of 2024, the balance for allowable depletion in the second increment was 2,066.465 acre-feet with a total of 3,279.73 certified irrigated acres in the HCA. The District did not receive any applications for depletion changes in 2024 so the above numbers are current as of the time of writing of this document. ***Appendix A, Figure 47*** shows the locations of those acres.

The certification is summarized as follows:

Total # of Acres Certified in HCA: 3,279.73

Cass County:	949.54 acres (17 certifications from 12 separate entities)
Lancaster County:	1,350.62 acres (13 certifications from 11 separate entities)
Saunders County:	979.57 acres (11 certifications from 7 separate entities)

4.2.1.2 Remainder of District

Applicable Regulations: Section I, Rule 2

As part of its ongoing efforts at groundwater quantity management, the District is also continuing certification of irrigated acres in the remainder of the District outside the HCA. In late 2009, the District revised its rules and regulations to move the deadline for certification of irrigated acres in the remainder of the District from January 1, 2010 to January 30, 2011. On October 31, 2011, the District revised its rules and regulations again to now state that any lands irrigated with groundwater shall first be certified by the District prior to those lands being irrigated with groundwater. In 2024, the District received and approved applications to certify an additional 89.74 acres, and so as of December 31, 2024, LPSNRD had certified a total of 25,343.81 acres. Adding the 3,279.73 certified acres in the HCA to the non-HCA acres brings the grand total to 28,623.54 groundwater irrigated acres in LPSNRD as a whole. The location of those acres is shown in ***Appendix A, Figure 48***.

In addition to gathering information about the irrigated acreage in LPSNRD, the Groundwater program also administers the water well meter program (see Section 8). Out of the readings received in 2024, District staff was able to calculate overall usage and the number of inches applied to a certain area. ***Appendix A, Figure 49*** shows the number of inches applied per acre in 2024 for 315 wells across the District. The wells are separated by use and the calculated usage amount, which varies from zero to greater than twenty inches. Note that about half of the wells were utilized to apply five acre-inches or less.

5. WATER WELL PERMITS

Applicable Regulations: Section B

An important responsibility given to NRDs is that of permitting new and replacement water wells within their jurisdiction. In the LPSNRD's 2008 revisions to the Groundwater Rules and Regulations, the District adopted additional requirements for the permitting of all wells which pump more than 50 gpm. These requirements vary based on the actual pumping rate and total amount of water pumped, as well as whether the proposed well is located within a Groundwater

Reservoir or the Remaining Area (the District requires additional activities for non-domestic wells pumping more than 20 gpm in the RA). The regulations establish five classes of well permits (see LPSNRD Groundwater Rules and Regulations, Section C for more details): Class I is for wells in a GWR proposed to pump more than 50 but less than 1000 gpm; Class II is for wells in a GWR proposed to pump more than 1000 gpm; Class III involves wells in the RA designed to pump more than 20 but less than 250 gpm; and Class IV is for wells in the RA designed to pump more than 250 gpm (again, domestic wells pumping less than 50 gpm are exempt from NRD permit requirements). Class V is for wells that will pump over 500 acre-feet per year. Since GWRs generally have greater supplies than the RA, the thresholds for various permit actions are higher in GWRs than in the RA. Essentially, the regulations are aimed at demonstrating that there is groundwater of adequate quality and quantity in a given area before a specific well is permitted.

The District issued 14 water well permits during 2024, 4 of which have been completed (***Appendix A, Figure 50***). Of these, 9 were for irrigation, one for was other, three were for public water supply, and one was for industrial. By well permit class, the District received 5 Class I permits and 0 Class II permits; these permits are for wells located within a Groundwater Reservoir. In addition, the NRD received 4 Class III permits and 5 Class IV permits; these permits are for wells located within the Remaining Area. The district did not receive any Class V permits this year. All filing fees and required information were submitted for these applications.

6. WATER WELL DECOMMISSIONING

If not properly sealed at the surface, water wells can be a physical safety hazard to people and animals, as well as conduits for surface runoff and pollution to make its way directly into groundwater. Therefore, since the mid-1980s, Nebraska has had requirements not only for proper water well construction, but also the proper decommissioning or abandonment of unused wells to protect human health and groundwater quality. The state's NRDs are charged with promotion of proper well decommissioning through cost-share programs, inspections, and information and education programs.

In 2024, LPSNRD approved 12 applications and completed the decommissioning of 7 wells (***Appendix A, Figure 51***). Of the 7 wells that completed decommissioning, 5 were classified as irrigation wells, 1 was livestock and 1 was domestic. Since the LPSNRD's program inception in October 1990, as of December 31, 2024 **a total of 1,057 wells within the District have been decommissioned**.

7. CHEMIGATION

Chemigation is generally defined as the application of chemicals such as liquid fertilizers, pesticides, fungicides, etc. through an irrigation distribution system. Properly done, chemigation is a safe, cost-effective, and efficient means of applying such materials. However, in order for this to be true, the irrigation system has to be fitted with appropriate safety equipment. Such equipment has been required by Nebraska law since the late 1980s, and NRDs, together with NDEE, are charged with overseeing chemigation activities in the state. The Districts issue chemigation permits and inspect systems for proper installation and operation of the required safety equipment.

In 2024, LPSNRD continued its inspection and permitting duties pursuant to the Nebraska Chemigation Act. The District inspects systems on a three-year rotation or when modifications are made to an already permitted system. In 2024, the Lower Platte South NRD inspected 17 systems, and issued 36 renewal permits for a total of 41 permits (***Appendix A, Figure 52***). Chemigation permits were issued for a total of 3,951 acres in 2024. A breakdown of permits and number of acres covered by groundwater reservoir or area is presented in ***Appendix B, Table 5***.

District staff also performed permit compliance monitoring on systems by noting the locations of chemigation sites while in the field. The chemigation locations were recorded while performing such duties as groundwater sampling and water level monitoring. The permit status for each location was verified upon returning to the office. No violations were found in 2024.

8. WATER METERS

Applicable Regulations: Section C

Water meters for accurately measuring the flow from a well are among the most important tools used to document and manage the use of groundwater. In Nebraska, NRDs are given the authority to require the installation of water meters, and several Districts throughout Nebraska have implemented that requirement.

The LPSNRD Groundwater Rules and Regulations require that all new wells constructed to pump over 50 gallons per minute (gpm) be fitted with a water meter that could accurately measure the flow, and that the annual volume of water pumped from those wells be reported to the District annually. In addition, those regulations required that all wells capable of pumping 50 gpm be fitted with a water flow meter prior to use. There is no specific requirement of a given type of meter; LPSNRD only requires that the meter installed be accurate, and have the capability of showing the total volume of water pumped. In addition, these wells that are retrofitted with water meters must also begin reporting total annual pumping to LPSNRD.

2024 was the 14th year that the District required any well owner and/or operator who has a well equipped with a water flow meter to provide water usage information on the volume of water pumped on an annual basis. Out of the readings received this year and at the end of 2024, we were able to calculate overall gallons used in 2024 from the metered wells across the District (***Appendix A, Figure 53***). These wells used a total of 5,120,606,169 gallons in 2024. Of those wells, 293 are irrigation wells and are responsible for 66% of that total, or 3,369,106,618 gallons (10,338 acre-feet).

The District also receives pumping information from the various municipalities that have PWS wells in the District. This usage information is displayed in ***Appendix B, Table 6***.

The District has also implemented a cost-share program to promote adoption of this important management tool. The program provides 50% cost-share for the purchase of a water meter, to a

maximum of $750. The District completed two applications for the water meter cost-share program in 2024; the locations of those are shown in ***Appendix A, Figure 54***.

9. SOIL SAMPLING

Sampling soil content and analyzing it for nutrients assists in determining the application rate of additional nutrients needed for a field while reducing the potential for water and soil pollution. LPSNRD cost-shares on the sampling of a field's soil content to accurately determine application rates of essential crop nutrients.

In 2024, the District approved 19 applications and completed eight of those for payment. The locations of the approved and paid applications are shown in ***Appendix A, Figure 55***. The maximum amount an applicant is eligible to receive is $1,500. Note: there may be more approved and paid application locations displayed on the map due to multiple fields being sampled as part of the same application.

10. FERTILIZER METERS

Accurate application of nitrogen fertilizer to crop ground is an important part of protecting groundwater from leaching of nitrates. If producers can accurately control the amount of fertilizer applied, it is less likely that excess nitrates will leach below the crop root zone and infiltrate to groundwater. LPSNRD cost-shares on the purchase of these meters as a way of promoting proper nitrogen management.

In 2024, the District completed ten applications for the Fertilizer Meter Cost-Share Program (***Appendix A, Figure 56***).

11. SPRING NITROGEN APPLICATION PROGRAM (SNAP)

The SNAP program aims at encouraging an increase in spring and split applications of nitrogen fertilizer. Applying nutrients such as nitrogen closer to the growing season and in-season will help lower the risk of groundwater and surface water contamination.

In 2024, the District received and approved 25 applications for SNAP (***Appendix A, Figure 57***). For FY 2025, we implemented an application deadline for SNAP. To enroll producers must submit their applications by November 15th of the year prior. As of November 15th, 2024, we received 79 applications for FY 2025. Payments will occur in FY 2025 after the applicants turn in supportive documentation that indicates the agreed upon fertilizer application practice(s).

12. IRRIGATION MANAGEMENT

Proper irrigation management goes hand-in-hand with fertilizer management to prevent the leaching of nitrate to groundwater. If only the amount of water used by the crop is applied, less deep infiltration is available to carry excess nitrate to groundwater. The District cost-shares on a variety of best management practices associated with irrigation water management. In 2024, LPSNRD completed cost-share for Irrigation Management with one applicant on five farms/pivots.

13. SALT WATER INTRUSION

Applicable Regulations: Section H

In some parts of LPSNRD, the intrusion of salt water into fresh groundwater is a concern. This is especially so in areas where the Dakota Formation or older Paleozoic bedrock is fairly close to the surface, as some units within the Dakota and older units contain saline water. Excess pumping of shallow, fresh groundwater can induce intrusion of saline water from deeper geologic units, and therefore the District continues to monitor for indicators of salt water intrusion, as well as work with well owners to address such concerns. This condition is monitored by analyzing samples for such parameters as sodium, chloride, and total dissolved solids (TDS). In 2024, the District had no inquiries or reports of salt water intrusion. However, the District is continuing to cooperate with the Saline Wetlands Conservation Partnership to operate two wells producing saline water for restoration of wetlands at the Marsh Wren Saline Wetlands north of Lincoln, and in 2024 continued applying salt water to various portions of the wetlands complex to further this restoration effort.

14. IMPROPER IRRIGATION RUNOFF

Applicable Regulations: Section M

Nebraska's NRDs are granted authority to deal with the improper runoff of groundwater applied as irrigation water. Such runoff is a waste of groundwater, can contribute to both ground and surface water quality problems, and can cause a variety of erosion problems. In 2024, there were no new complaints received by the District.

15. TRANSFER OF GROUNDWATER

Applicable Regulations: Section N

The District has the responsibility of reviewing and approving or denying applications to transfer groundwater from one area to another. In 2024, no requests were received for such a transfer.

16. VARIANCES

Applicable Regulations: Section P
LPSNRD also has provisions in its regulations for granting variances from those regulations upon petition if a landowner, well owner, or other individual can demonstrate such a need. In 2024, no requests were received for a variance.

17. COMPLAINTS/ENFORCEMENT/INVESTIGATIONS

Applicable Regulations: Sections D, J, K, L, M, N, O

As described above, 2024 was the fourteenth year that the District required any well owner and/or operator who has a well equipped with a water flow meter shall provide water usage information on the volume of water pumped to the District annually. The Water Resources

Compliance Specialist requested usage information from all metered wells and will continue to work with owners of irrigation, commercial, and other wells so that they are in compliance with the water well flow meter rules and regulations.

Also, in 2024, the Water Resources Compliance Specialist inspected 285 wells for required water flow meters. The inspection included taking photos of the meter, GPS locations, verifying the serial number on the meters, checking for proper installation, and verifying the water meter readings and units. The Compliance Specialist tries to do the inspection while the well is running to verify the meter is working properly. All wells checked during these inspections had a meter installed properly with no violations found at the time of inspection. Wells that were listed as inactive irrigation wells were also checked to make sure they were not being used. The Compliance Specialist will continue inspecting at least 25% of the metered wells each year.

Beginning in 2014, the District revised the Groundwater Rules and Regulations to add the Dwight-Valparaiso-Brainard (DVB) Special Management Area (SMA). The District established an initial 3-year allocation of 21 acre-inches per irrigated acre not to exceed nine acre-inch annual maximum for sprinkler irrigation and thirty acre-inches per irrigated acre not to exceed a twelve acre-inch maximum for gravity irrigation, beginning in calendar year 2014. As of January 1, 2017, the District removed the allocation for the portion of the Special Management Area located in Township 13 N, Range 6 E, Saunders County and the rest of the Special Management Area will follow the same initial allocation. In January 2019, new Groundwater Rules and Regulations were adopted that modified the fixed allocation to a rolling allocation of 21 inches not to exceed 9 inches in any one year for all irrigation types. There were no violations of the 9 inch annual maximum in 2024.

From time to time, the District receives a variety of complaints or inquiries regarding various water resources concerns. These issues are investigated on a case-by-case basis, and the District will then determine if any violations of its rules and regulations have occurred. An ongoing issue has involved an irrigation complaint filed in September of 2009 due to groundwater irrigation runoff from a property located in Saunders County. The party involved worked with NRCS to prepare a plan to control irrigation runoff, which was approved in early 2010 and the party implemented the plan. Since that time, the downstream neighbor has reported that irrigation runoff has occurred again in years following the initial investigation and has showed staff and the Board of Directors video evidence of irrigation runoff. Each year, the operator submitted their irrigation management plan and it was determined that they were following their irrigation management plan. In early 2015, the operator informed the LPSNRD that they are working with NRCS to design a flood control structure to control any runoff from leaving their property. A hearing was held in April 2015 to enter into an Order to Cease and Desist for Irrigation Runoff Complaint #002 with regard to violator. In early 2016, a water/sediment control basin was constructed to control irrigation runoff. The District conducted site inspections in 2024. No evidence of violation was found during the inspections.

18. INFORMATION/EDUCATION

One of the most important activities that the LPSNRD undertakes is education of its citizens about groundwater quality and quantity issues. The District is involved in a wide variety of such activities. Highlights of the District's 2024 activities are described below.

18.1 Programs for Students and Teachers

- NRD staff gave groundwater-related classroom presentations to over 200 elementary, junior, and senior high school students. The students utilized hands-on models, kits, and activities such as the District's groundwater flow model, Hach nitrate test kit, Incredible Water Journey, and Wetland in a Bag.
- The District led field trips for 1,743 students - elementary and senior high school biology students - focusing on different water quality parameters and the influence of land practices on surface and groundwater.
- In 2024, The NRD hosted a "Test Your Well Night" in partnership with the local FFA chapter for the Malcolm community and assisted with another for the Brainard community. These events invite landowners with private wells to bring in water samples to be tested for nitrates. FFA students ran the nitrate tests using Hach equipment. If there were any samples at 6 ppm (parts per million) or greater, the NRD kept the sample and sent it to Midwest Labs for an additional nitrate test. In Malcolm, 103 water samples were tested for nitrates (only eight were sent to Midwest Labs).
- NRD partnered with 10 local elementary schools to host Family Nature Nights. The LPSNRD and partner agencies offered hands-on, environmentally focused activities for students and their families with many centered around water. The Family Nature Nights reached 1,662 people.
- The NRD's virtual classroom webpage on the NRD website remains a valuable resource for educators and families in the District. It features short Explorin' Videos, longer Environmental Education Field Trip videos, a presentation using a groundwater flow model, and activity sheets. The webpage covers a variety of natural resources topics, including groundwater, wildlife habitat, and wetlands, with staff available via Zoom for follow-up questions and answers.
- District staff has been working to implement the Know Your Well Program (KYW) into our local schools. The KYW Program is being led by the University of Nebraska-Lincoln. KYW is a student driven citizen science program that teaches students about water sampling and testing water quality. A curriculum has been developed and is anticipated to be launched widespread for the 2026-2027 school year. District staff introduced KYW with Louisville Public Schools 8th graders to conduct their own sampling efforts with local private well-owners. Private wells are not regulated by the State or Federal Government which means they are not required to sample their wells for known contaminants. This program is aimed at educating our youth and the general public about the importance of sampling private well water and the importance of groundwater protection. We are looking to add more schools to the KYW network.

18.2 Public Information

- LPSNRD utilized social media to report through Facebook the following updates on groundwater programs: groundwater spring and fall levels, number of wells sampled annually, groundwater meters, and Test Your Well Night information.
- The groundwater staff continued to provide input for website improvements at LPSNRD.org. The website allows access to a variety of groundwater information and is compatible with a variety of devices. The website gives landowners new tools for electronically submitting well flow meter reports and it allows interactivity with constituents on information concerning certified acres, chemigation, water quality, and water levels.
- LPSNRD continued implementation of its voluntary Integrated Management Plan (IMP) in 2024. The 2023 annual report summarizing IMP progress was posted on the websites of both the NRD and NDNR.
- A webpage dedicated exclusively to the IMP was maintained throughout 2024, featuring links to the entire plan, as well as to the *Water Balance* and *Water for the Future: Stakeholder Perspectives* studies that preceded it, along with the Annual Report. The IMP webpage is accessible through the website's Programs menu and the IMP and IMP Annual Report are also accessible through the Publications menu.
- In 2024, LPSNRD.org continued to provide links to data from seven aerial electromagnetic (AEM) surveys conducted across different areas of the district. Additionally, links to the Eastern Nebraska Water Resources Assessment website (ENWRA.org) are available for further data access.
- The District's voluntary Water Quality Management Plan (WQMP) was updated in July 2024 and approved by the Environmental Protection Agency in October 2024. The plan, which is posted on LPSNRD.org, serves as a guide in the development and implementation of water quality, hydrology, and aquatic resource projects in the District and can aid in securing financial support for these types of projects.
- LPSNRD continues to advertise its groundwater quality and conservation programs and activities in many printed publications across the District.
- Groundwater quality/quantity programs and management are aired year-round on Lincoln radio stations owned by NRG Media and Alpha Media.
- The District's "Look Out Below" logo remains on a Cass County Rural Water District #2 water tower near Eagle.
- LPSNRD groundwater programs and activities are also regularly promoted in the LPSNRD newsletter, on social media, and at LPSNRD.org.
- Groundwater programs and water quality best management practices (BMPs) are featured in brochures being produced and printed in-house on an as-needed basis.

19. EASTERN NEBRASKA WATER RESOURCES ASSESSMENT (ENWRA)

The Eastern Nebraska Water Resources Assessment (ENWRA) was formed in 2006 by a joint agreement between the six NRDs which cover the easternmost portion of Nebraska. The Lewis and Clark, Lower Elkhorn, Lower Platte North, Lower Platte South, Nemaha, and Papio-Missouri River NRDs formed a coalition aimed at developing a three-dimensional geologic framework and water budget for all of eastern Nebraska (Divine *et al.*, 2009). In the years since

its inception, ENWRA has hired a project coordinator, and has completed a variety of projects and investigations aimed at gaining a better understanding of the complex water system in the glaciated portion of eastern Nebraska. An excellent description of these activities is presented in Divine *et al*., 2009. Additional updated information can be found on the website, https://enwra.org/. In 2022, ENWRA renewed its 5-year interlocal agreement for a fourth time to continue cooperative project activities through June 30, 2027.

The *Nebraska GeoCloud and AEM Data Integration Project* (GeoCloud), a Water Sustainability Fund (WSF) ENWRA project online since June 30, 2020, houses all the Airborne Electromagnetic (AEM) survey data collected in Nebraska statewide in a cloud-based platform. The GeoCloud project's multi-NRD Interlocal agreement (which includes ENWRA NRDs) goes through June 30, 2027 and includes $23,000 annually to include enhancements and to maintain and continue the Platform. Recent additions to the Nebraska GeoCloud include: the 2020 and 2022 Cass County AEM survey data, summer 2023 Nemaha NRD AEM Survey data, and the Lower Platte South NRD early 2024 Hydrogeologic Assessment Report. Additionally, upgrades to the three-dimensional (3D) data viewing tools and the organization of datasets are in progress. More information on the AEM related projects can be found in Section 20 below.

ENWRA will close out the Recharge and Focus Area Mapping (WSF #5312) three-year project with the UNL-CSD and U.S. Geological Survey ($144,000 from WSF, $96,000 in matching funds from ENWRA, and $74,000 in USGS Cooperative dollars) in March 2025 (go.unl.edu/enwra2024map). The in depth local evaluations for this project included LPSNRD's Crete-Princeton-Adams Groundwater Reservoir, part of the Dorchester Sterling paleochannel system. ENWRA plans an early 2025 WSF grant application to address the recommendations stemming from the WSF5312 work for further regional refinements and additional local focus area assessments. The regional recharge map completed in late 2024 will be uploaded to the Nebraska GeoCloud and documented in a USGS publication.

Additional 2024 ENWRA activities included:

- ENWRA Technical Meeting June 28, 2024 and subsequent preparation activities for the Annual Meeting (February 19, 2025) including 3 biennial updates to 3 NRD boards
- Major upgrade to the ENWRA website (went live July 1, 2024), UNL-CSD and Nebraska GeoCloud collaborations adding newer 2020 to 2023 datasets, large file sharing and posting to ENWRA Dropbox (backup drive planned for quarterly updates)
- ENWRA and AEM-related data presentions: Well Drillers booth in February 2024, Southeast Nebraska Water Tour in Nemaha NRD June 17, 2024, UNL Discovery Days booth August 2024, and Nebraska State Irrigation Association November 2024 conference booth
- Coordination with NeDNR and NeDEE with database portal testing (ENWRA has a new State of Nebraska login primarily for public well location and data access)
- Coordinating public/consultant/agency inquiries for AEM flight data
- Geologic test-hole and new geophysical equipment (tTEM, WalkTEM) fall 2024 demonstrations and initial planning with various NRDs
- Administering agreements, financials, and grants
- Improvements to the 3D projects for each ENWRA NRD in GeoScene 3D

- Collecting, analyzing, compiling, and graphing annual water levels and water quality results.
- Maintaining pilot site well cluster installations and instrumentation

20. RESEARCH

In addition to the research activities undertaken by the ENWRA project, the District engages in a variety of other research related actions. As already mentioned in Section 4.1.2, LPSNRD has begun and will continue a program to collect data on the occurrence of nitrate in the vadose zone at several CWSPA locations throughout the District. Over the next several years, LPSNRD expects to include locations which represent a wide variety of land use, soil, and hydrogeologic settings to help determine loading amounts and general rates of movement, which will help to guide future nitrogen management activities. Again, it is the District's intent to continue working with UNL-WSL on additional vadose zone sampling activities in the future. Also, as mentioned, in 2024 NRD personnel budgeted for equipment capable of taking vadose zone samples down to about 15'. This would provide data from multiple locations in a short time, and will supplement the more detailed vadose zone data collected by UNL-WSL to help evaluate the movement of contaminants below the vadose zone. This effort was not funded in 2024, but will be brought forward in future budget cycles.

Regarding AEM developments in 2024, LPSNRD did not obtain any additional flight line data. As of this writing, LPSNRD has a total of 4,377 line-miles of AEM data, covering the majority of the District. The GeoCloud project went live online in the summer of 2020 and houses all AEM for Nebraska. It is possible that additional airborne or other geophysical data collection will be undertaken in the future, but it is anticipated this would be on a more local and focused scale than what has been accomplished to date. This could include utilization of ground-based geophysical equipment currently being utilized by UNL. The next step is initiation of pilot projects focusing on products (e.g., geological models, groundwater models, etc.) that can be created with the AEM data. A first step toward that district goal was achieved in December 2021 with a $247,500 award in grant funds from the Nebraska WSF, administered by the Nebraska Natural Resources Commission (WSF #5311). The grant will be matched with another $165,000 in LPSNRD funds for a two-year project to develop a three-dimensional (3D) AEM-based hydrogeologic framework (or "Framework" for brevity) using existing AEM data, geologic logs, and other relevant available geologic and hydrogeologic reports and data. The Framework will be developed using state-of-the-art 3D visualization computer software to develop 3D geological models from large datasets (like AEM), and will also include hardcopy map products. In addition, this grant will be used to prepare all of LPSNRD's AEM data for incorporation into numerical groundwater models, both on a regional and local scale. Finally, the project will also develop a set of detailed recommendations for additional work with the AEM data and hydrogeologic framework, as well as evaluate the necessity for groundwater modeling. The grant was finalized in early 2022 and a consultant was selected to perform the work. Work was nearly complete on this project by the end of 2023, with draft copies of the map book presented to Board members as well as several overview presentations by the contractor. Work on this project was completed early in 2024, with final maps, visualization tools, and data upload to the GeoCloud, as well as recommendations from the contractor for future work. In conjunction with the creation of the Drinking Water Protection Specialist position, it is anticipated that much of

this work will focus on more detailed groundwater modeling in LPSNRD's CWSPAs as well as additional data collection needed to evaluate effectiveness of practices implemented in those areas. Current plans are to continue emphasis of the Waverly CWSPA as well as the Phase II and Phase III CWSPAs for the first several years of this activity, and then branch out into the remainder of the CWSPAS. In addition, with the initiation of revision/update of the District's Ground Water Management Plan (GWMP) in 2024, this information will provide valuable support for background information as well as additional analysis in support of the District's ground water programs. Finally, this information will also be used to aid private well owners throughout the District as needed to provide increased support for protection and effective management of drinking water.

21. GROUNDWATER MANAGEMENT PLAN UPDATE

The District is currently utilizing their GWMP that was developed and approved in 1995 according to State statutory requirements to aid in decision making regarding quality and quantity. The District elected to begin the process of updating this plan in 2024. A contractor was selected in late 2024 to work with the District on these updates. The entire update process is expected to last approximately one and a half years, after which the District anticipates the need to update our current Groundwater Rules and Regulations. This process will include public involvement sessions throughout the revision of the plan, utilizing data collected since 1995 to aid in the update of the document, maps, and associated components, stakeholder meetings and having the final plan reviewed by state agencies before being ultimately presented to the District Board and public for adoption.

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Appendix A

Figure 1 – General Location Map

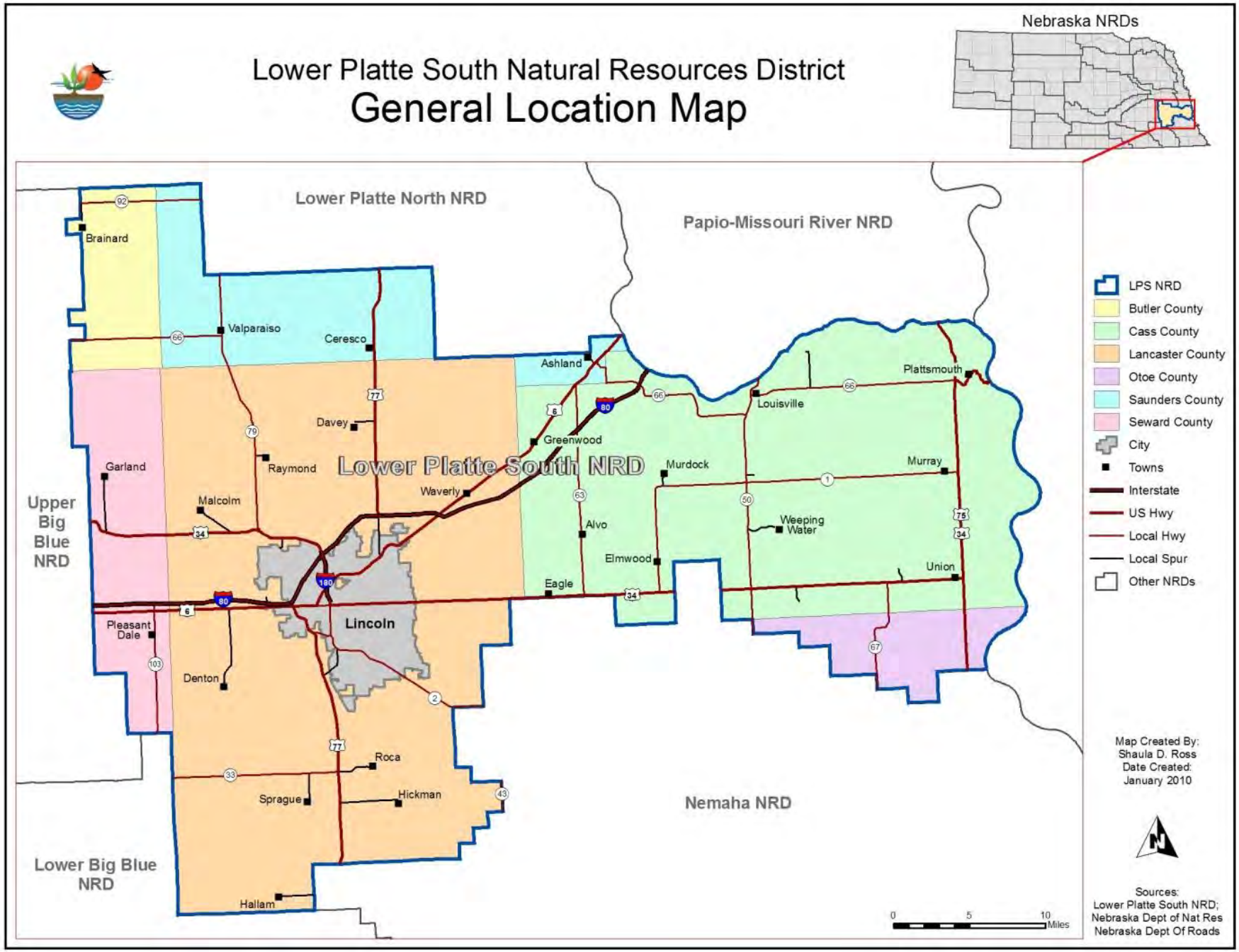


Figure 2 – Groundwater Reservoirs

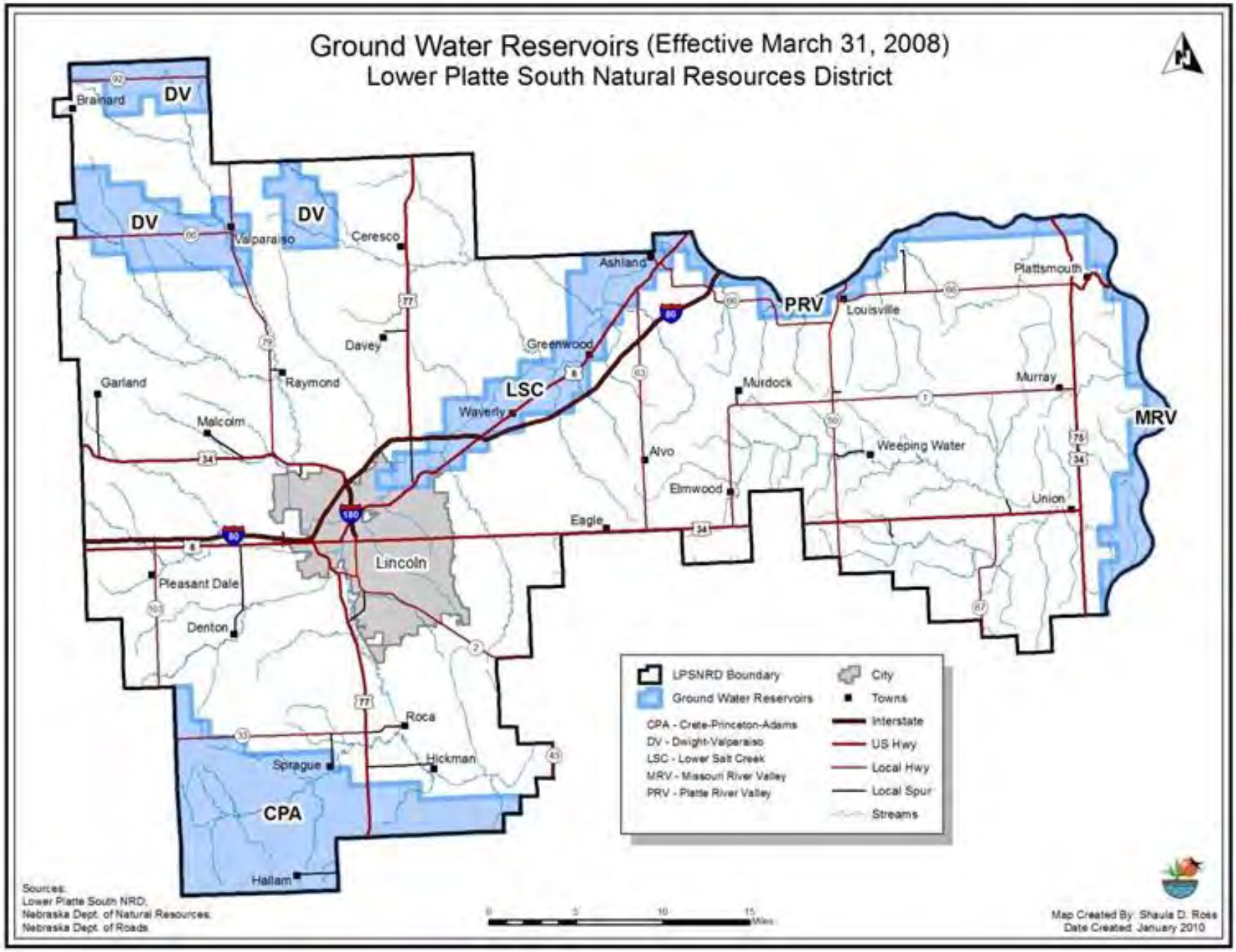


Figure 3 – Community Water System Protection Areas

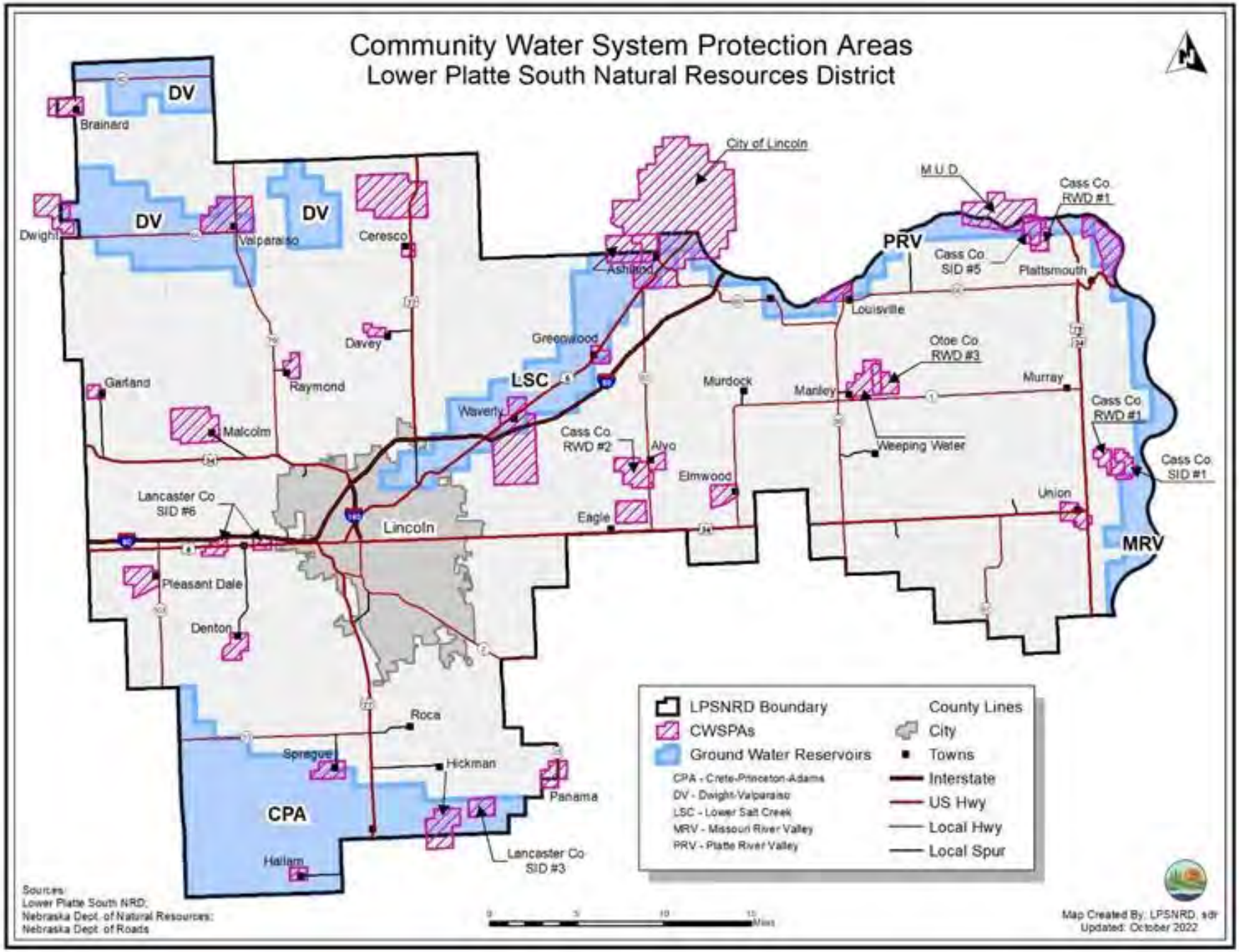


Figure 4 – Locations of Registered Domestic and Public Water Supply Wells– General Location Map

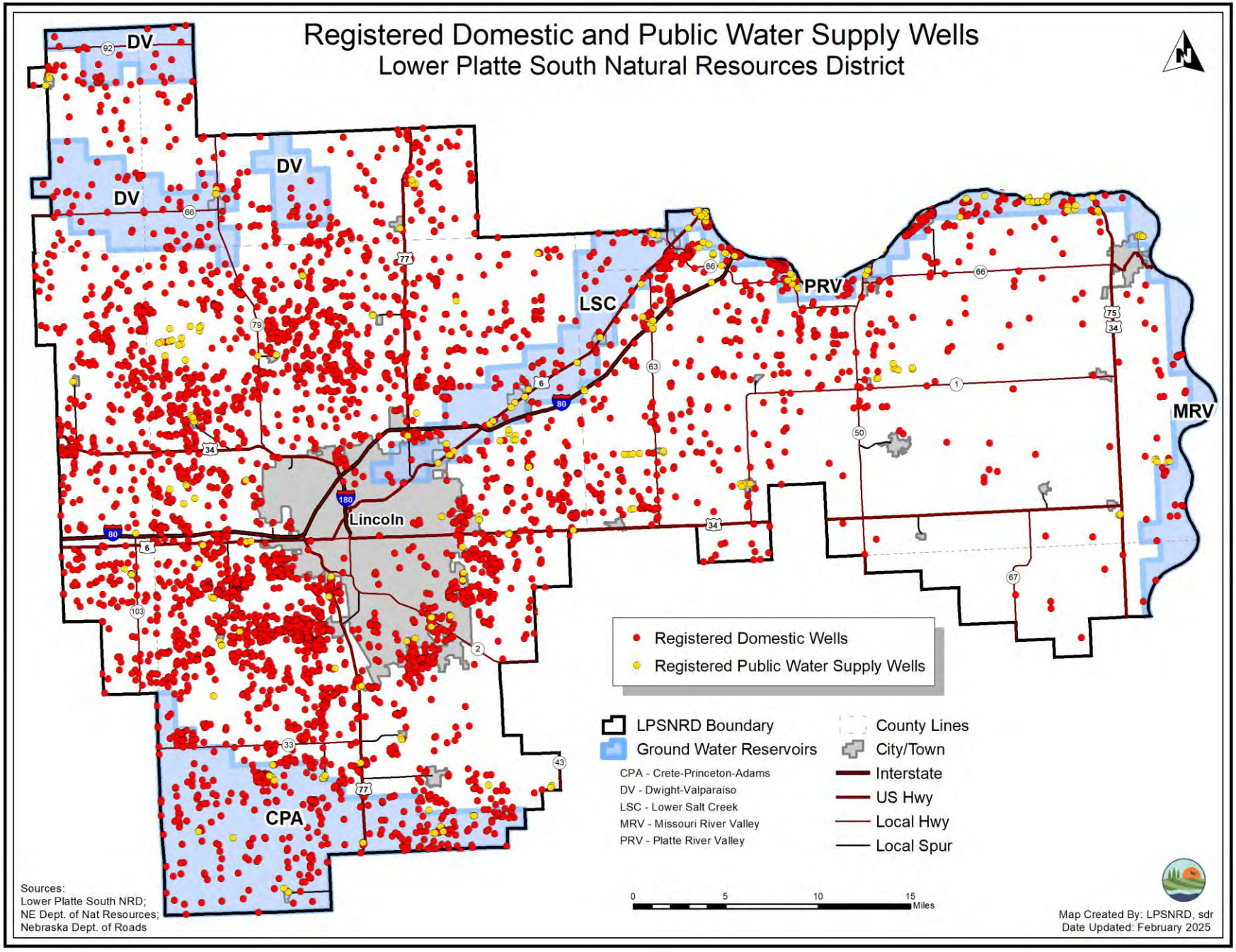


Figure 5 – Locations of Registered Irrigation Wells

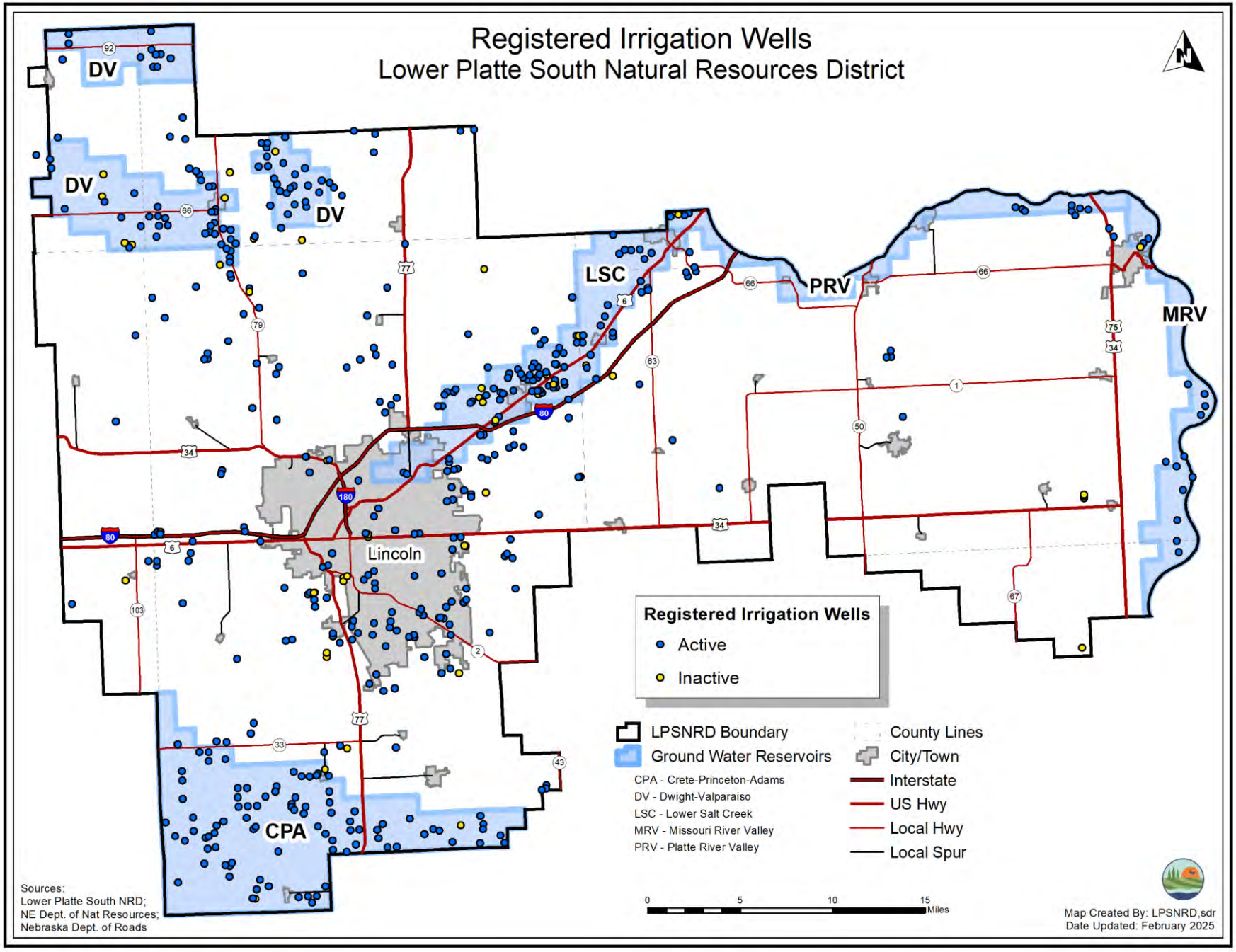


Figure 6 – Nitrate Results – Groundwater Monitoring Network

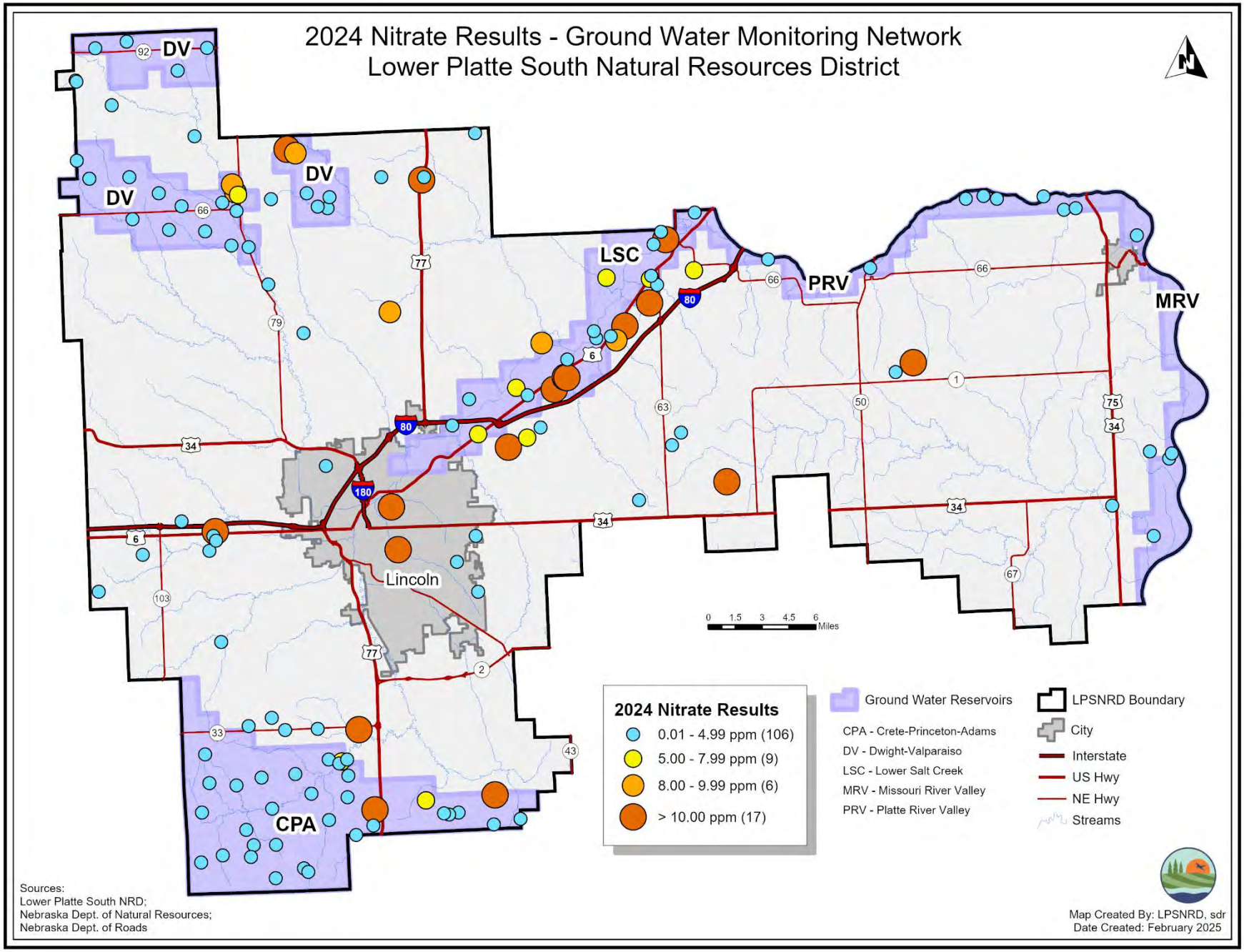


Figure 7 – Nitrate Results – Additional Wells Sampled

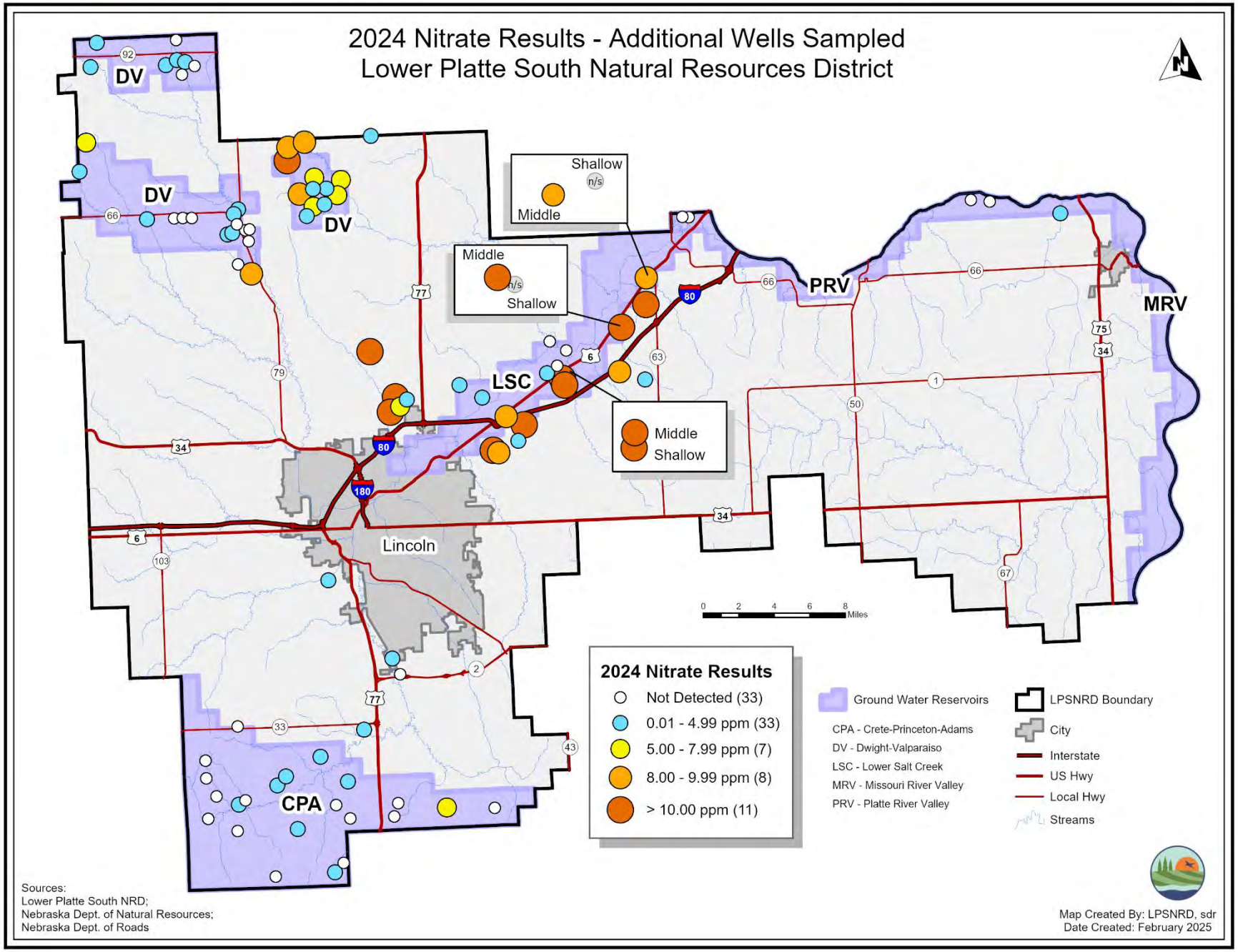


Figure 8 – Pesticide Sample Locations

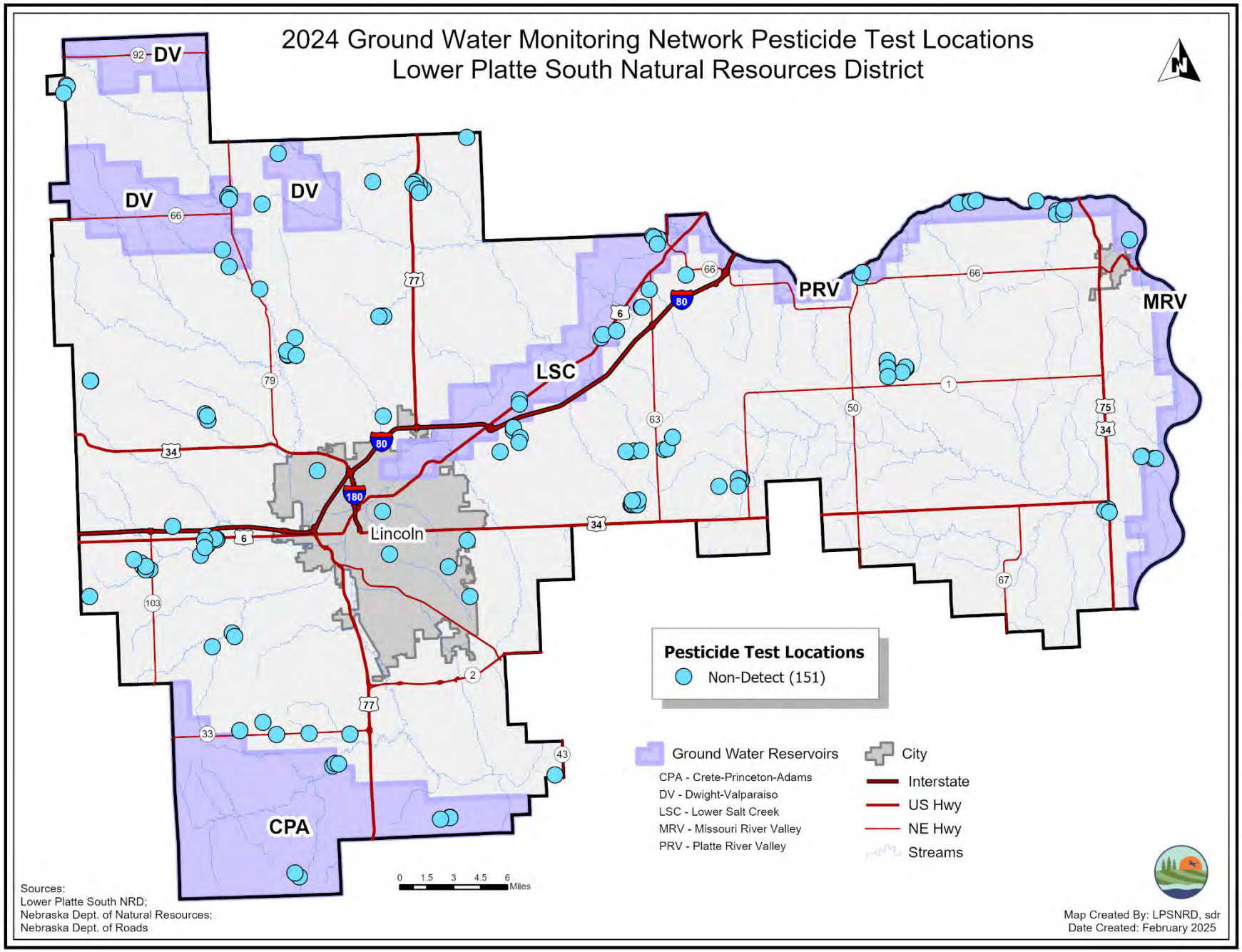


Figure 9 – Arsenic Detections

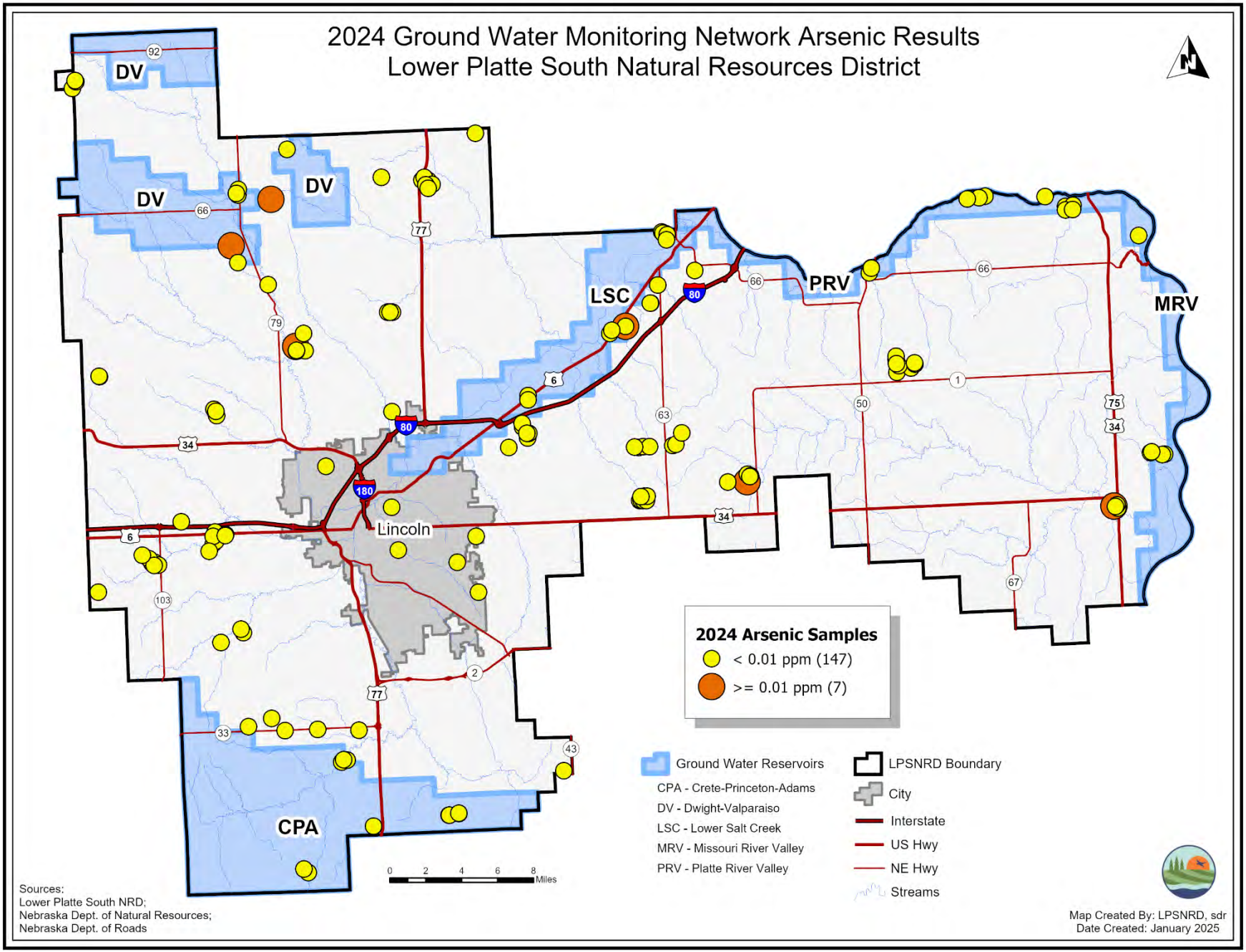


Figure 10 – Groundwater Level Measurement Locations

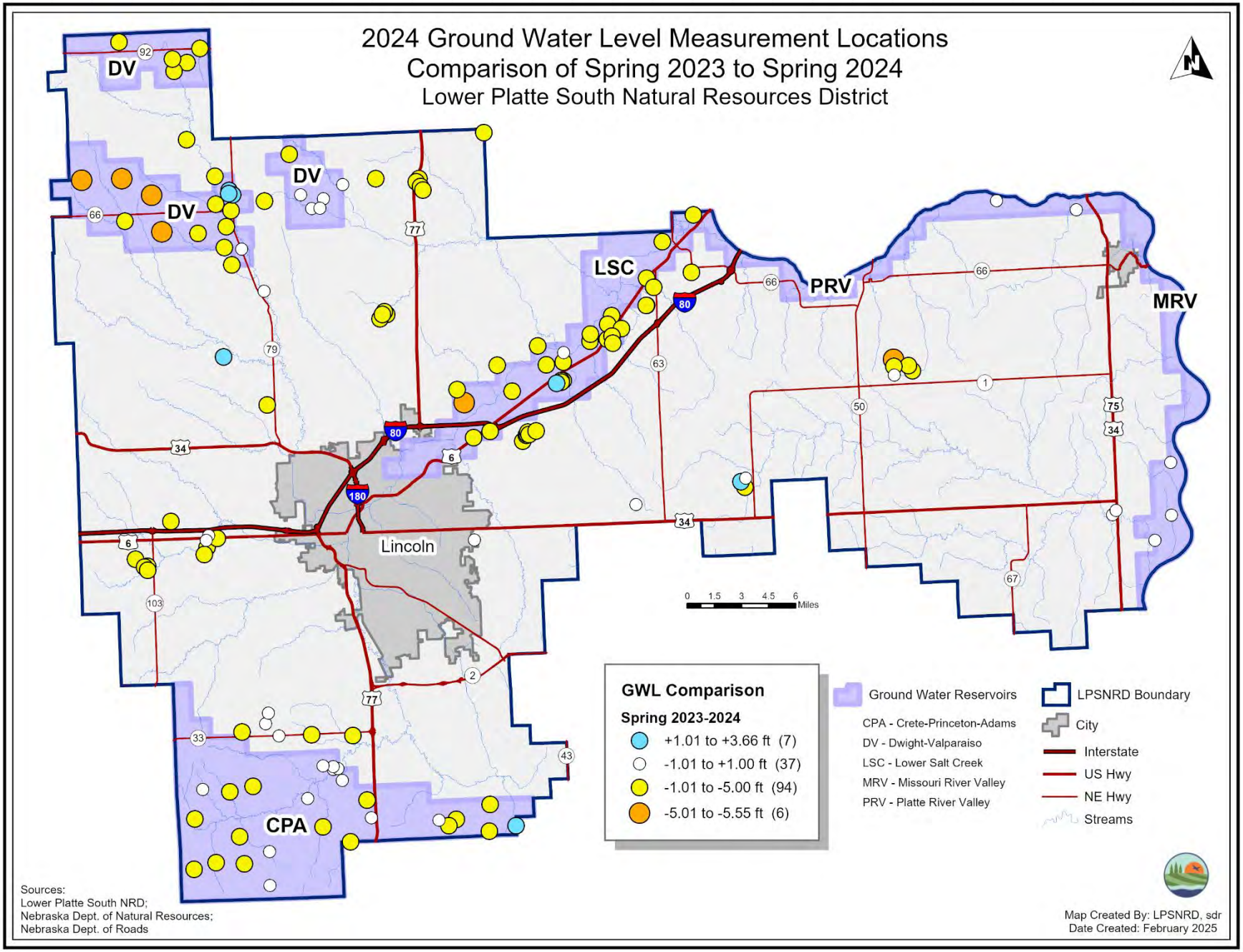


Figure 11 – Representative Spring Groundwater Level Graphs from Each Groundwater Reservoir

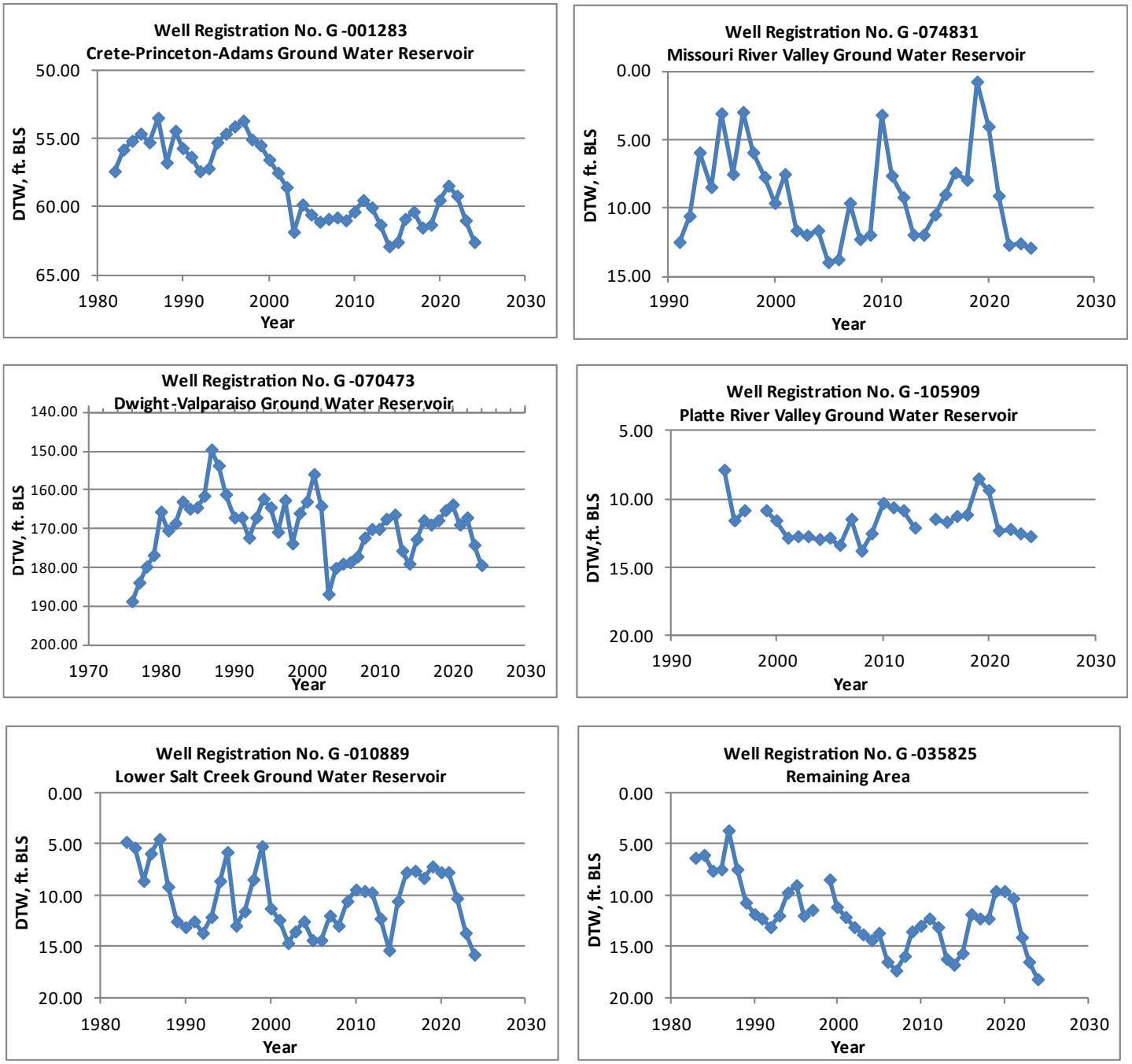
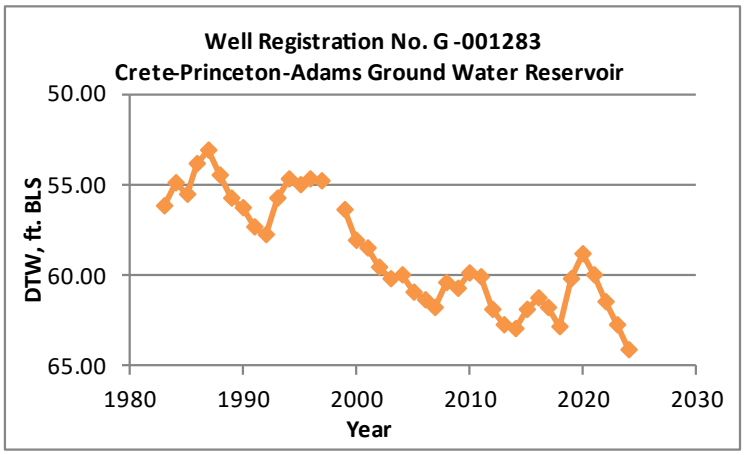
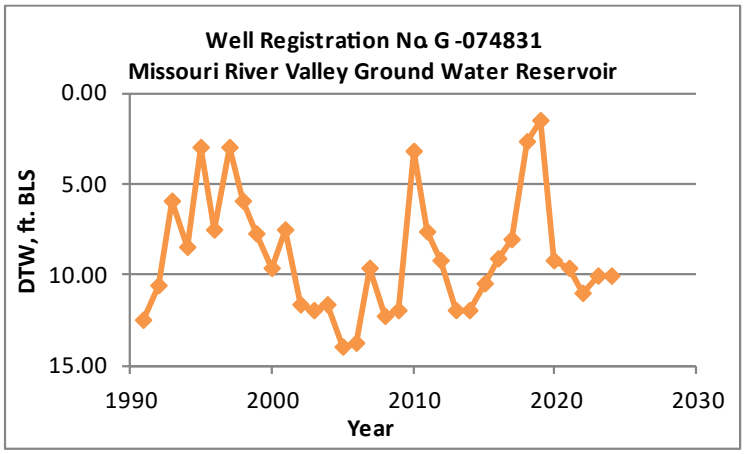
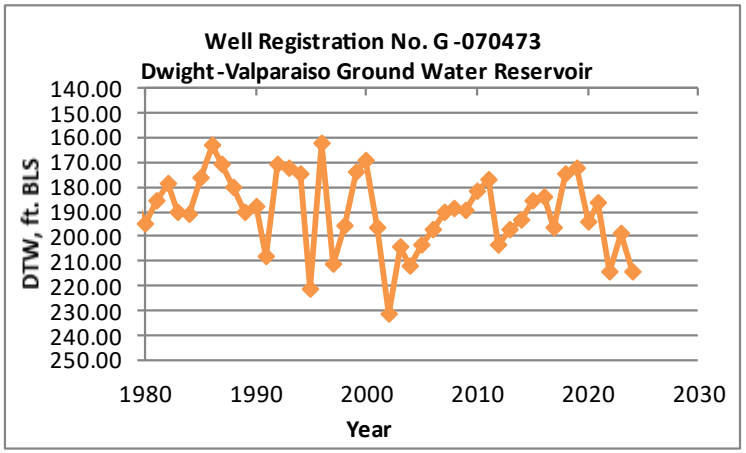
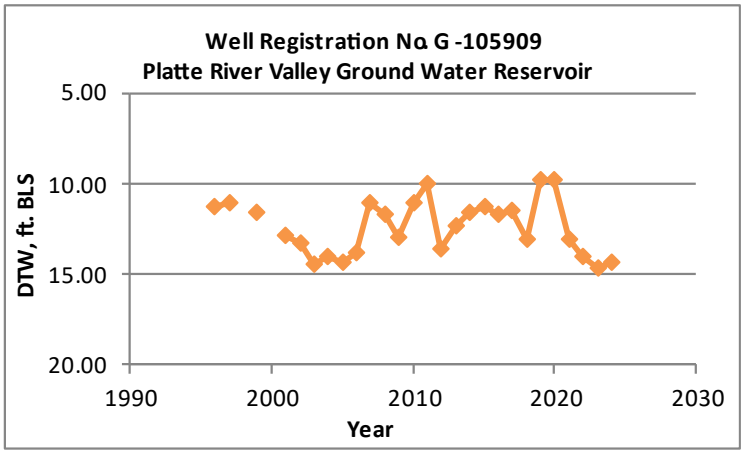


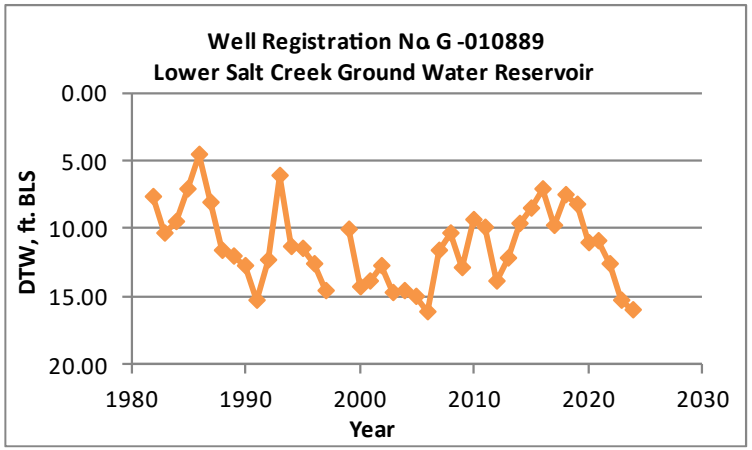
Figure 12 – Representative Fall Groundwater Level Graphs from Each Groundwater Reservoir











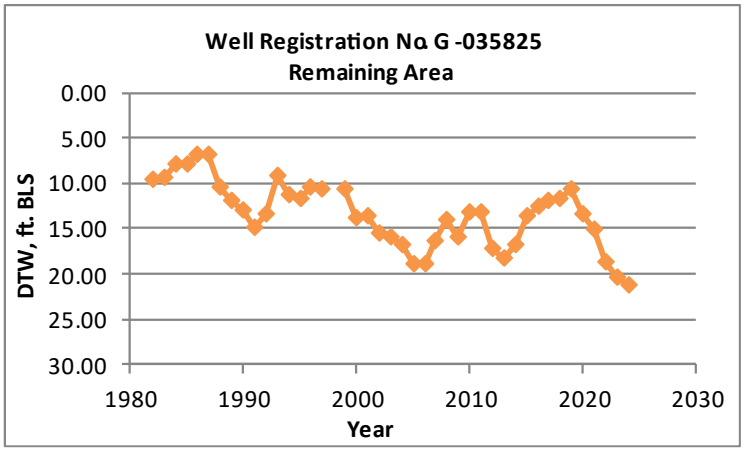


Figure 13 – Vadose Zone Sampling Locations

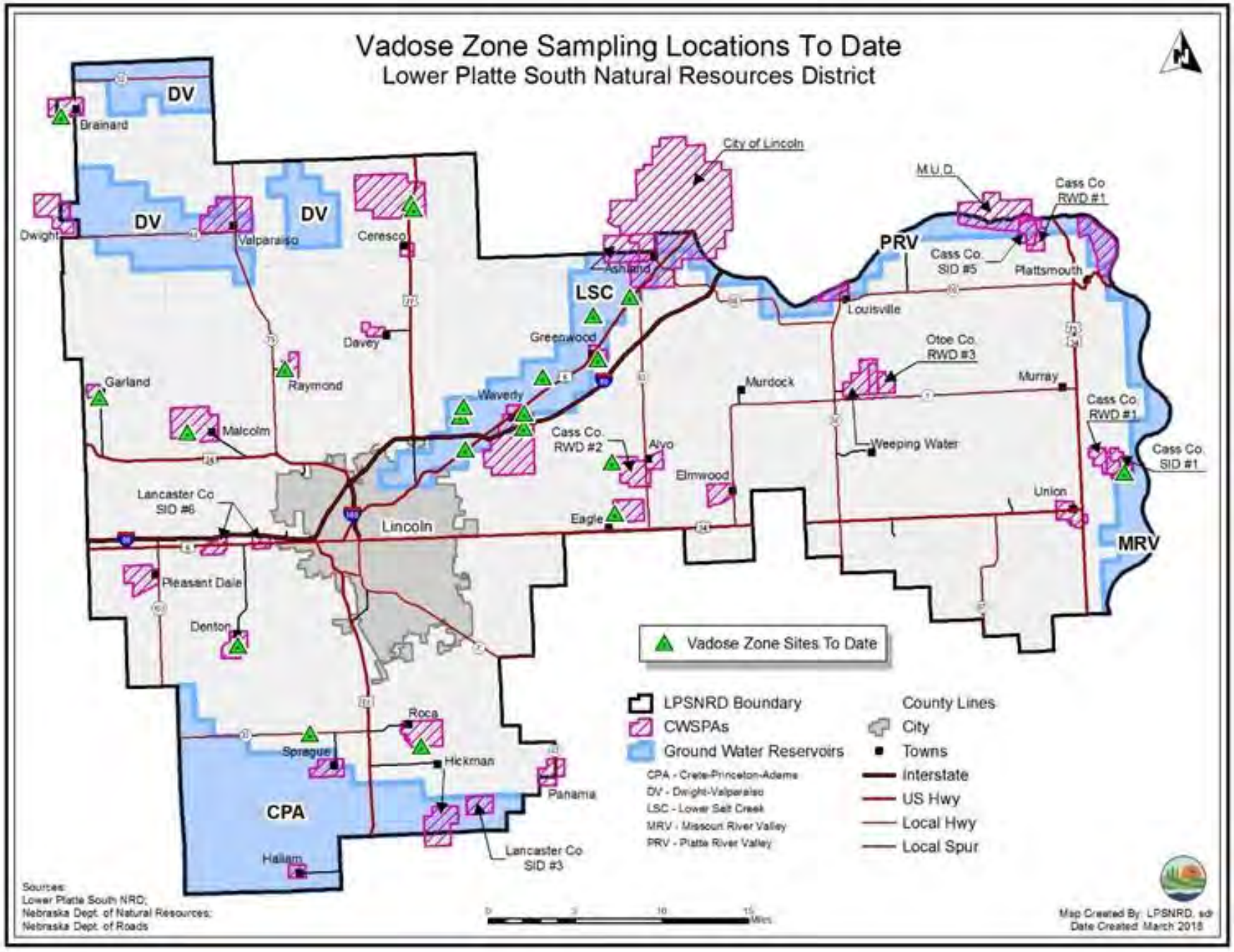


Figure 14 – Alvo

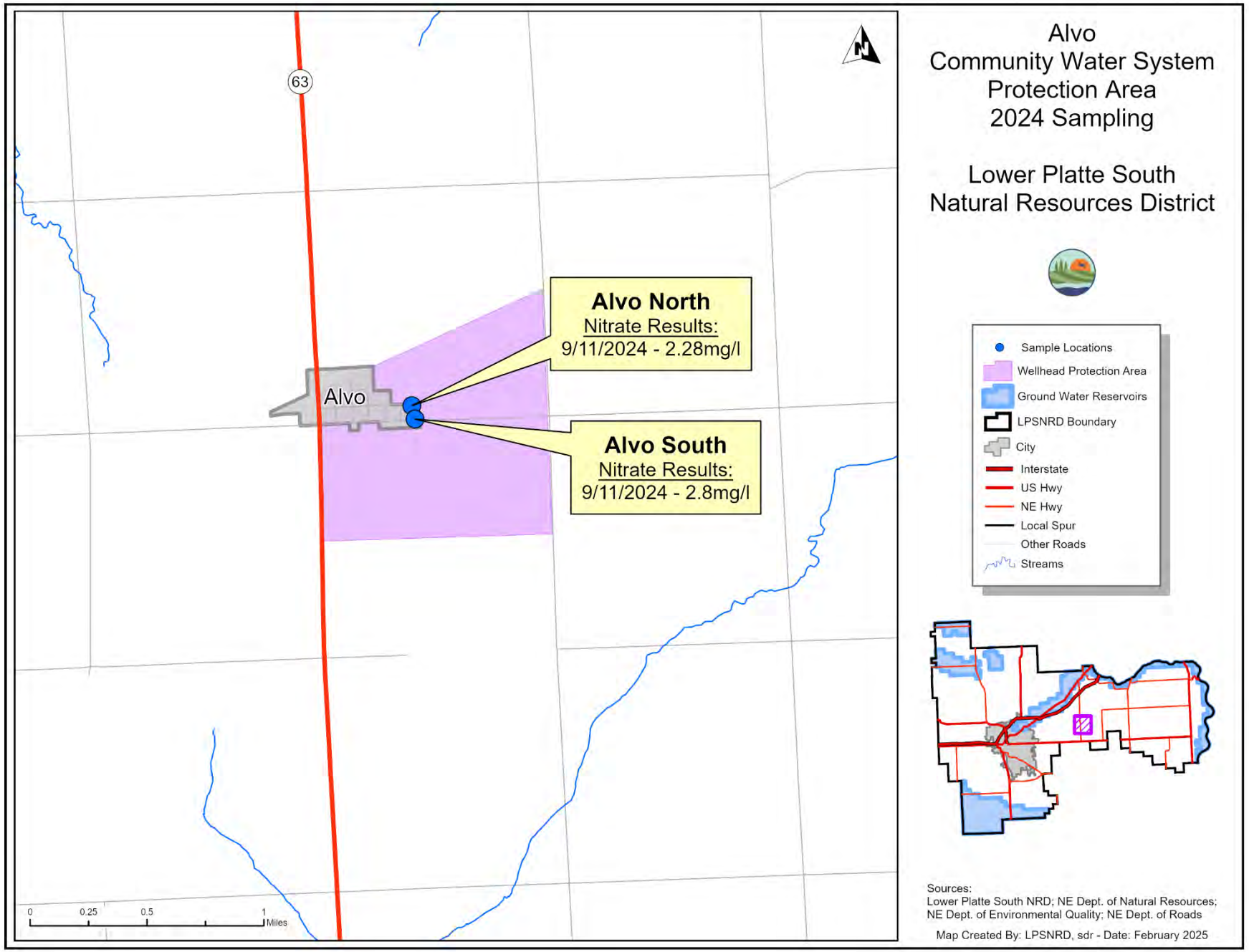


Figure 15 – Ashland

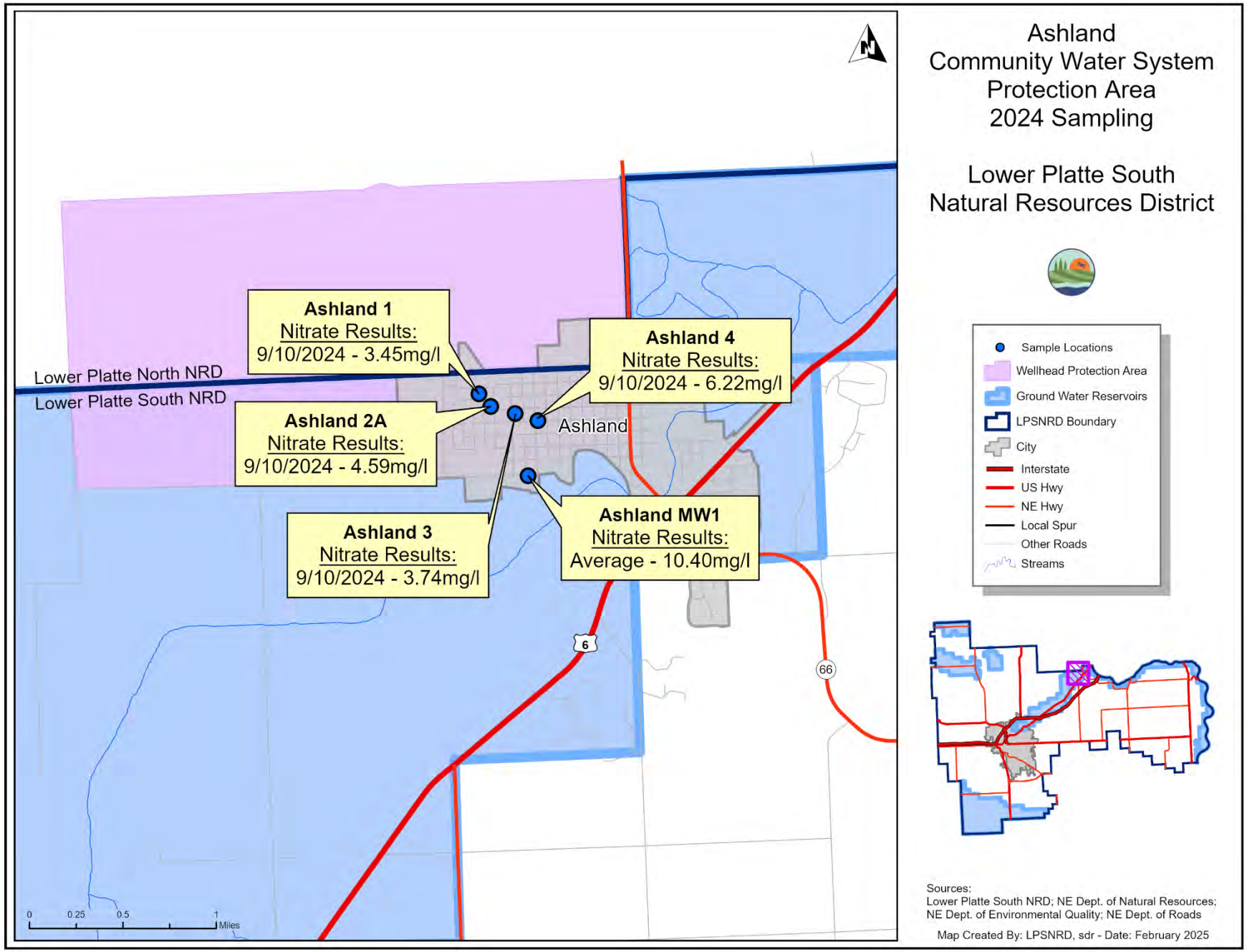


Figure 16 – Brainard

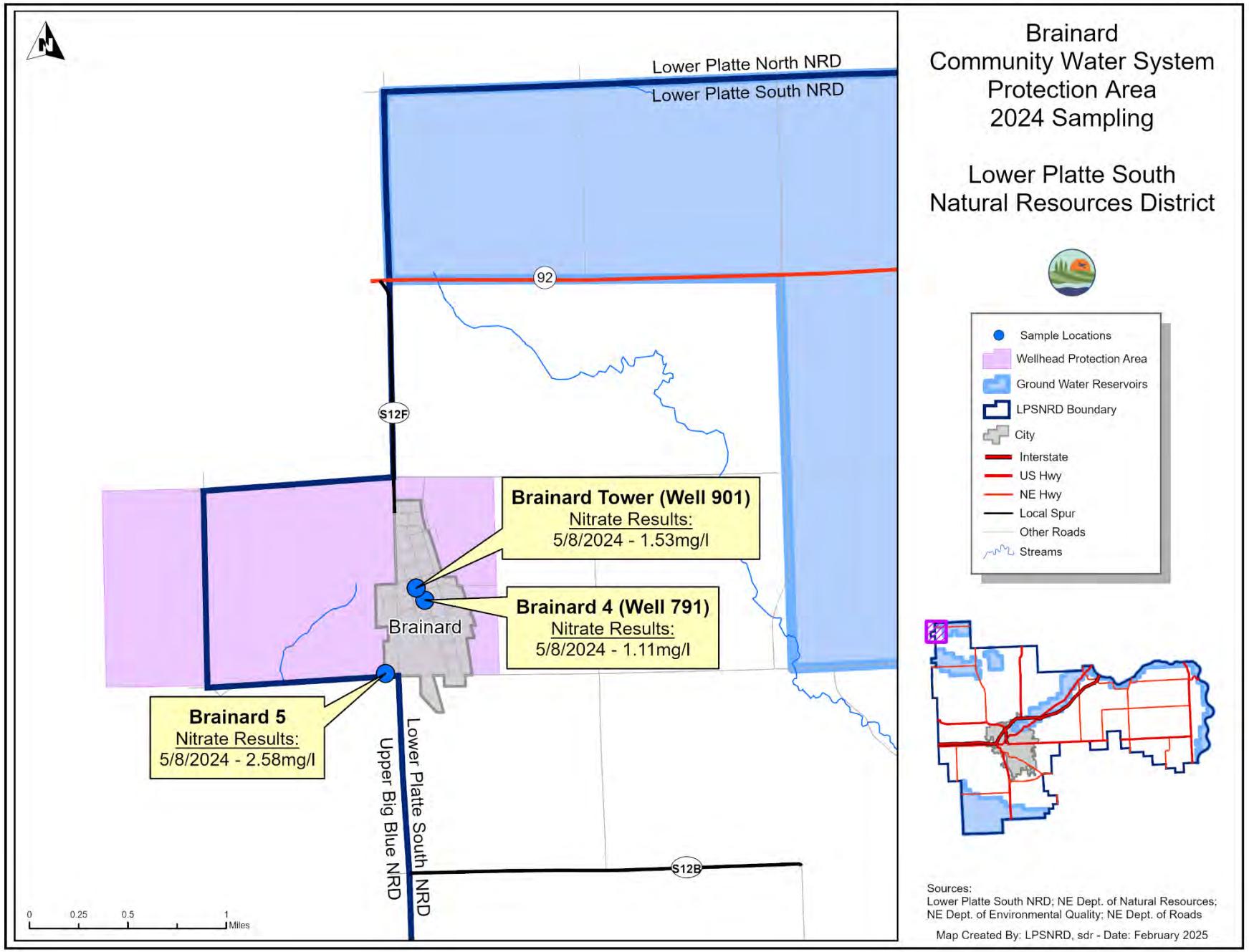


Figure 17 – Cass County RWD #1/SID #1 (Lake Waconda)

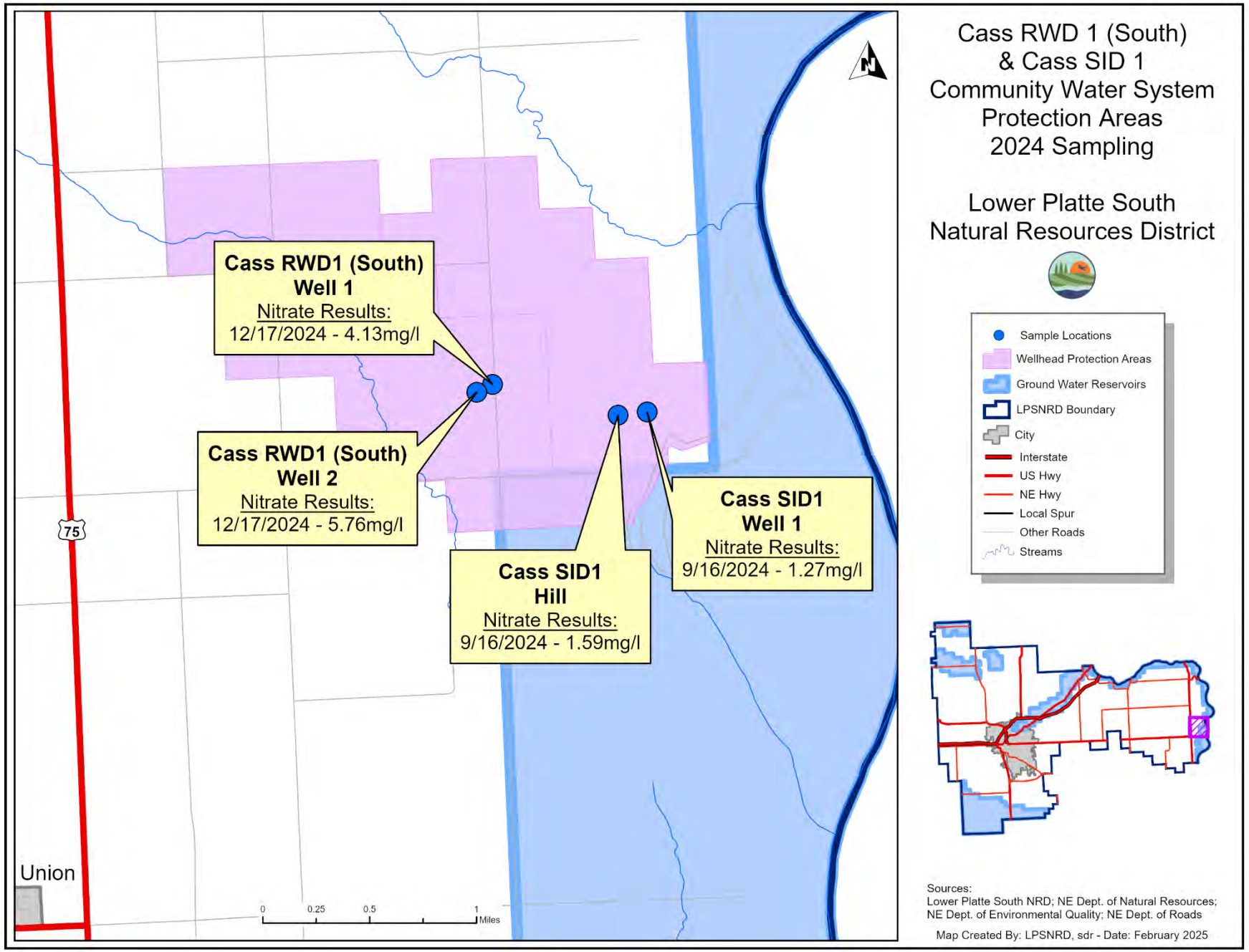


Figure 18 – Cass County RWD #2

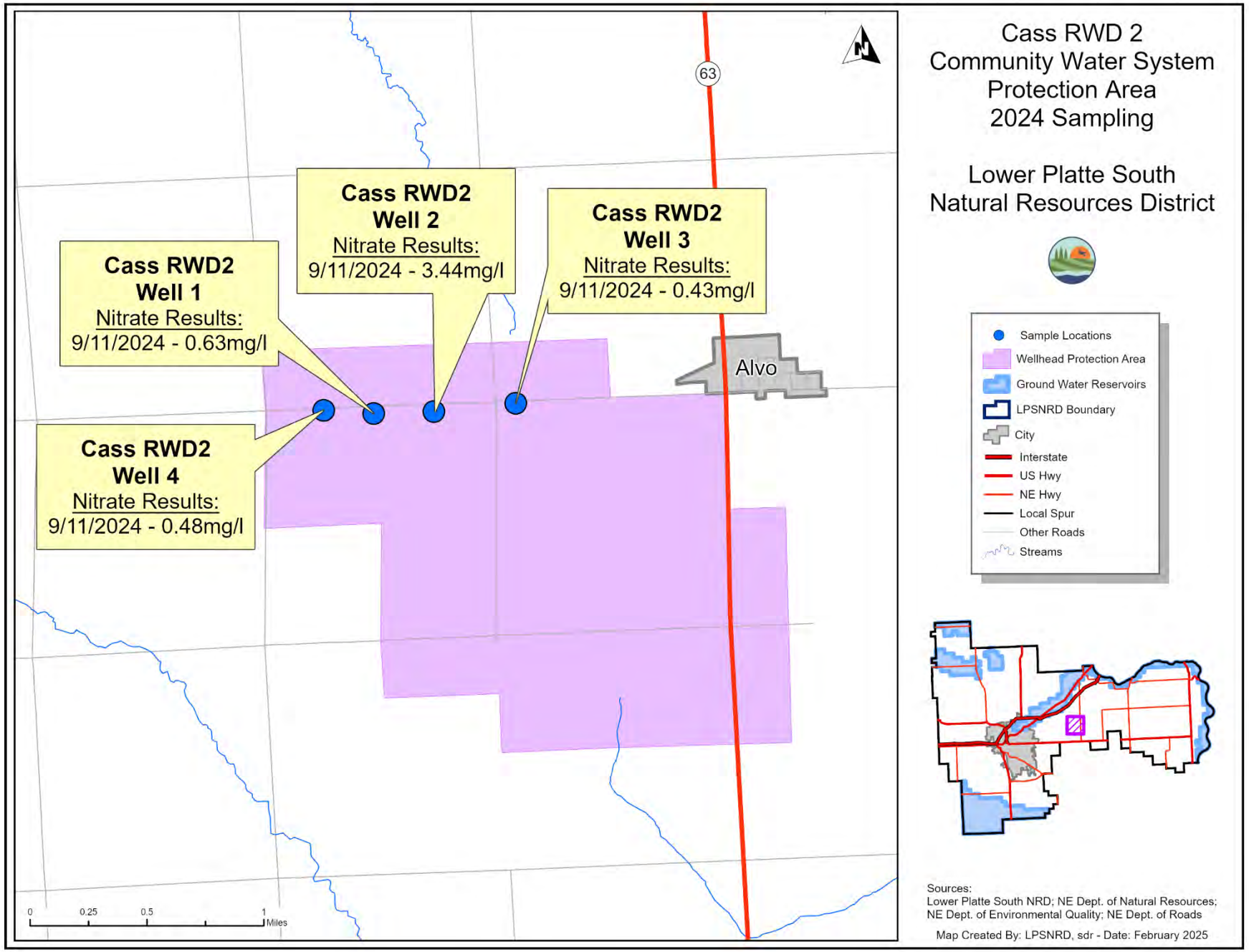


Figure 19 – Cass County SID #5/Buccaneer Bay

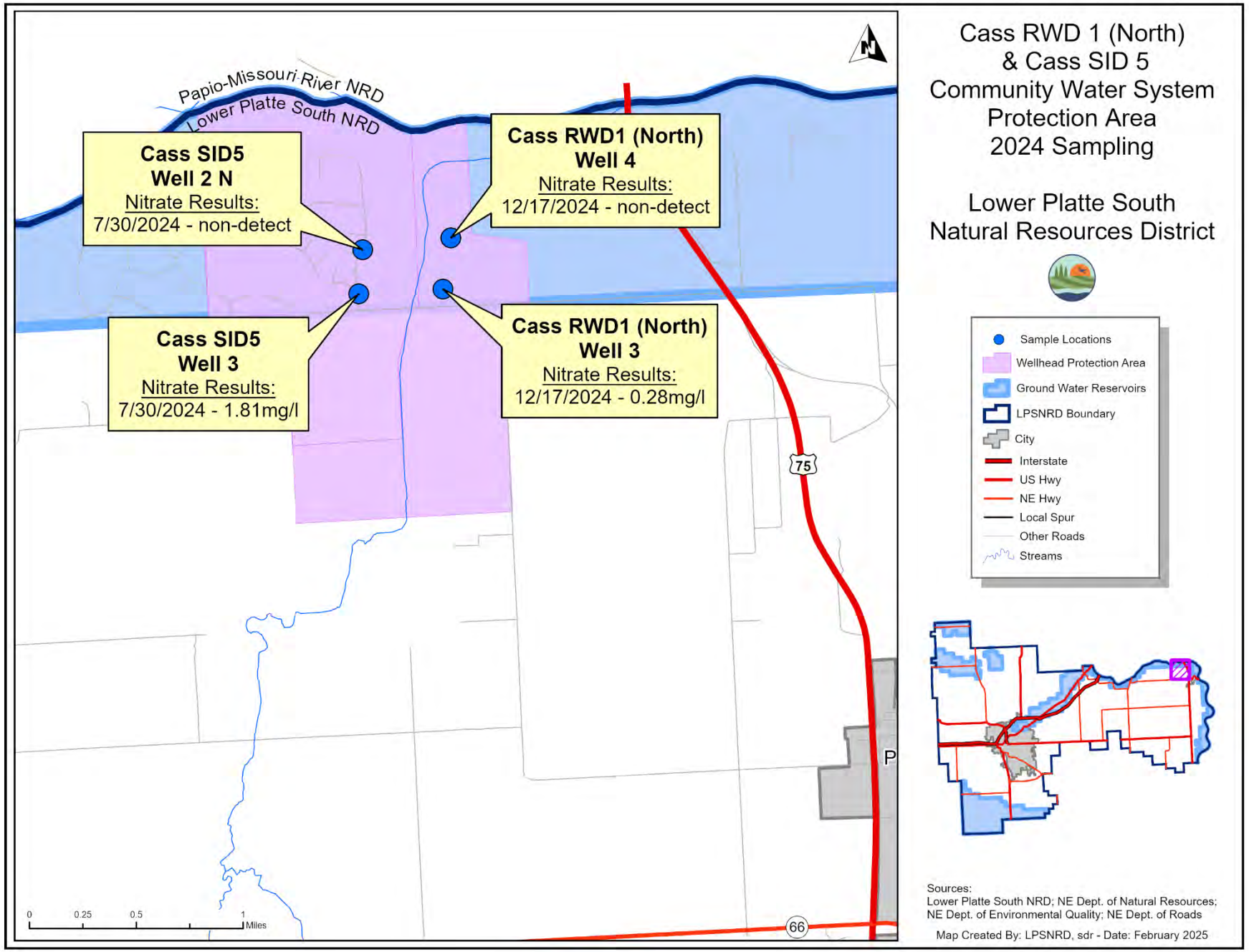


Figure 20 – Ceresco

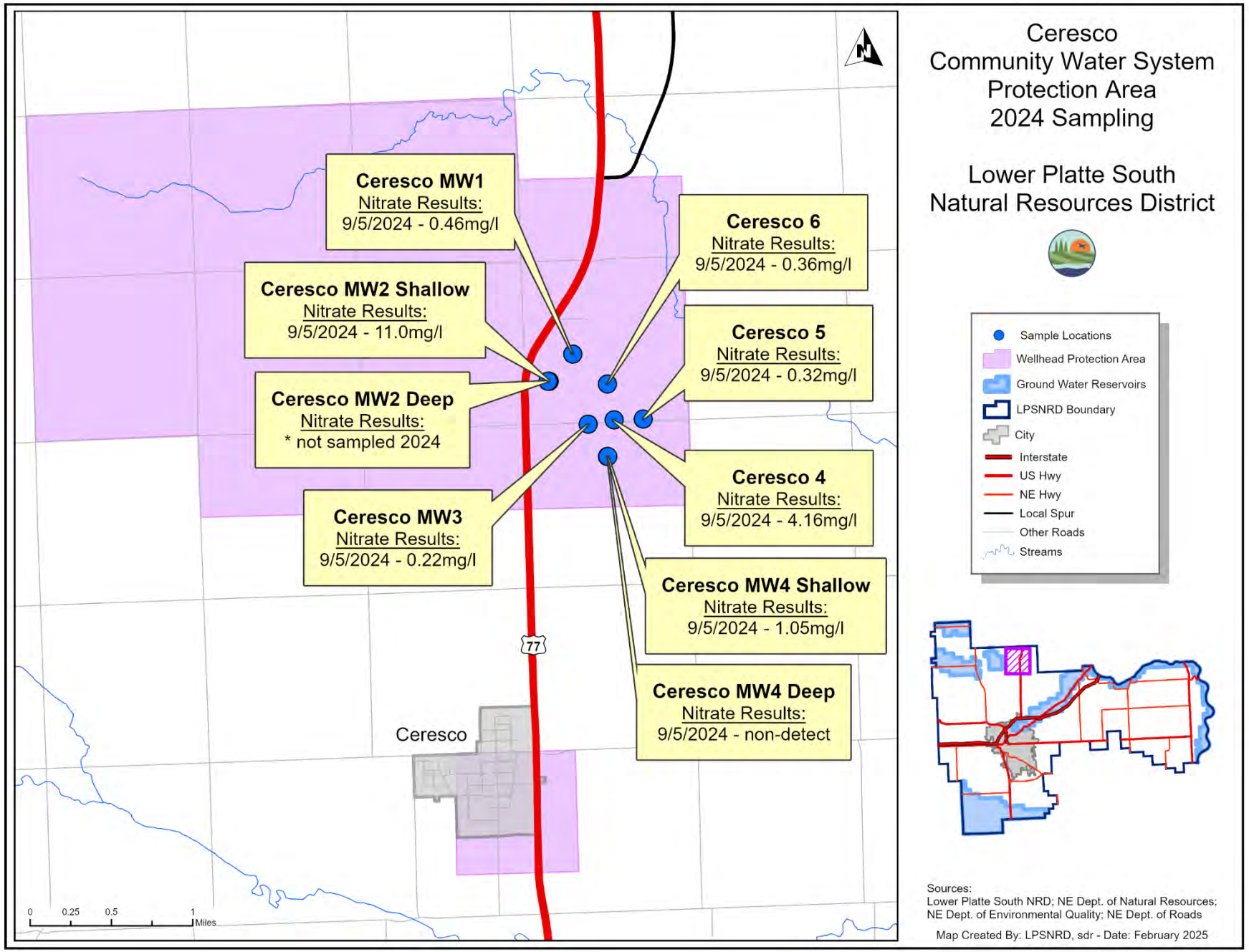


Figure 21 – Davey

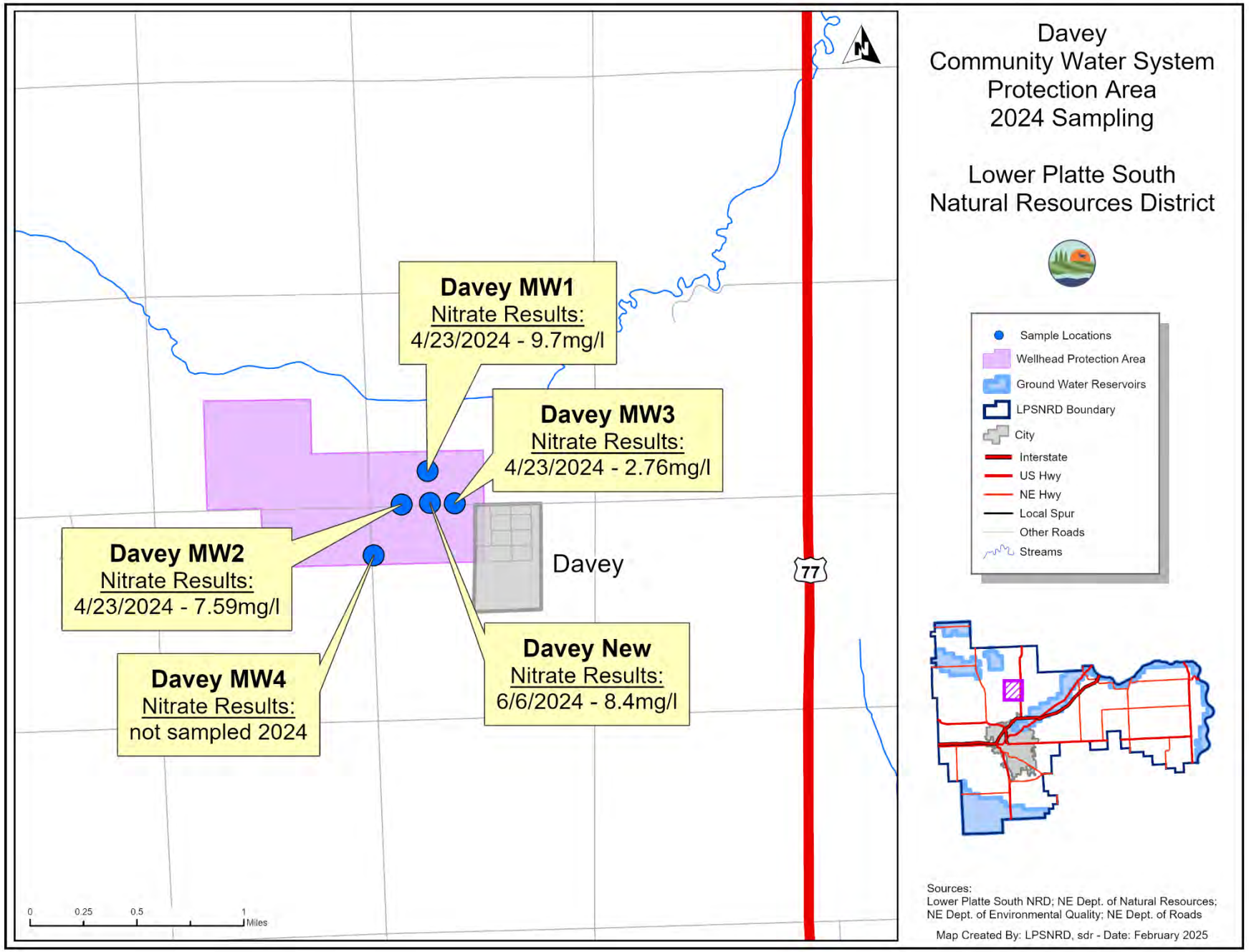


Figure 22 – Denton

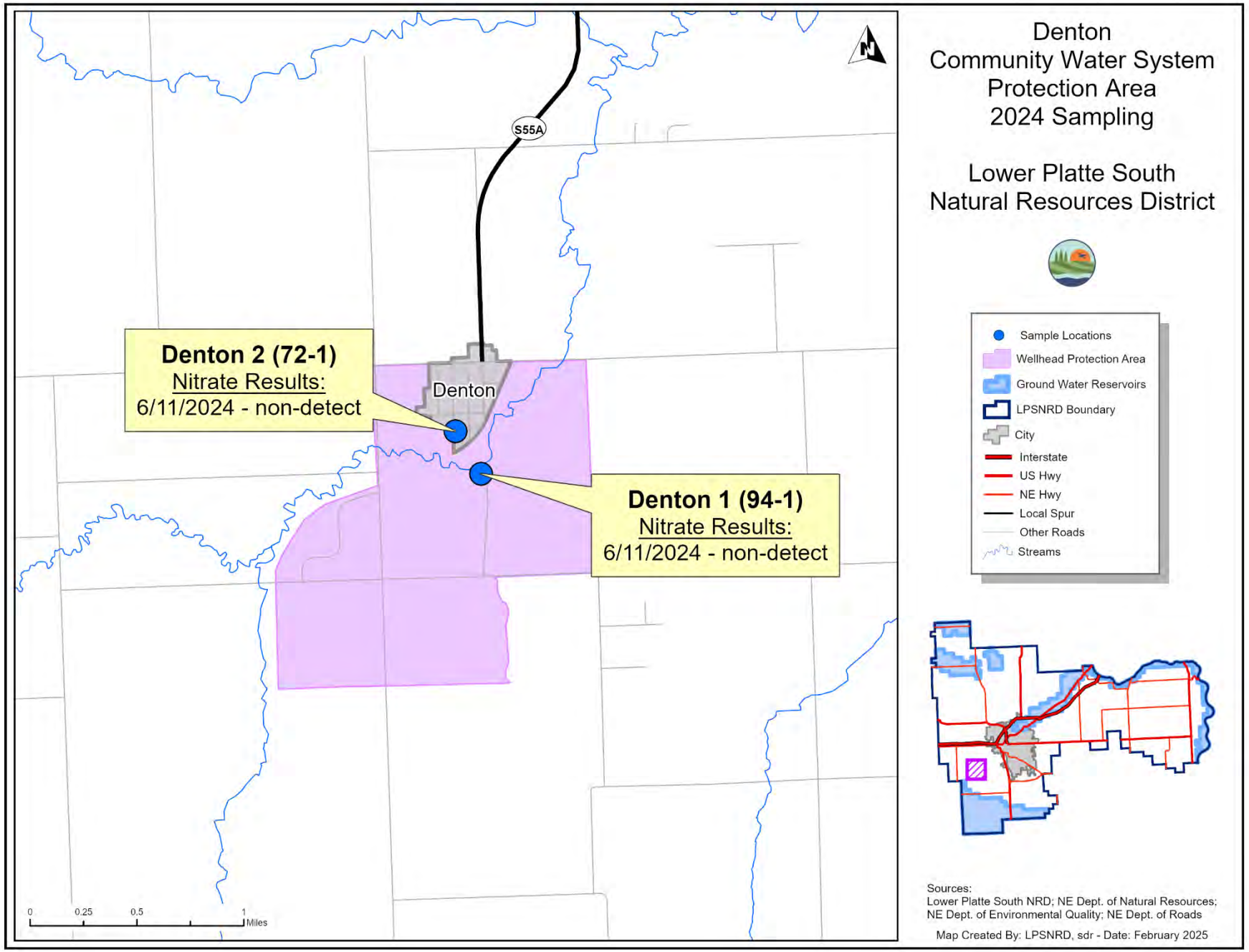


Figure 23 – Eagle

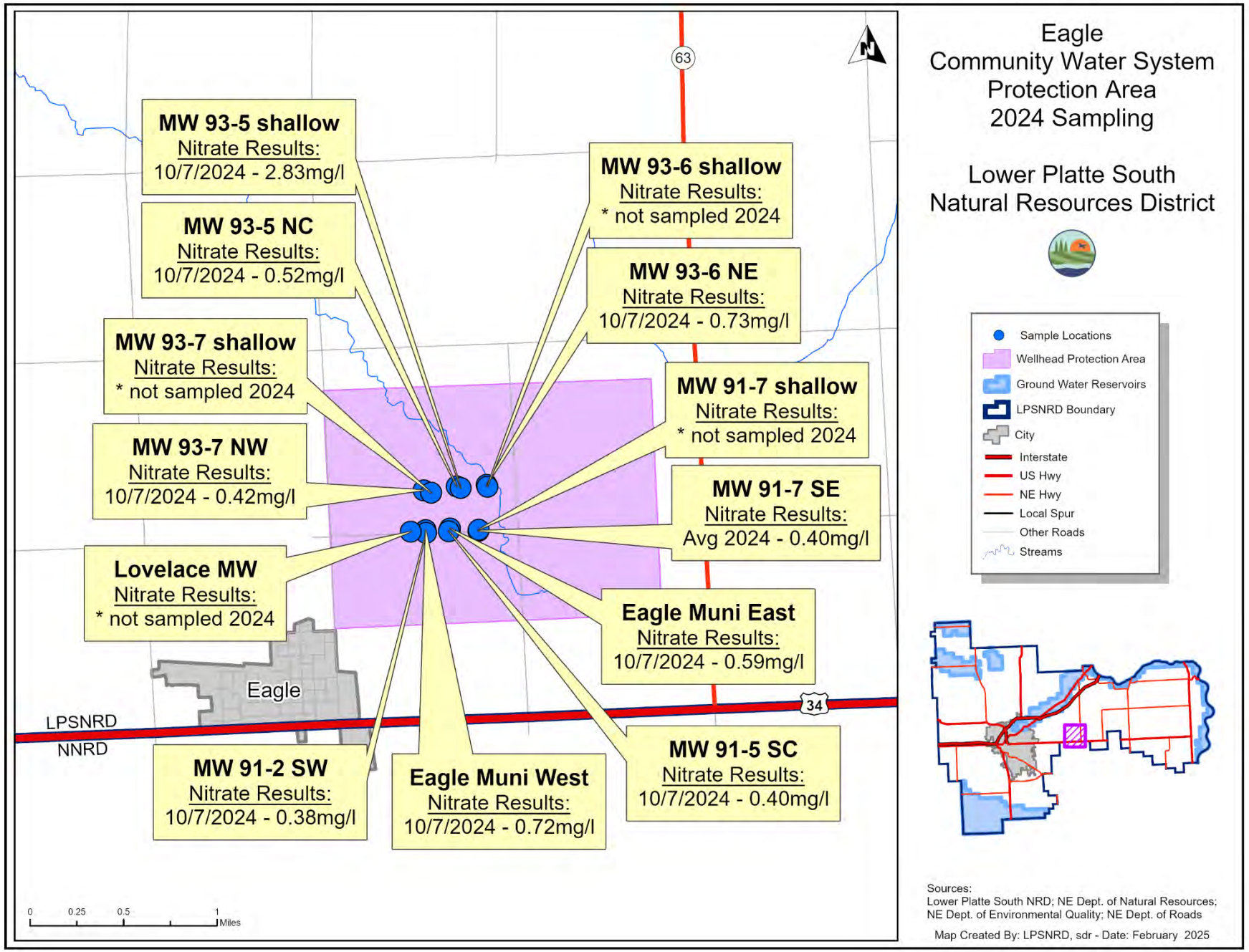


Figure 24 – Elmwood

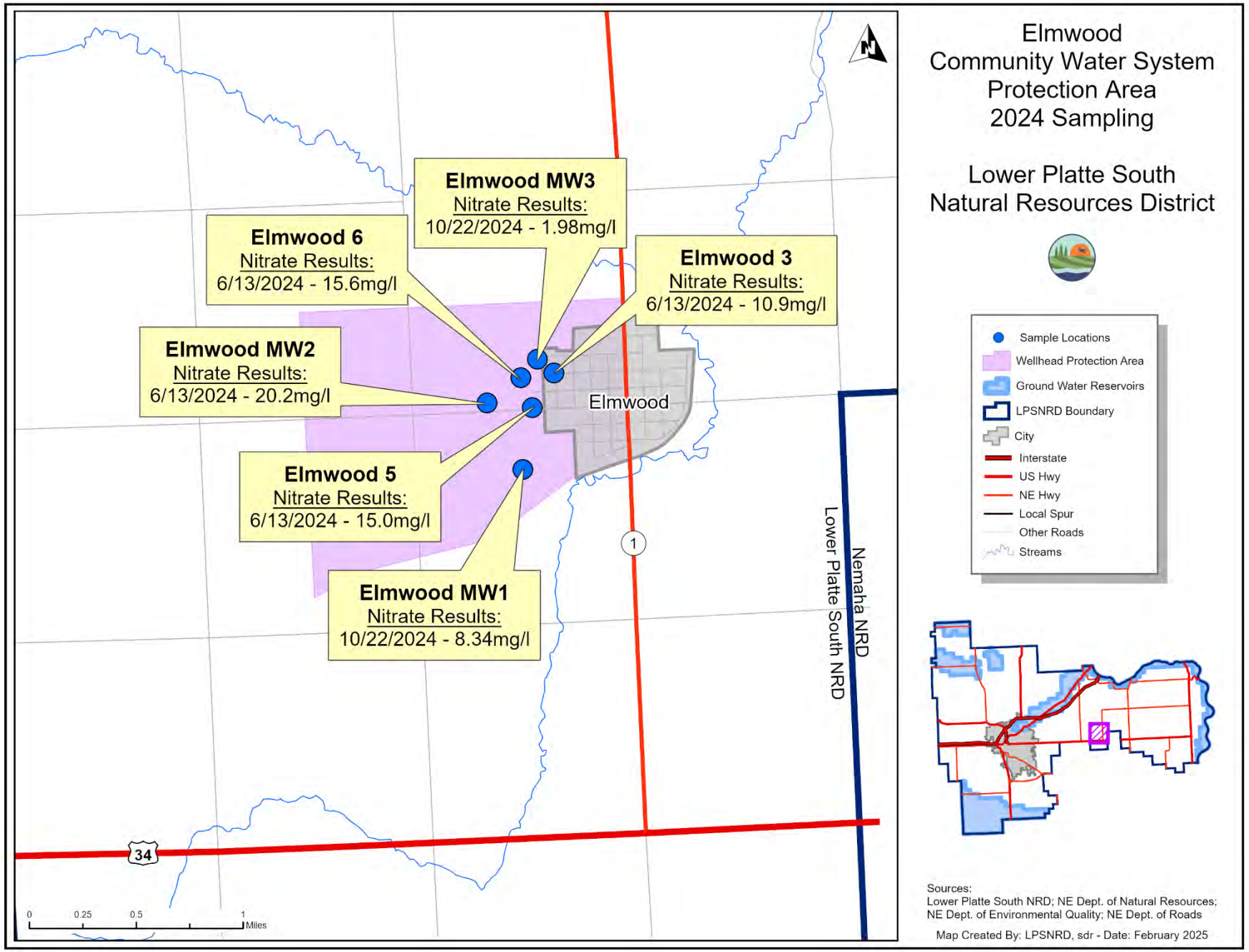


Figure 25 – Garland

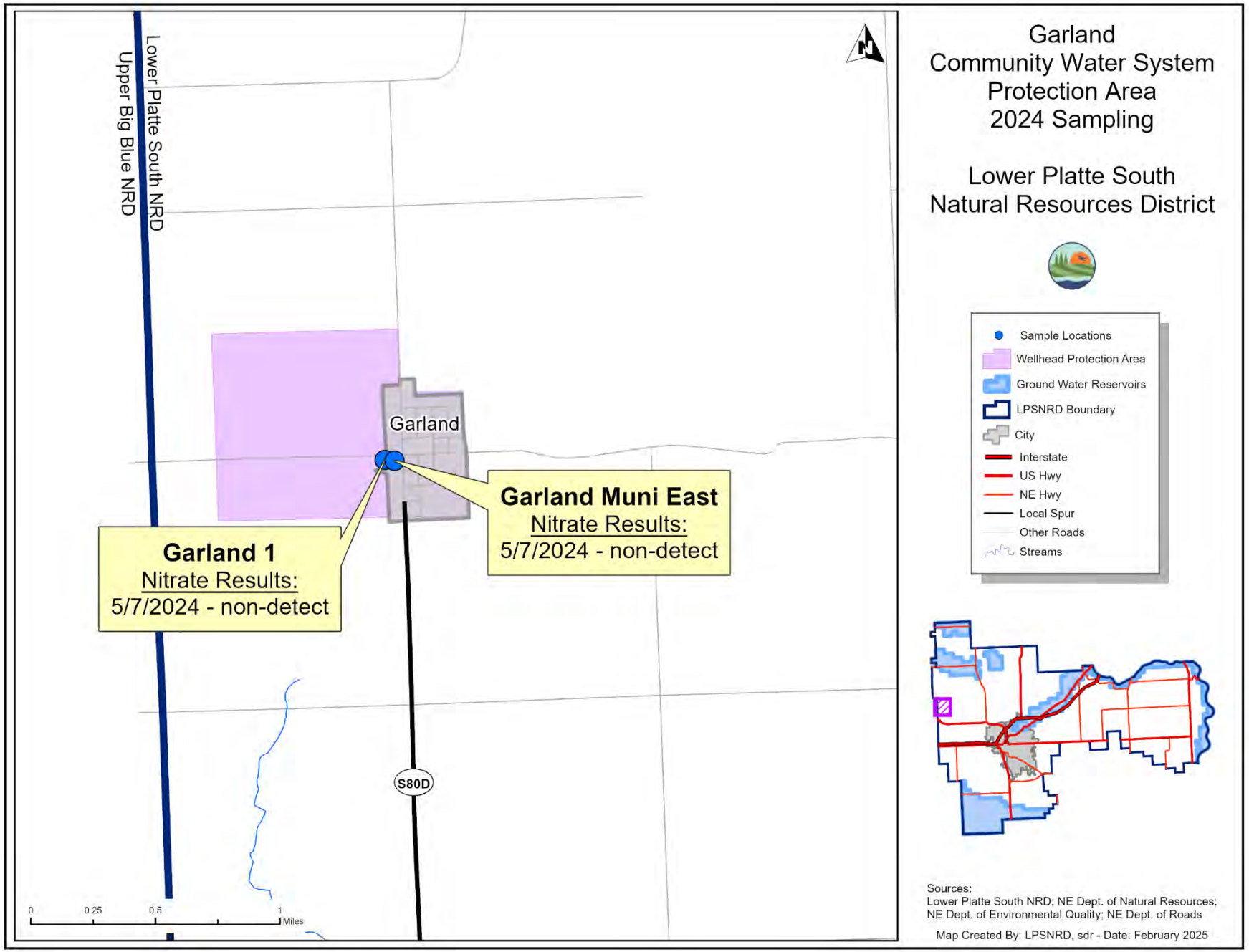


Figure 26 – Greenwood

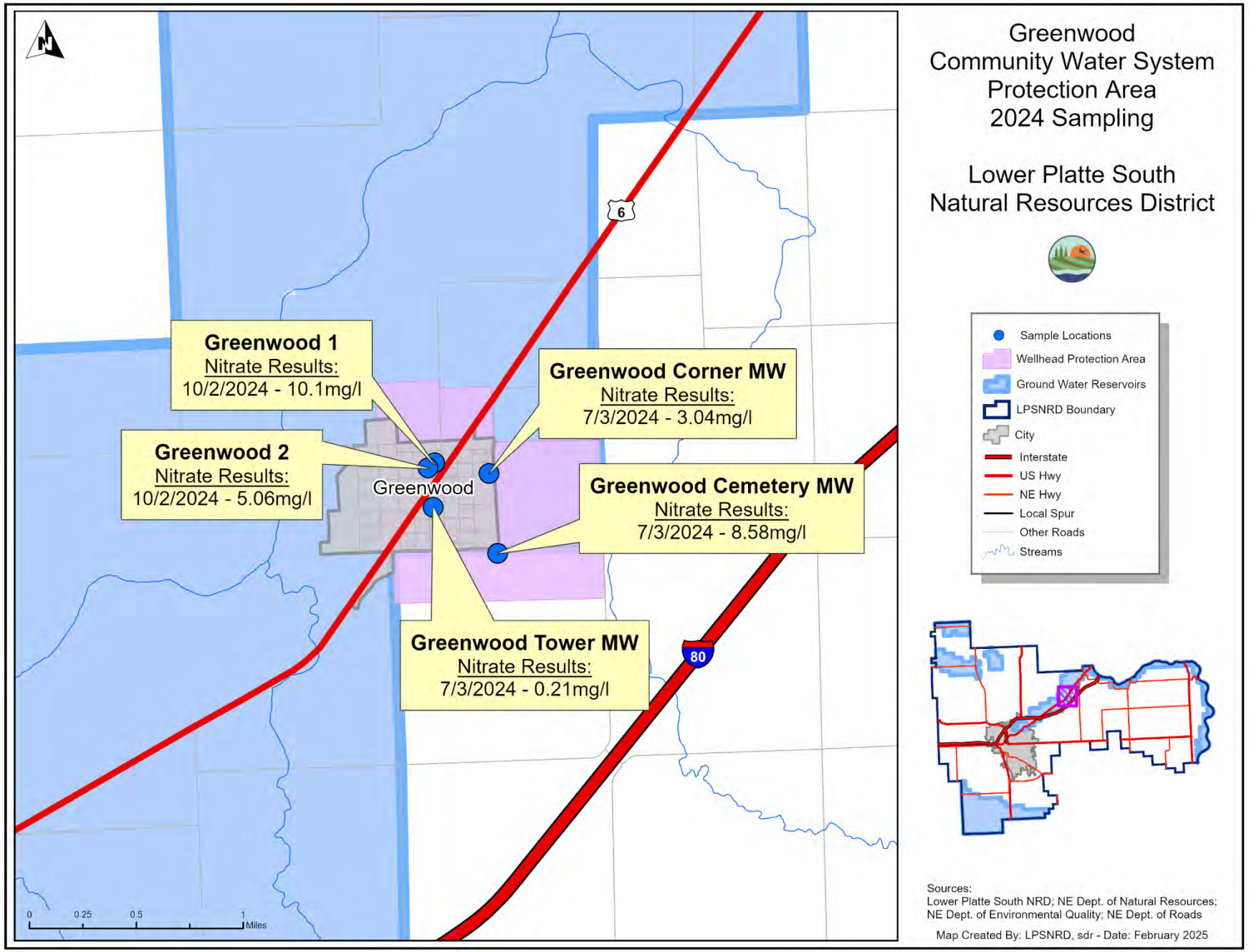


Figure 27 – Hallam

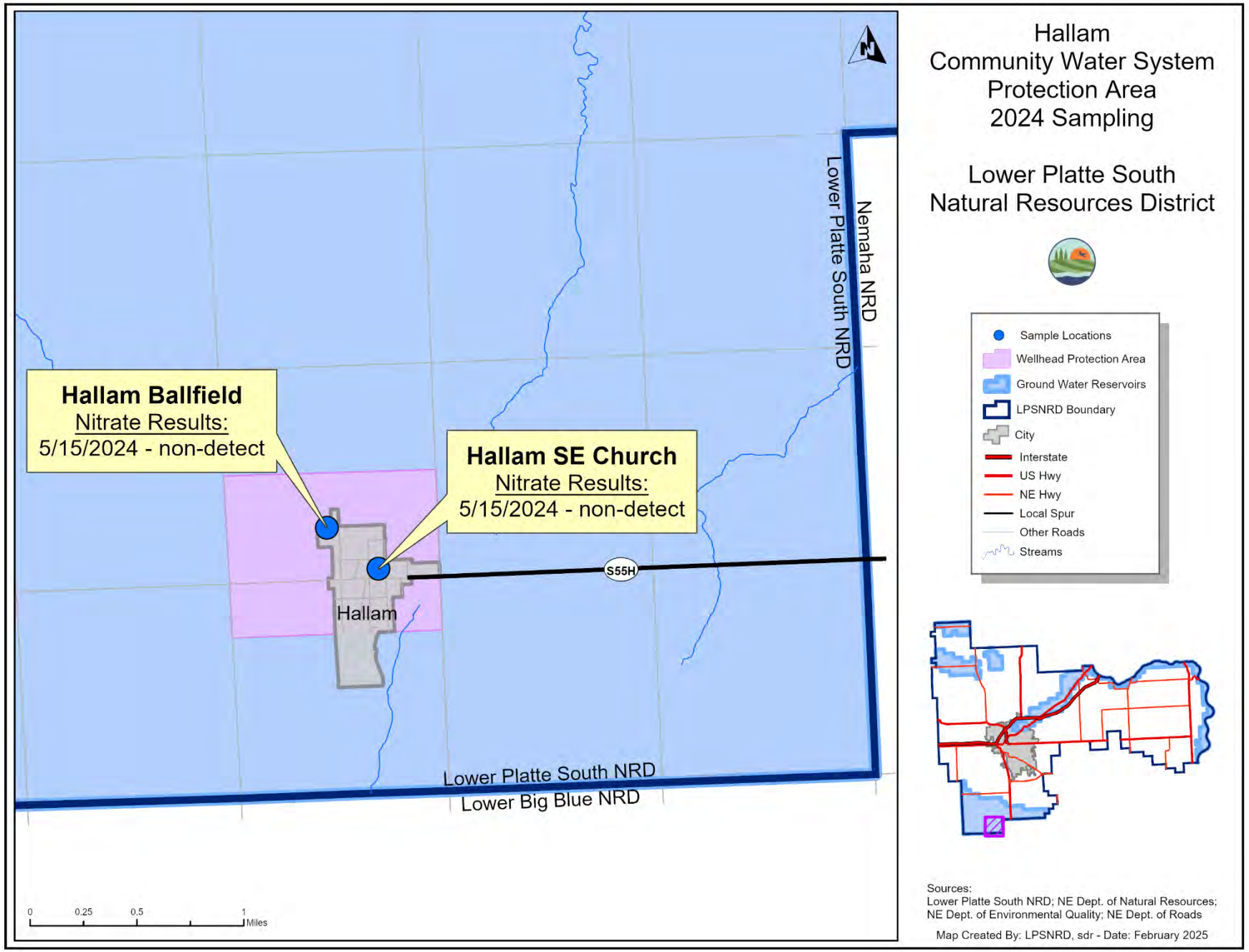


Figure 28 – Hickman

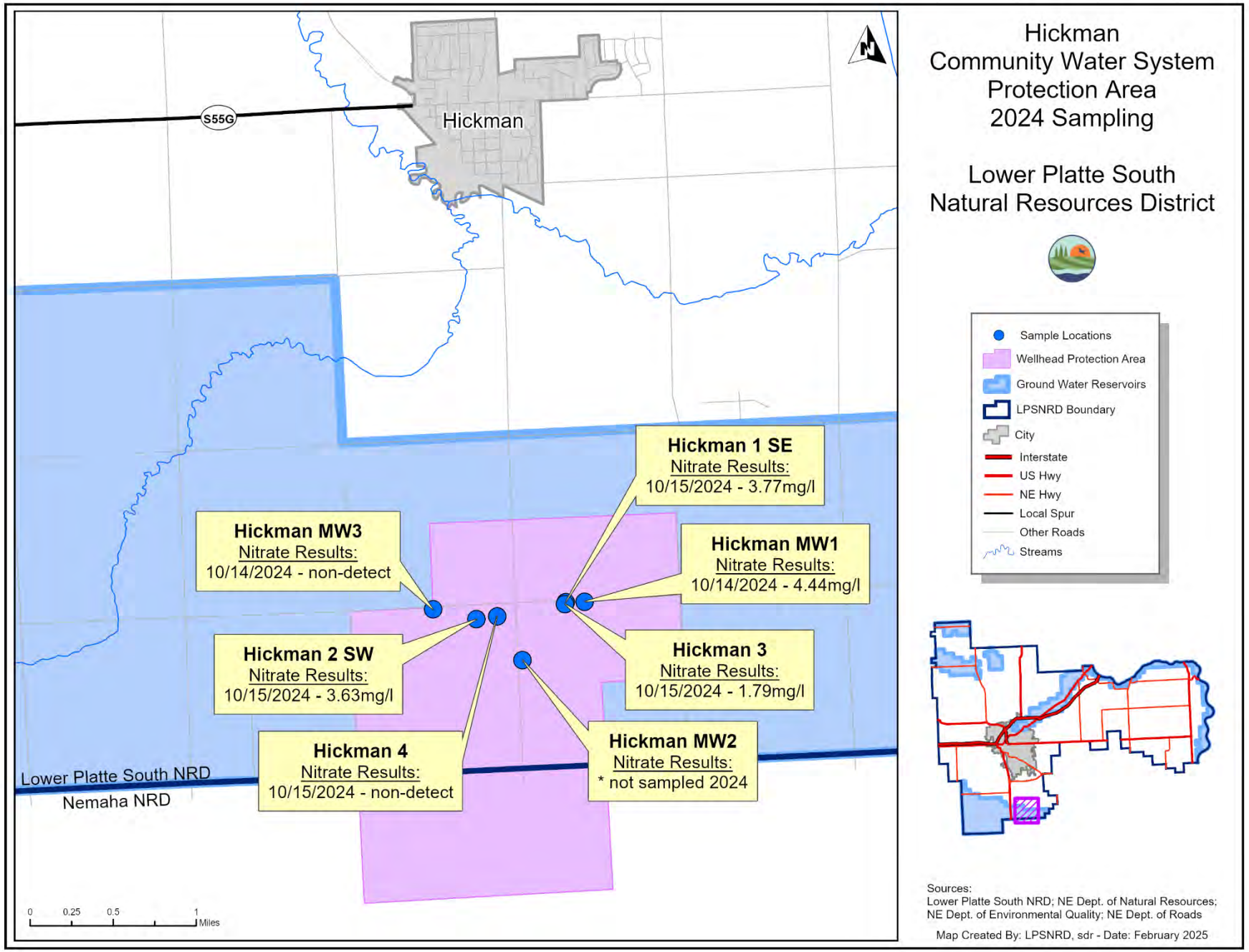


Figure 29 – Lancaster County SID #6/Emerald

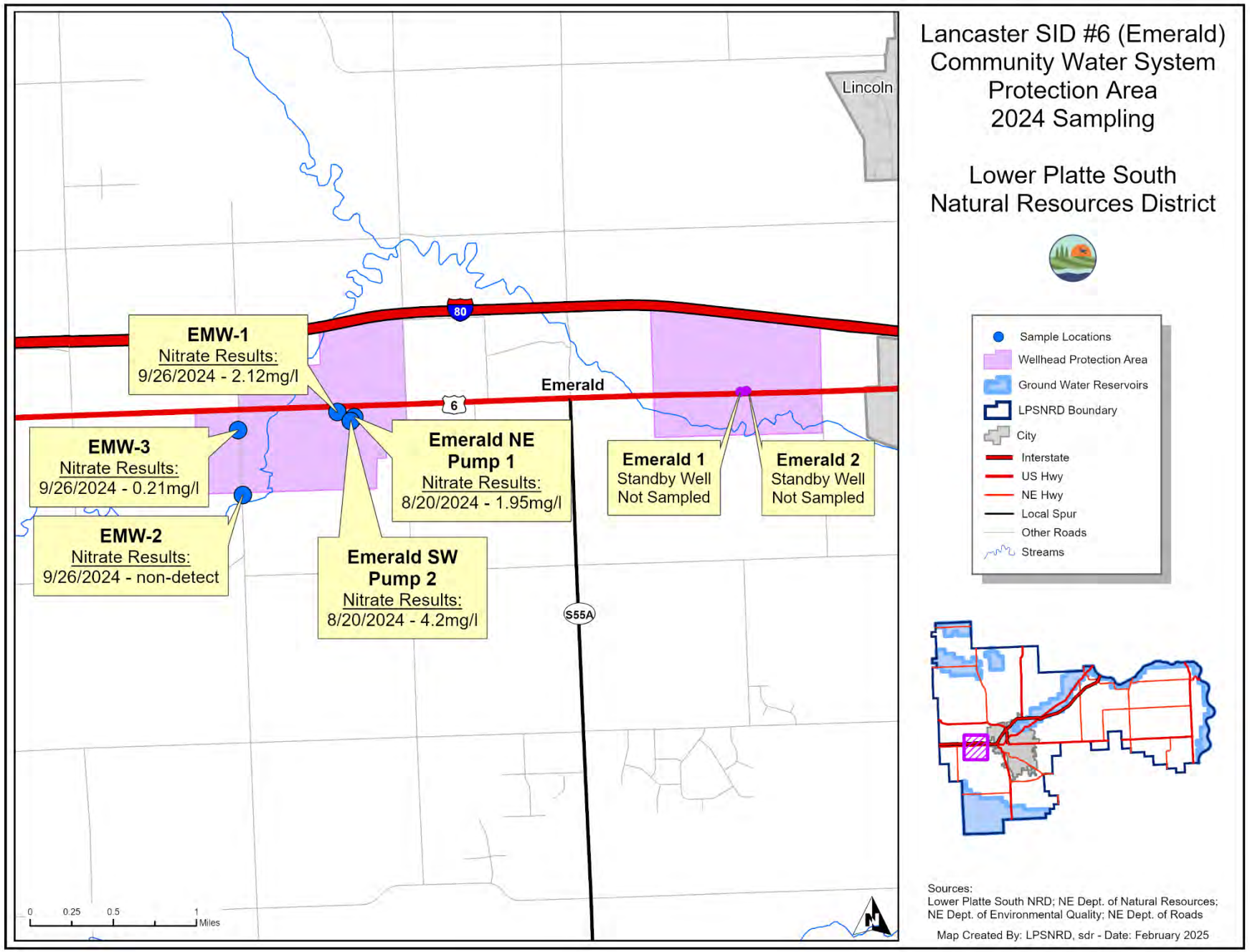


Figure 30 – Louisville

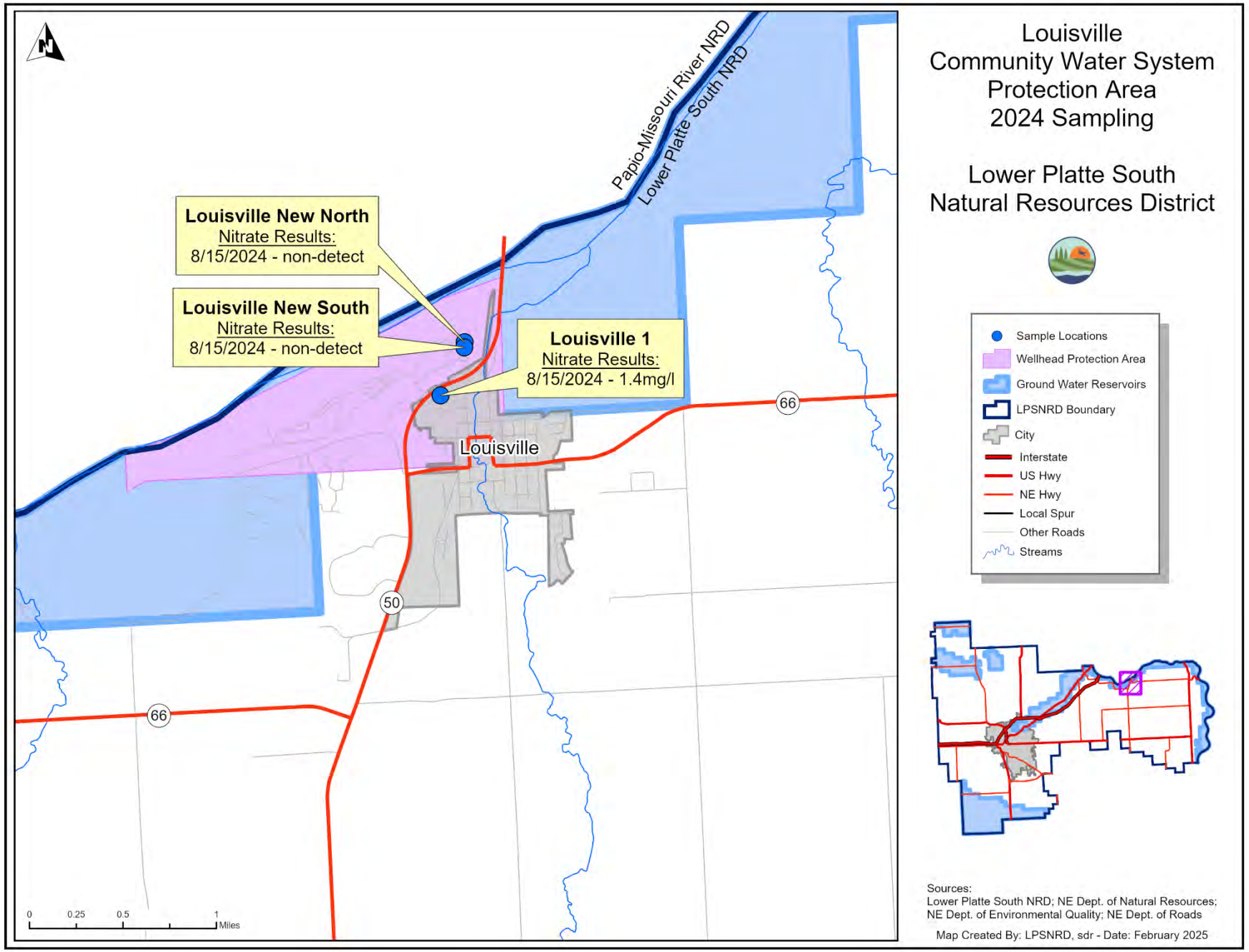


Figure 31 – Malcolm

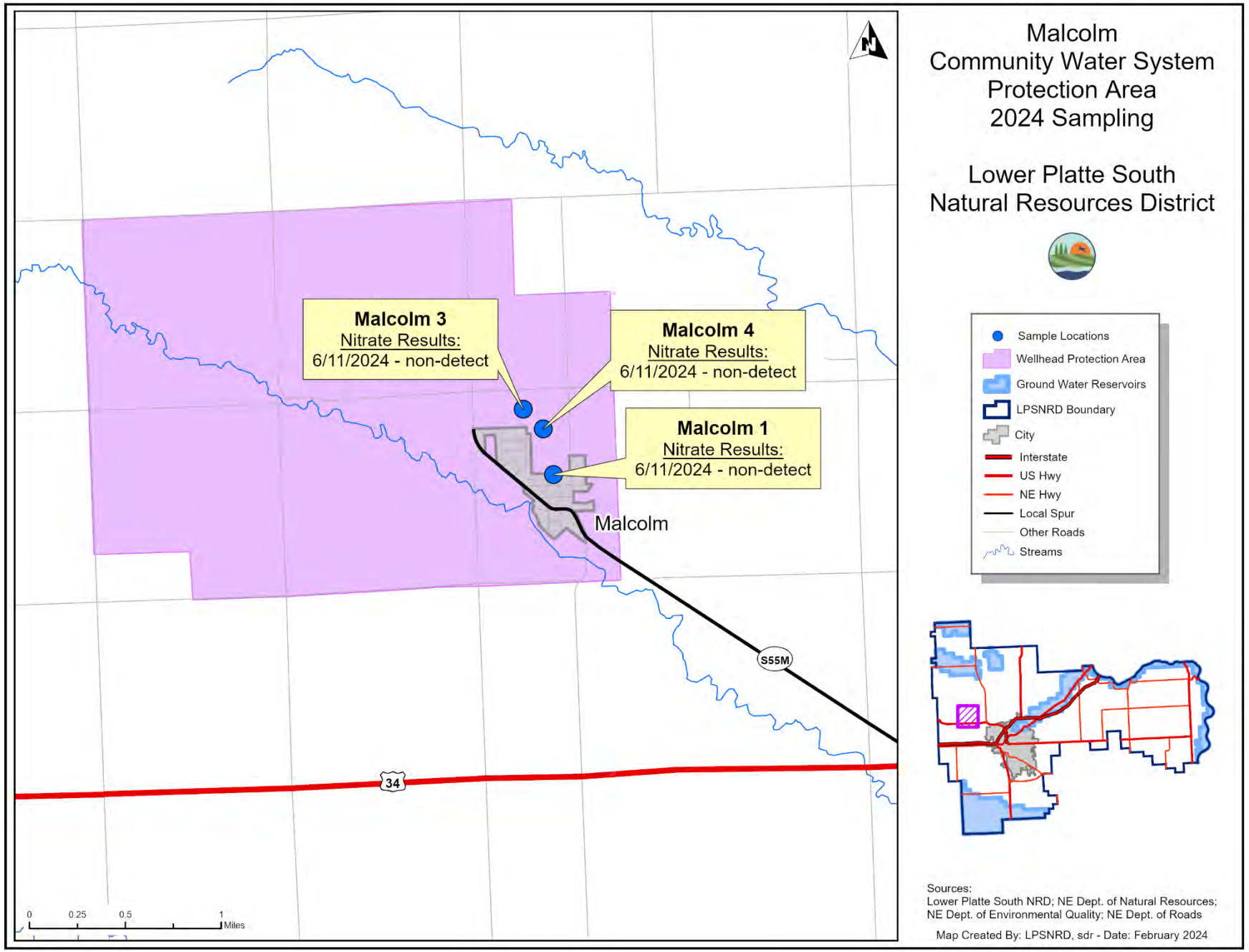


Figure 32 – Metropolitan Utilities District (MUD)

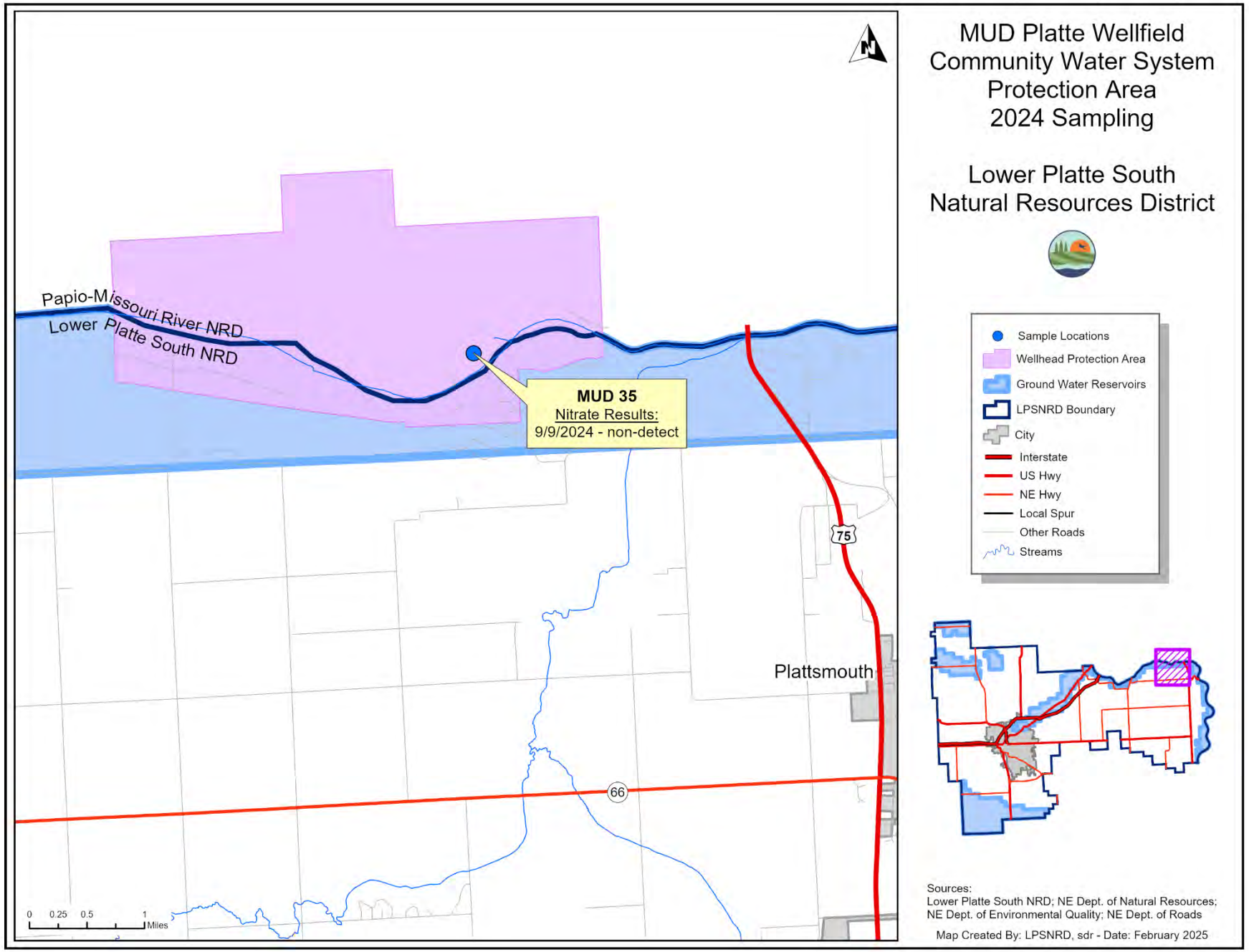


Figure 33 – Otoe County RWD #3/Weeping Water

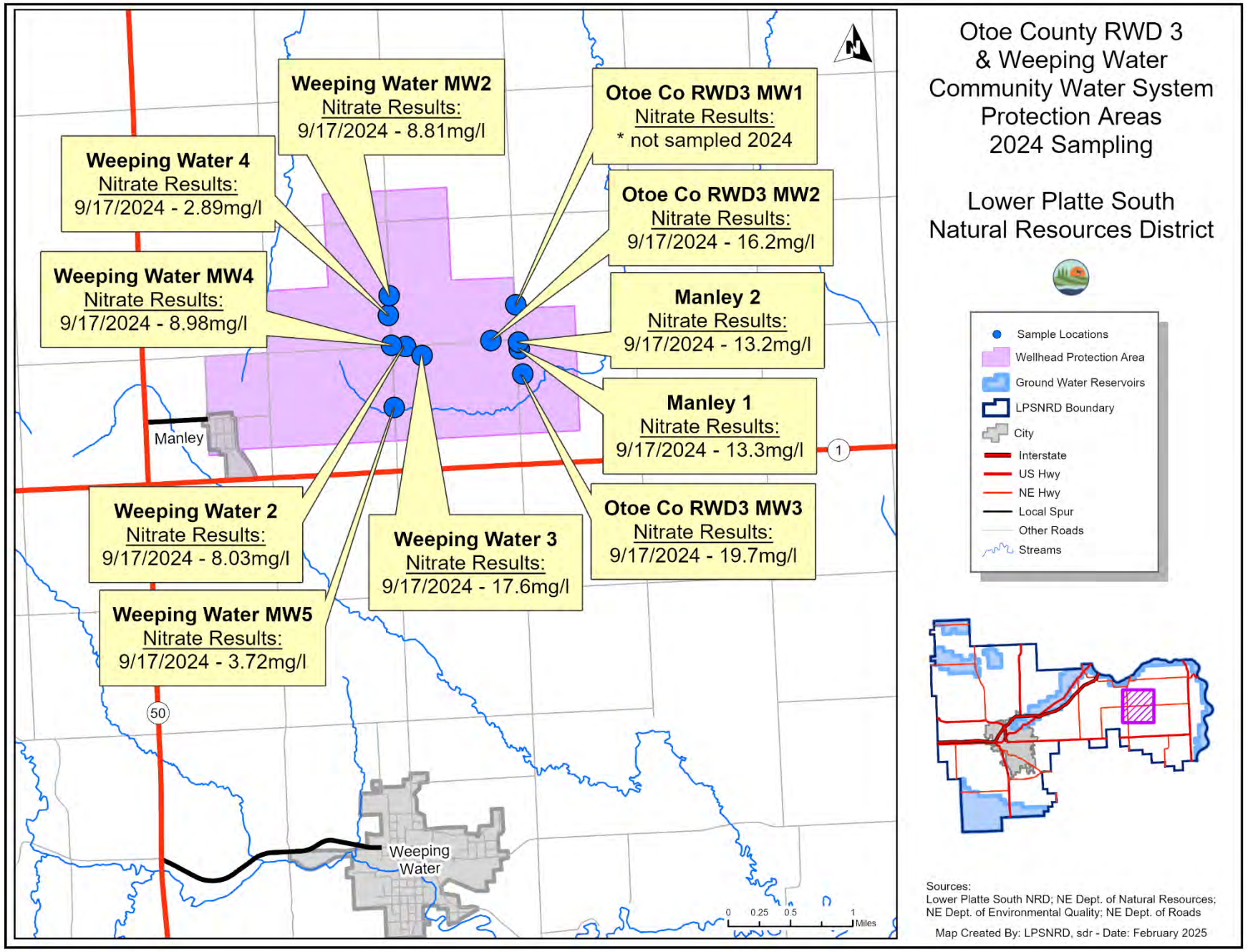


Figure 34 – Panama

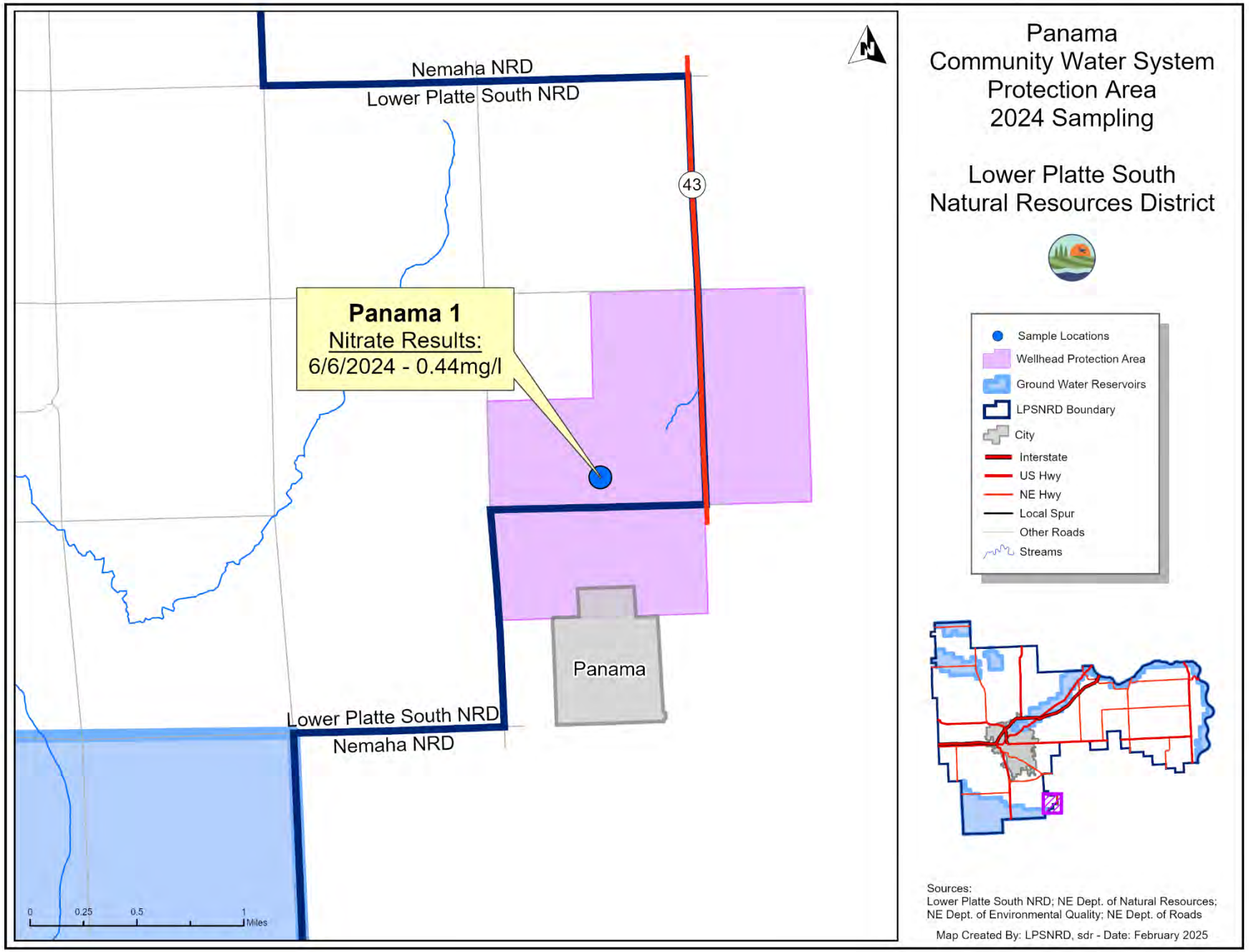


Figure 35 – Plattsmouth

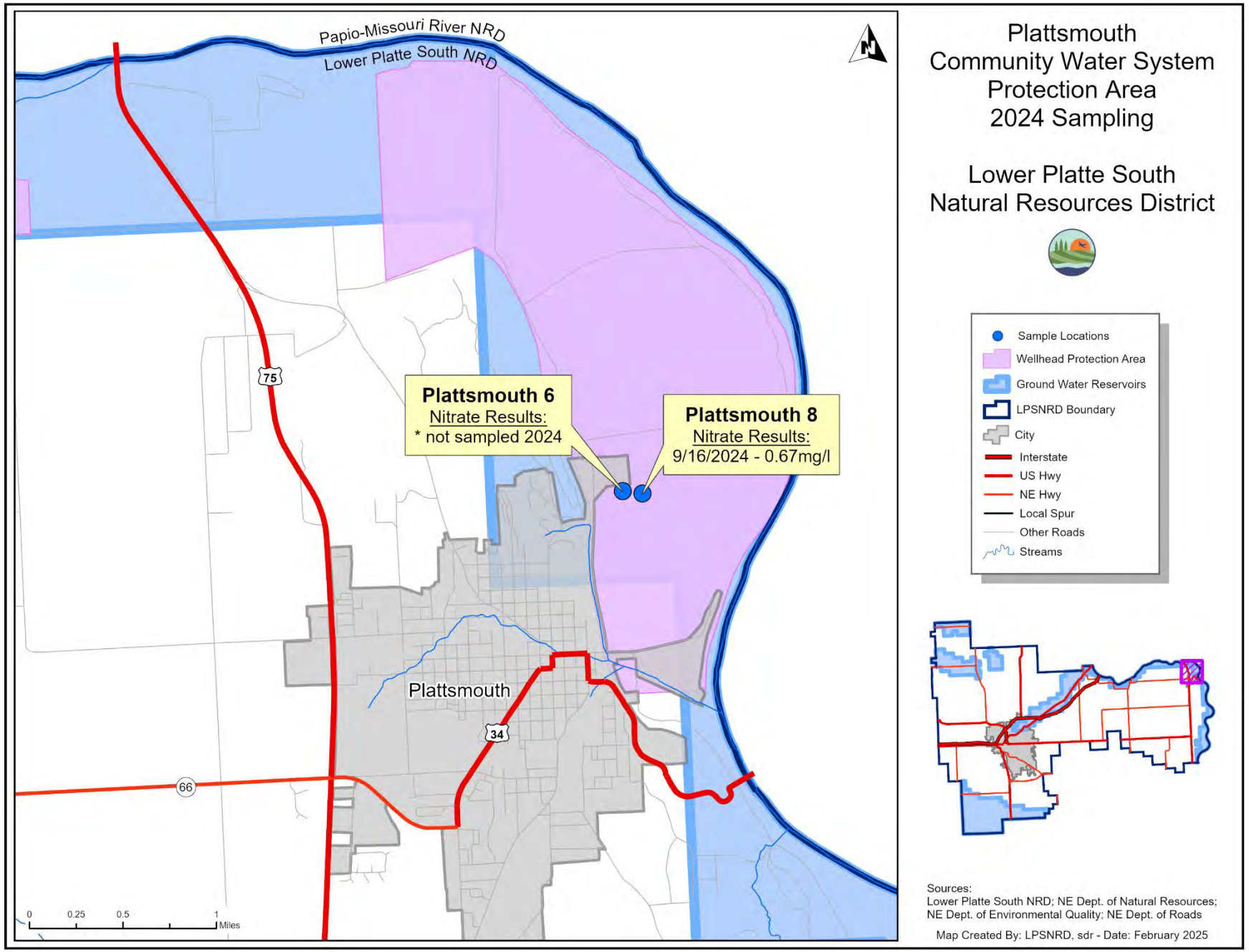


Figure 36 – Pleasant Dale

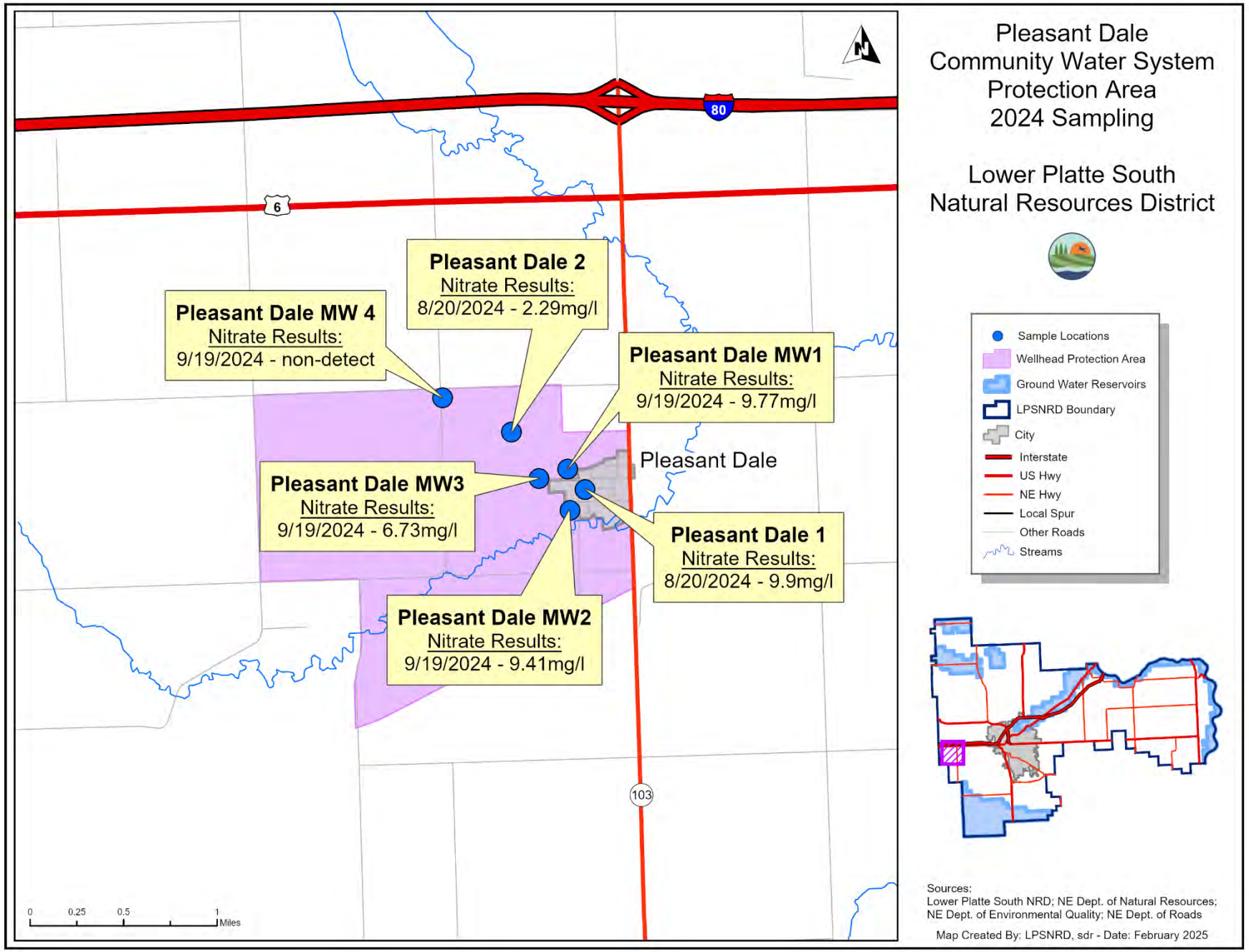


Figure 37 – Raymond

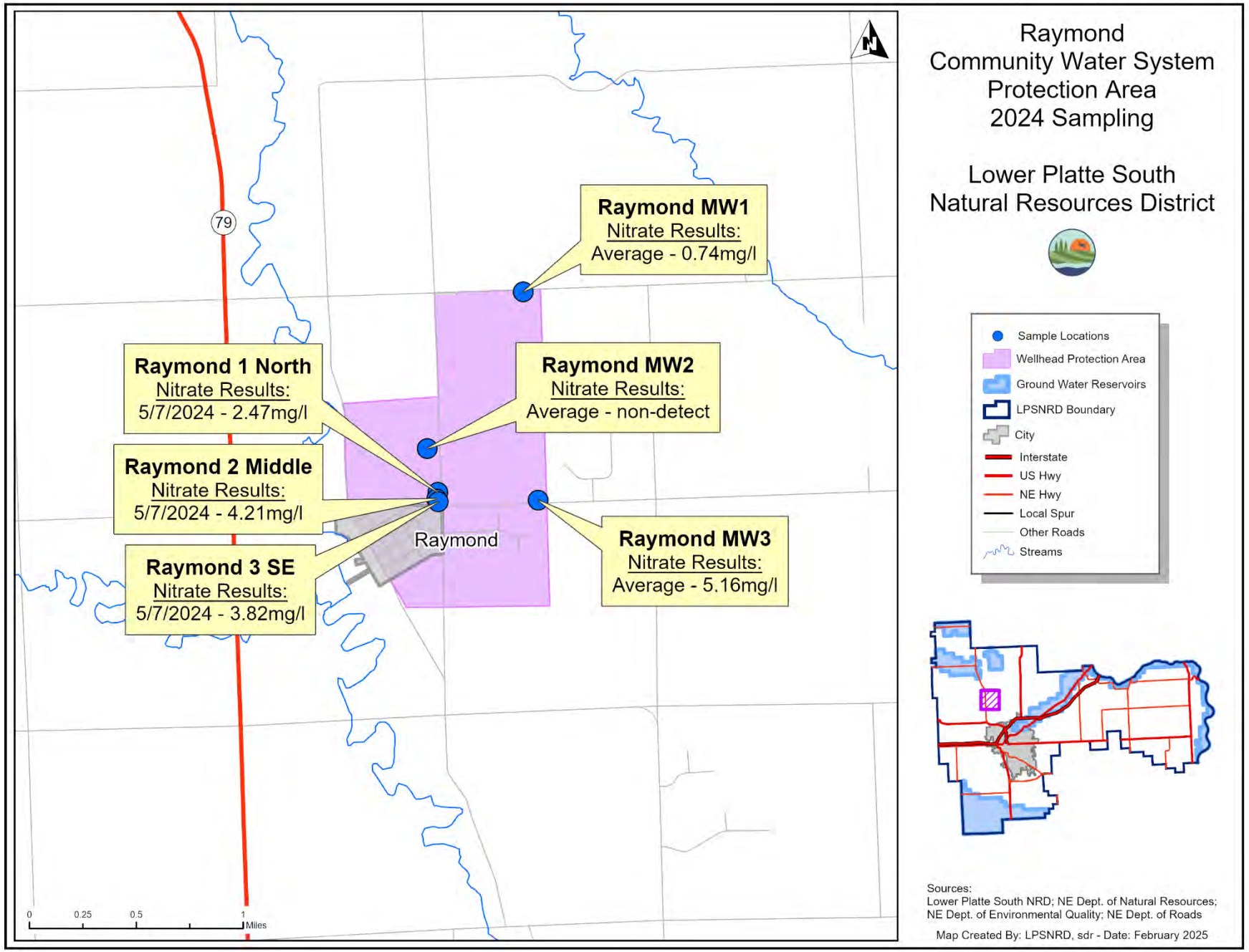


Figure 38 – Sprague

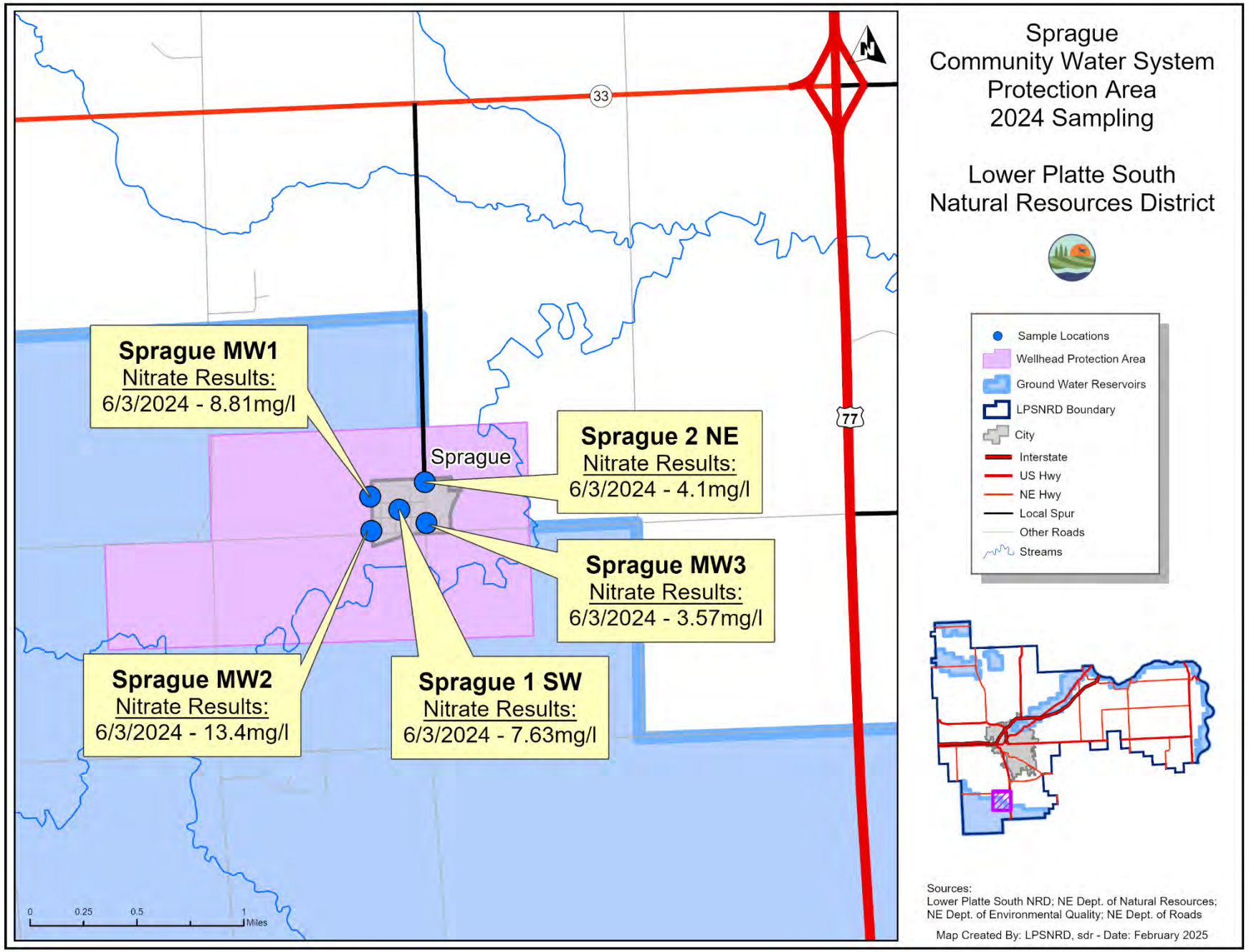


Figure 39 – Union

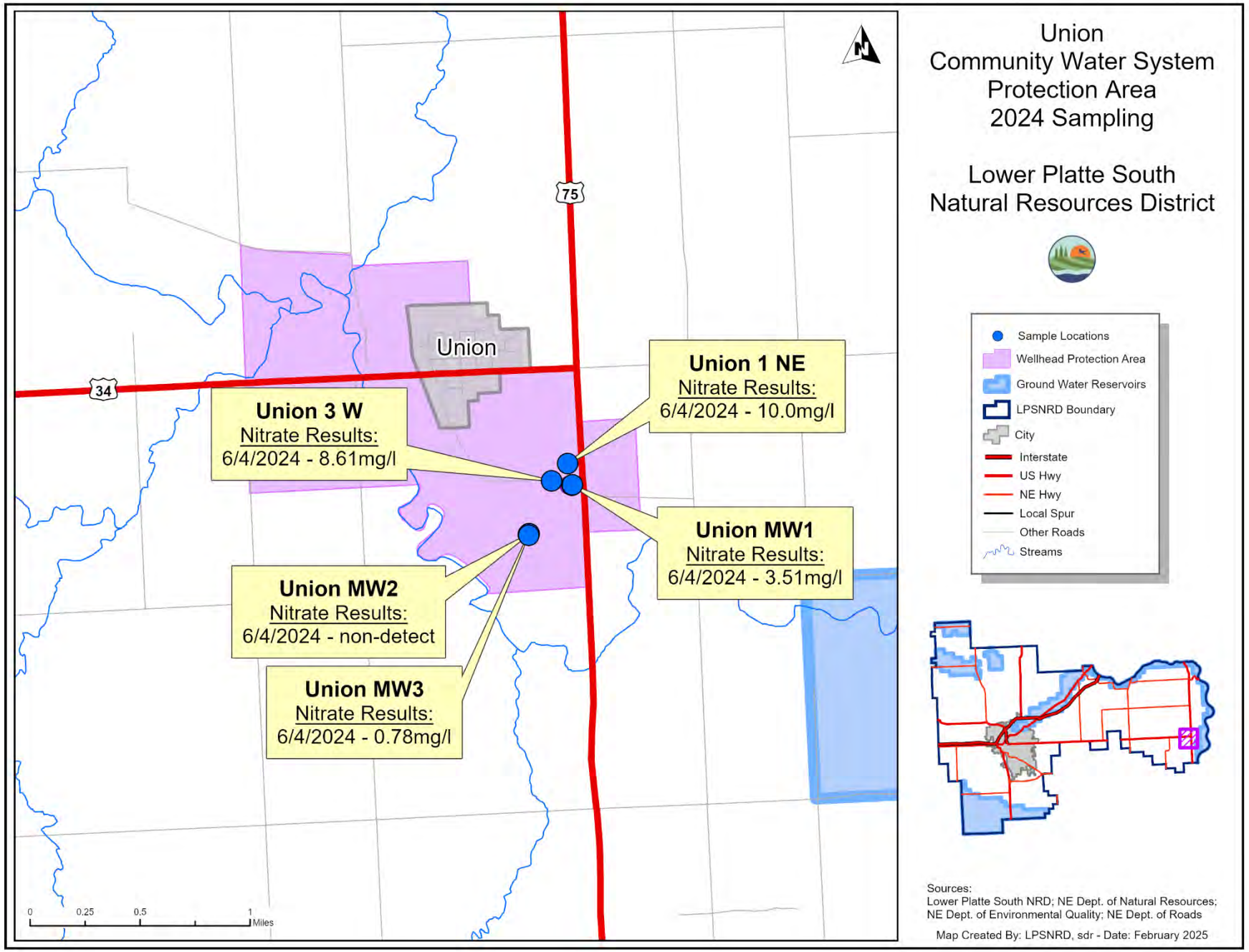


Figure 40 – Valparaiso

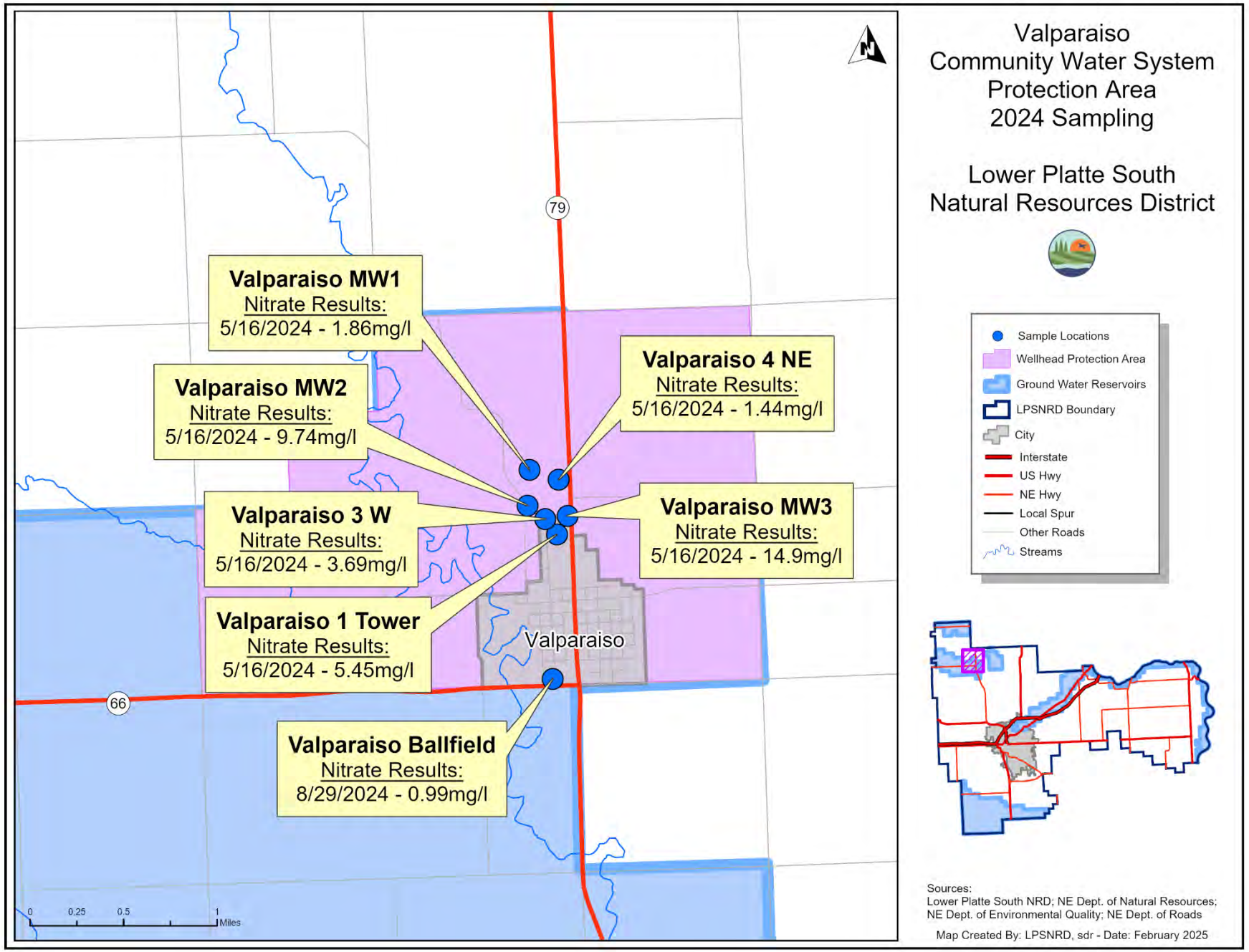


Figure 41 – Waverly

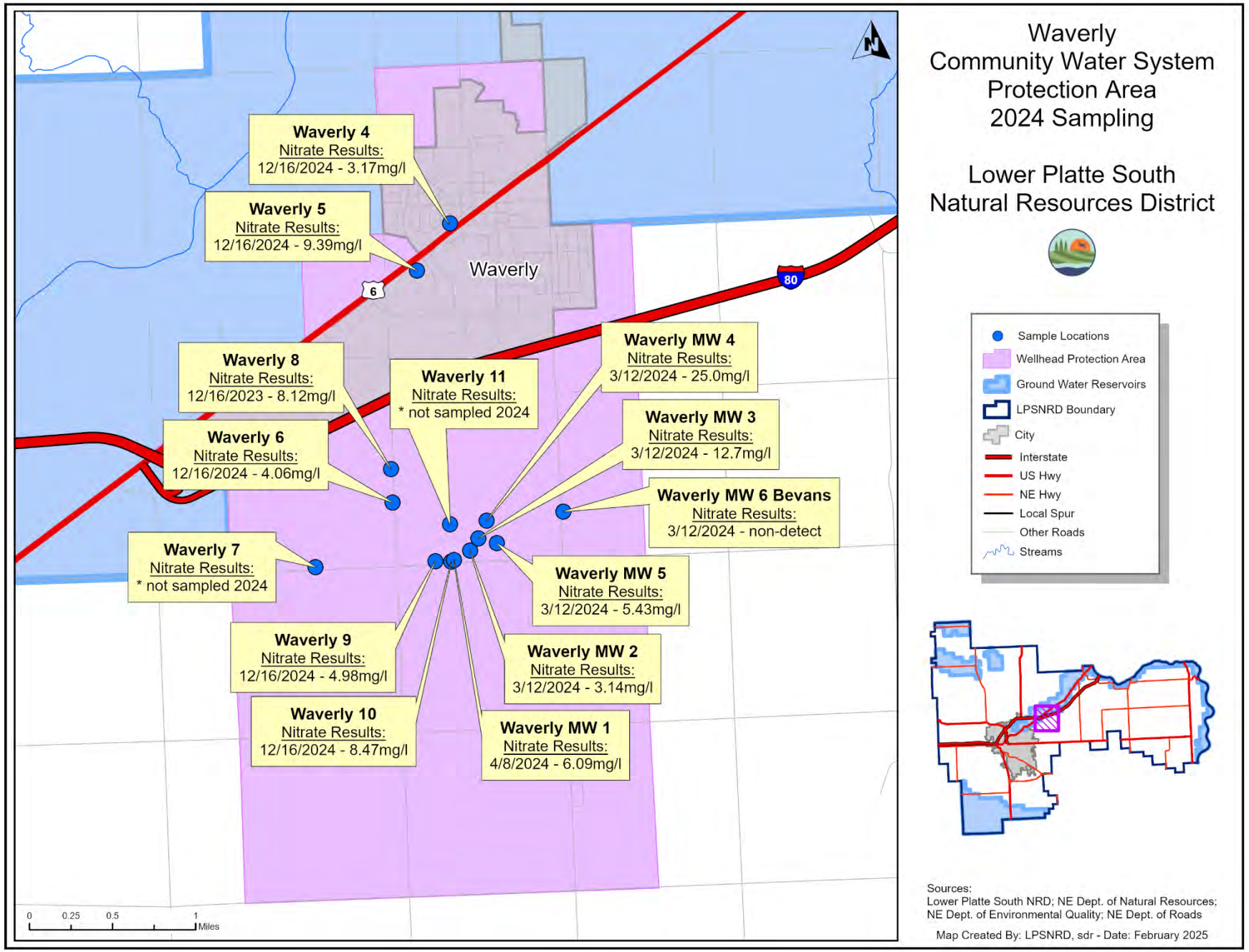


Figure 42 – Dwight-Valparaiso-Brainard Special Management Area

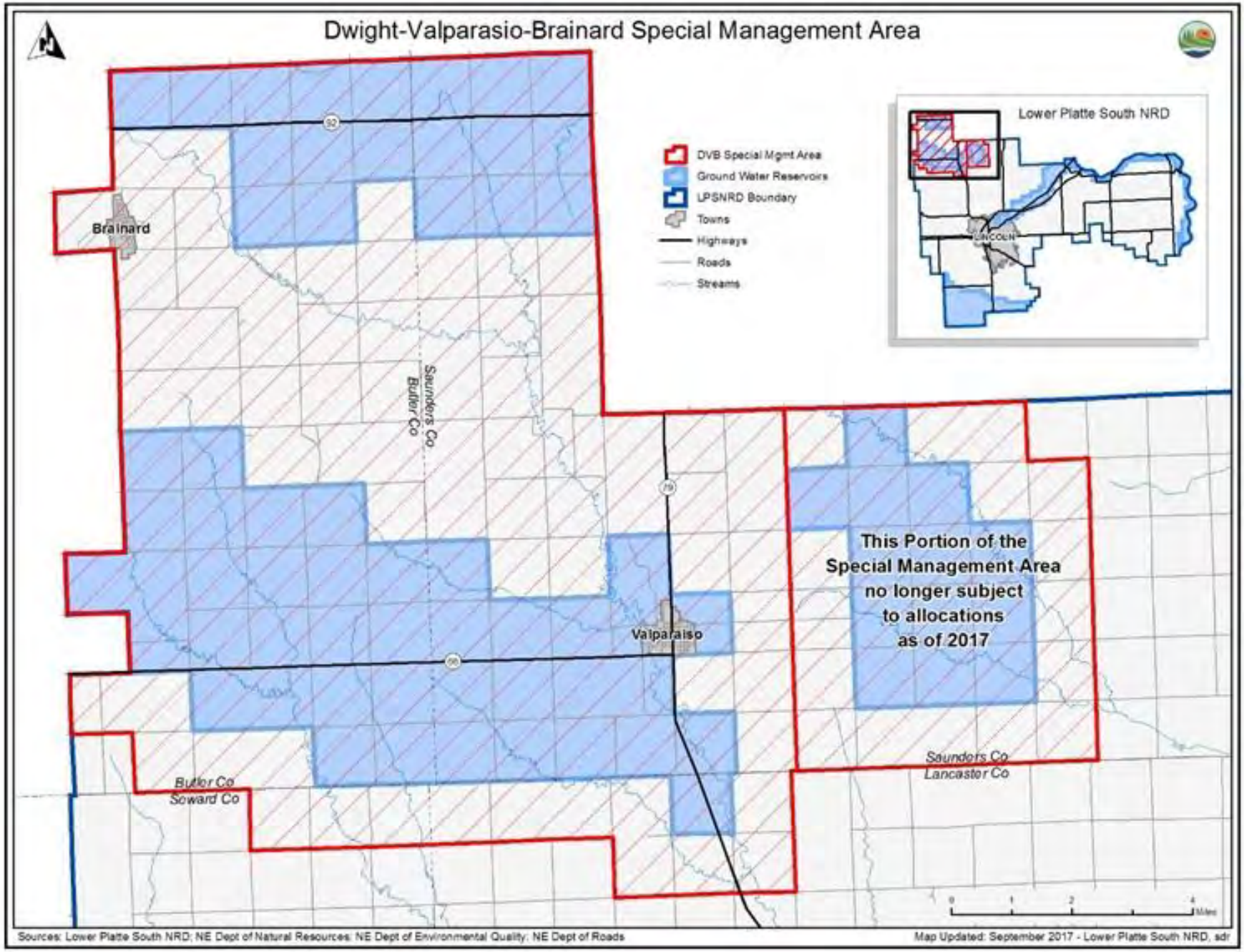


Figure 43 – DVB SMA Average Water Pumped

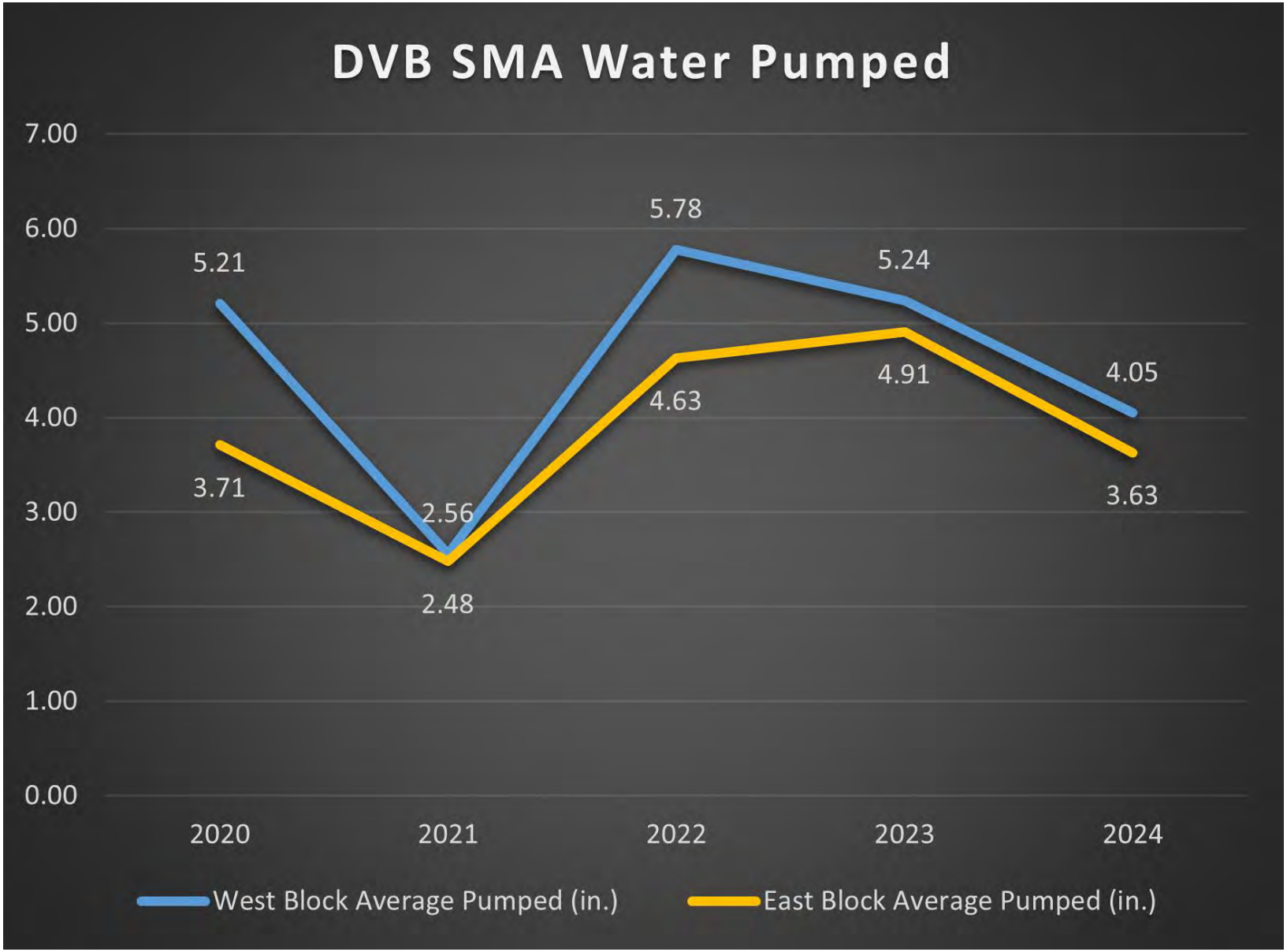


Figure 44 – DVBSMA West Block Rolling Allocation Usage

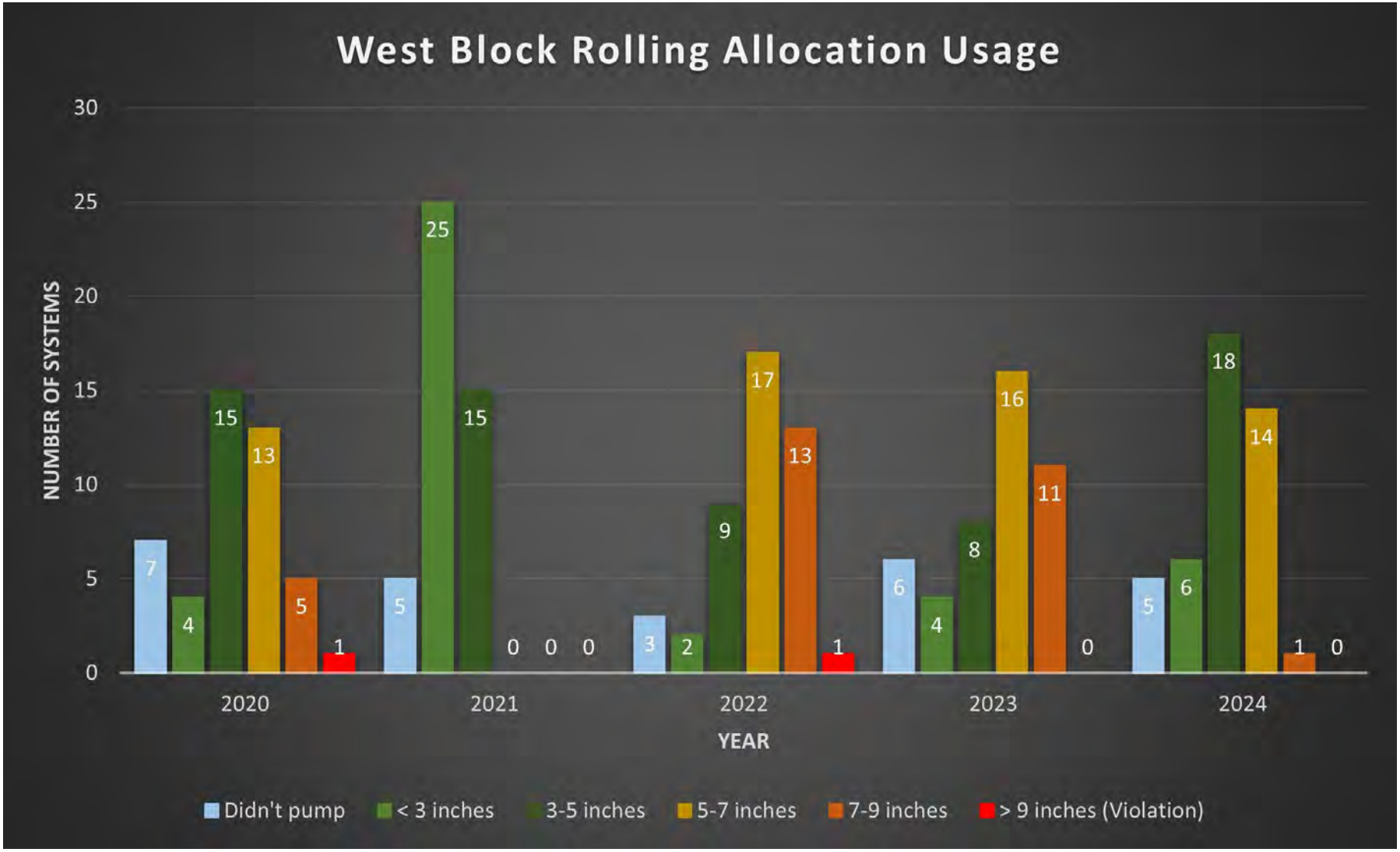


Figure 45 – DVBSMA West Block Remaining Allocation

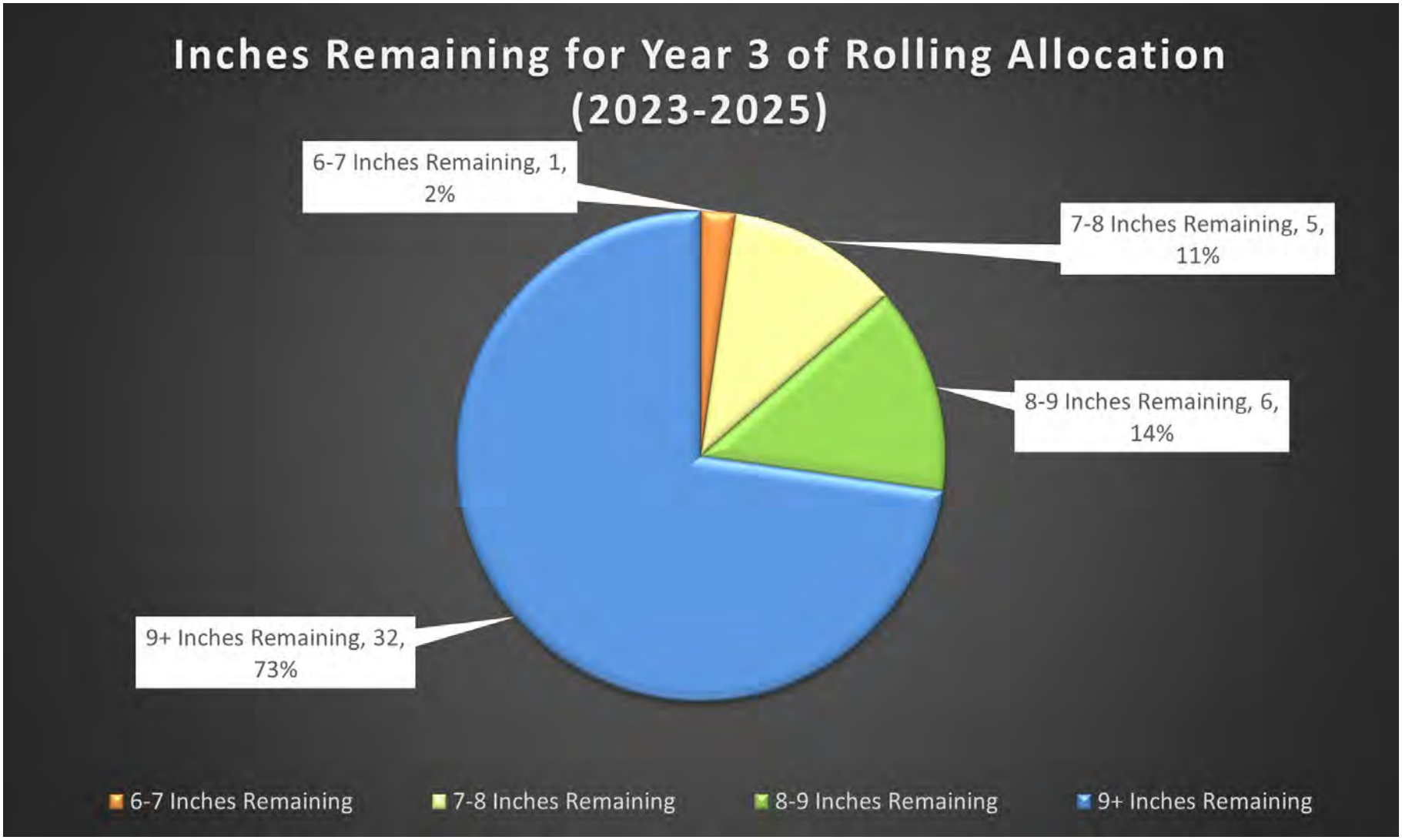


Figure 46 – Hydrologically Connected Area (HCA)

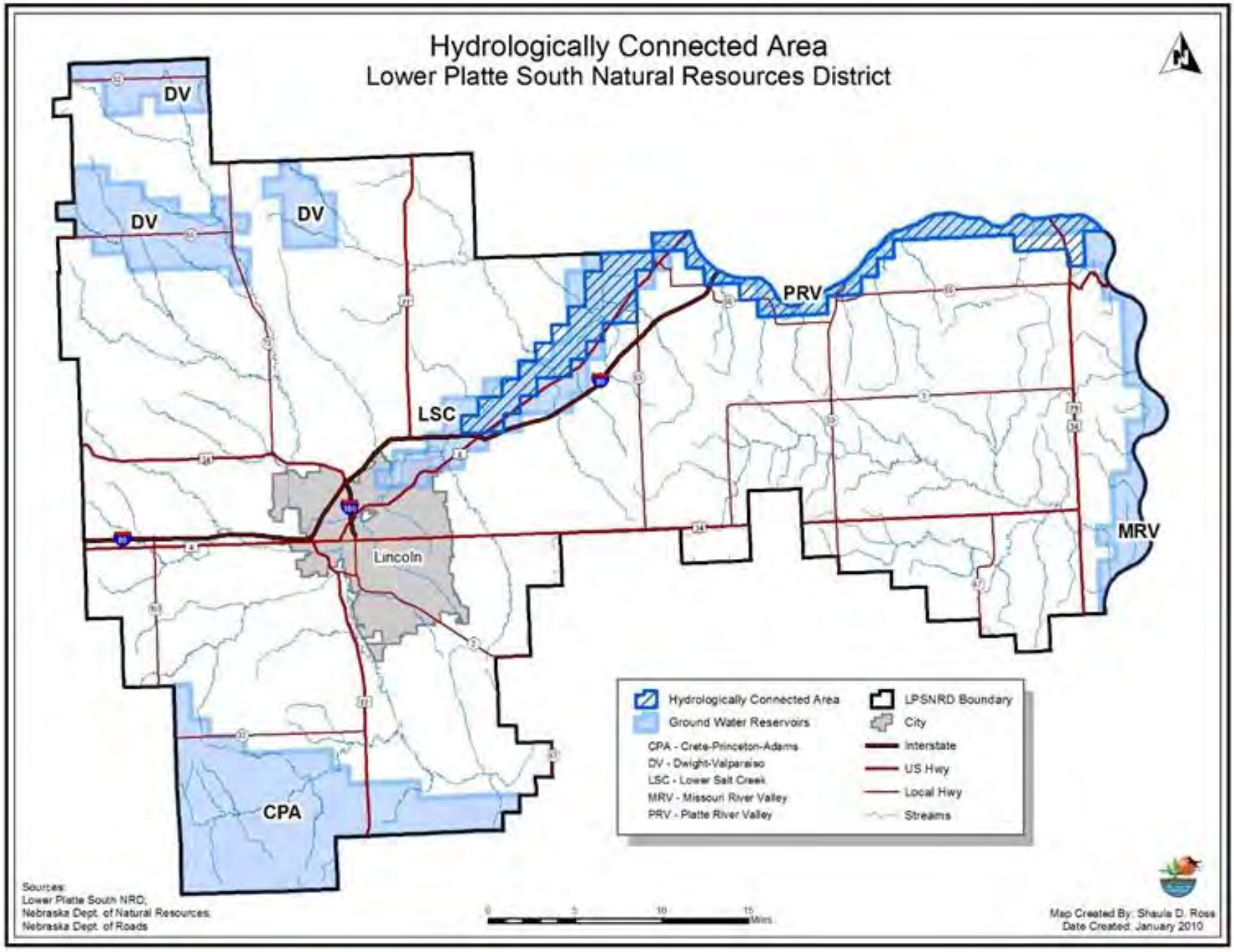


Figure 47 – Locations of Certified Irrigated Acres in the Hydrologically Connected Area

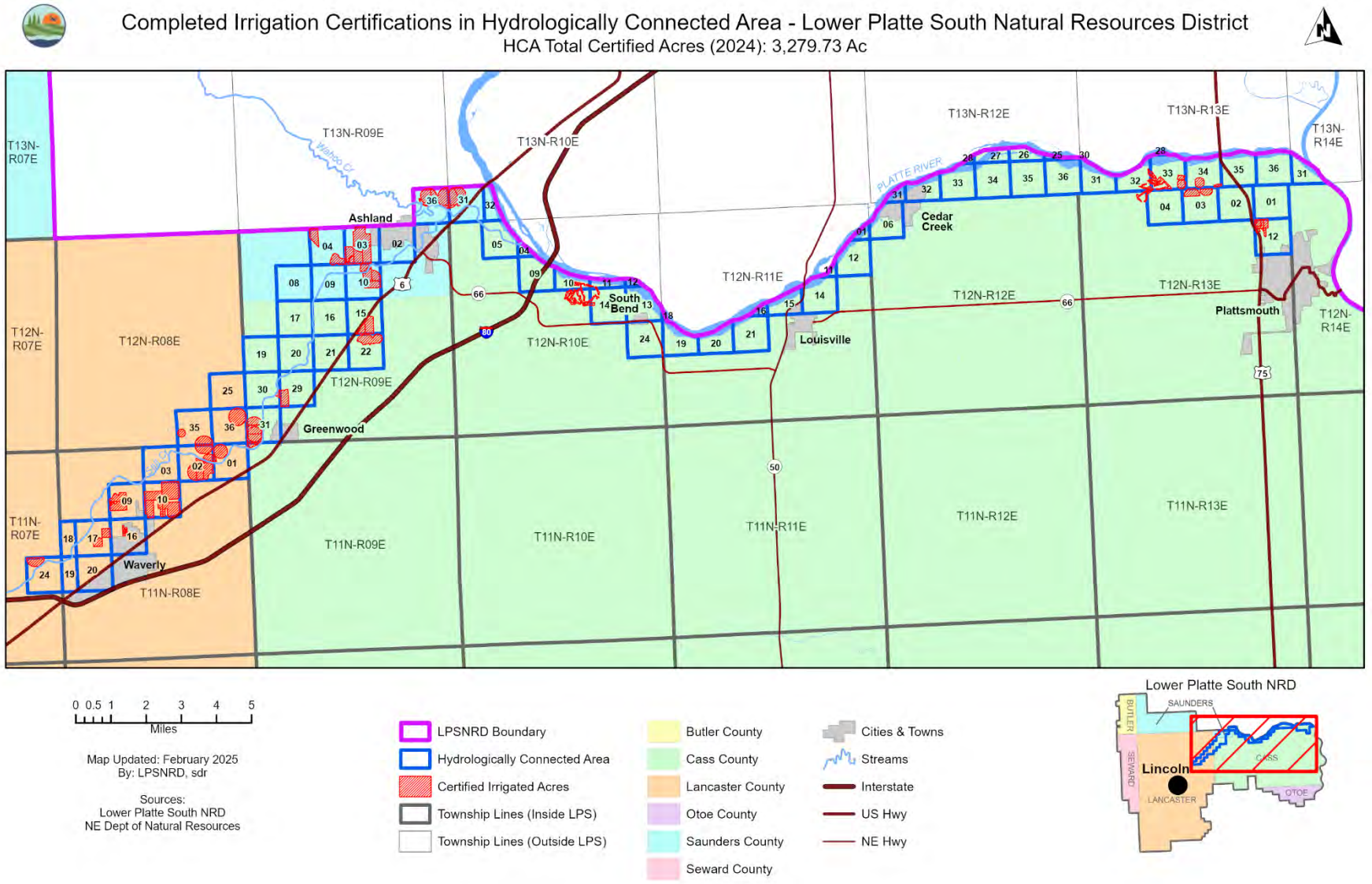


Figure 48 – Location of Certified Irrigated Acres in the Lower Platte South NRD

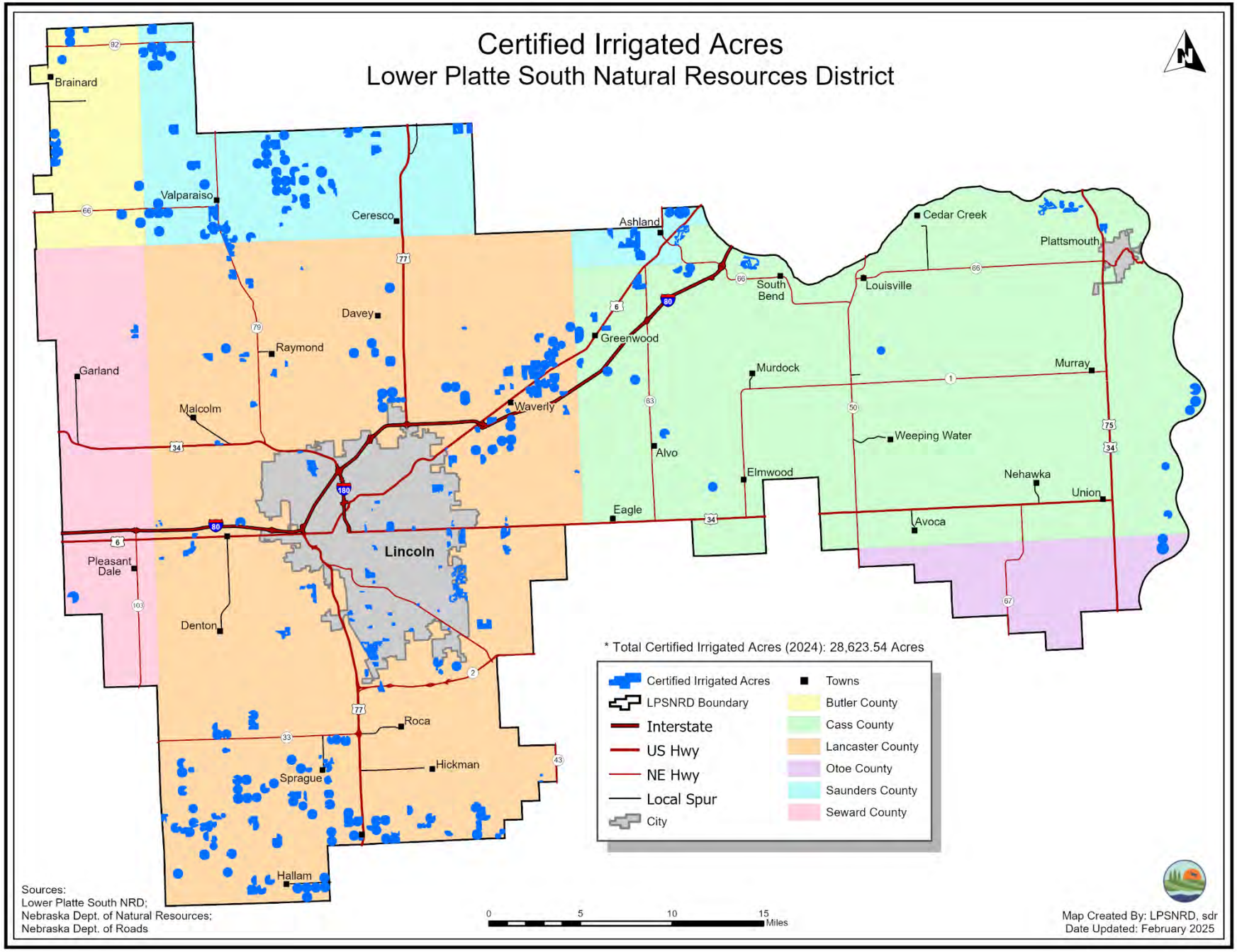


Figure 49 – Irrigation Application Amounts

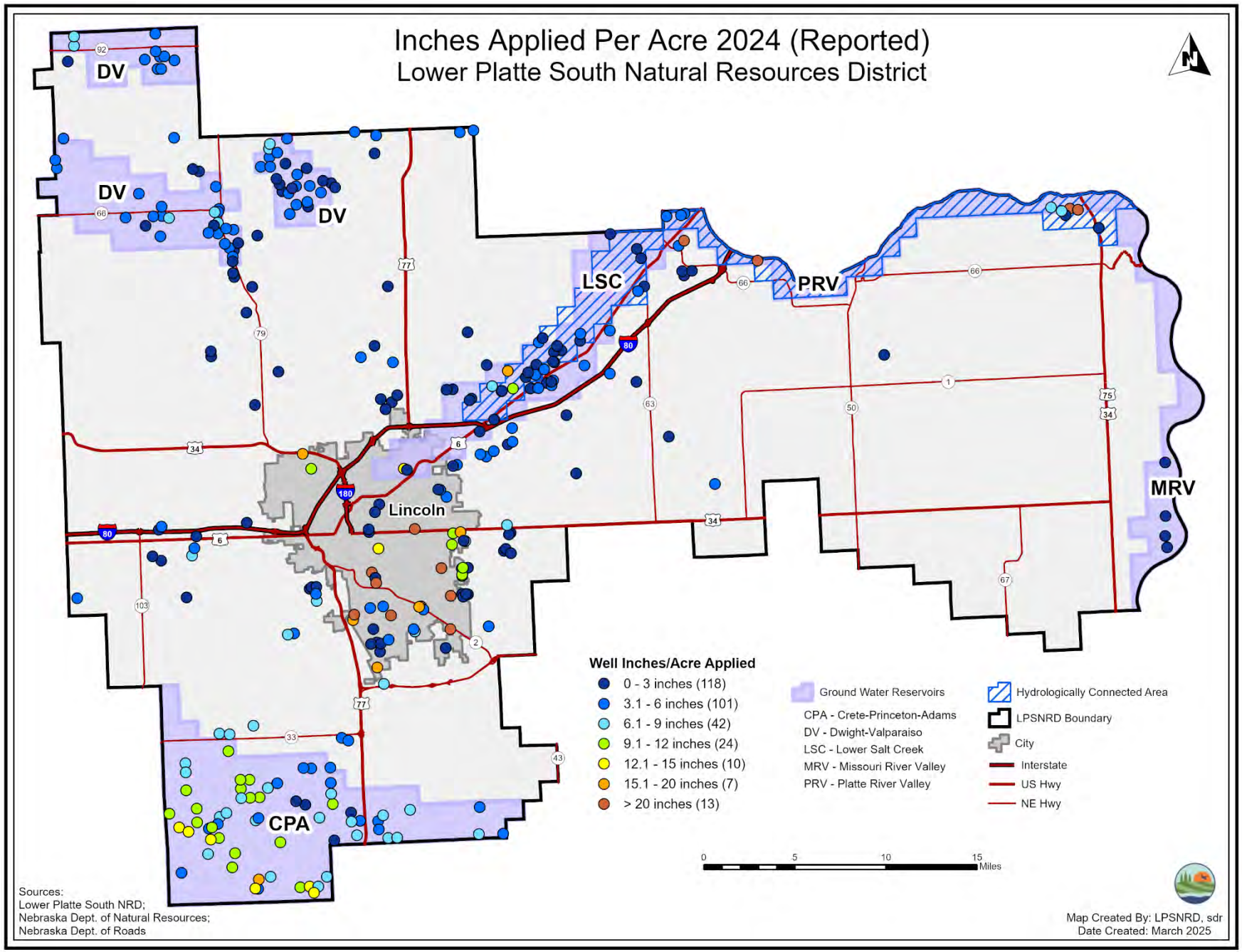


Figure 50 – Approved Permits to Construct a Water Well

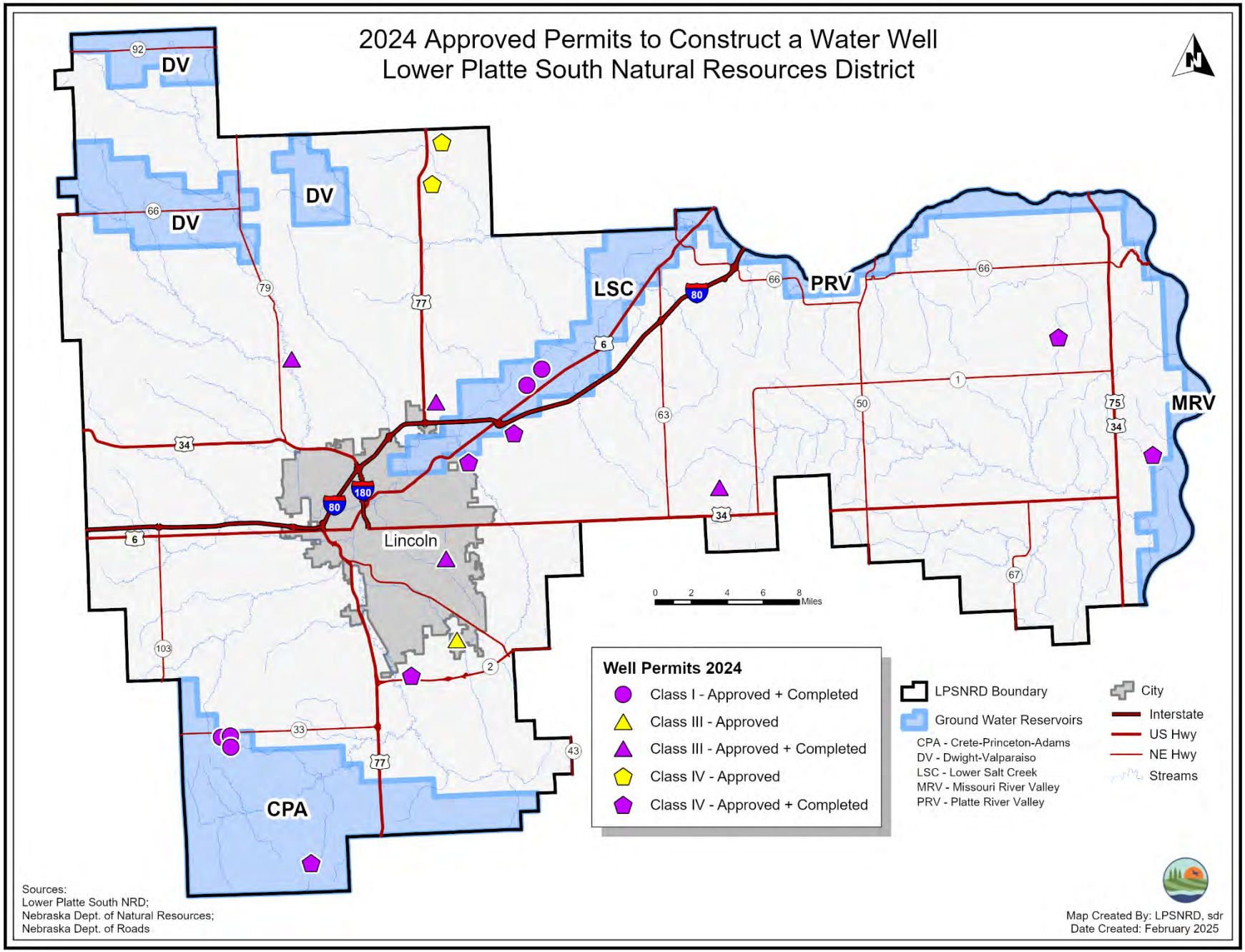


Figure 51 – Well Decommissioning Application Sites

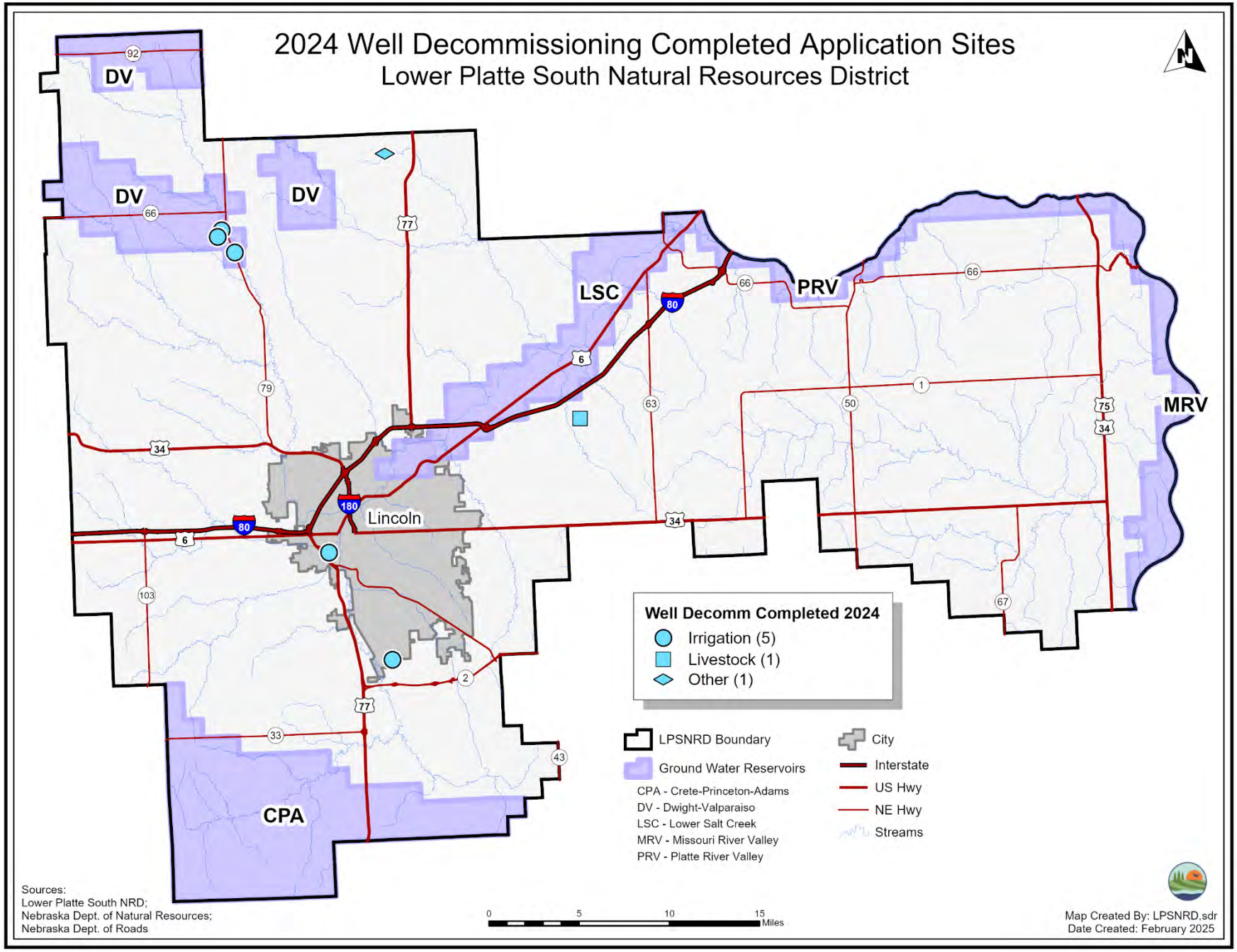


Figure 52 – Approved Chemigation Permit Locations

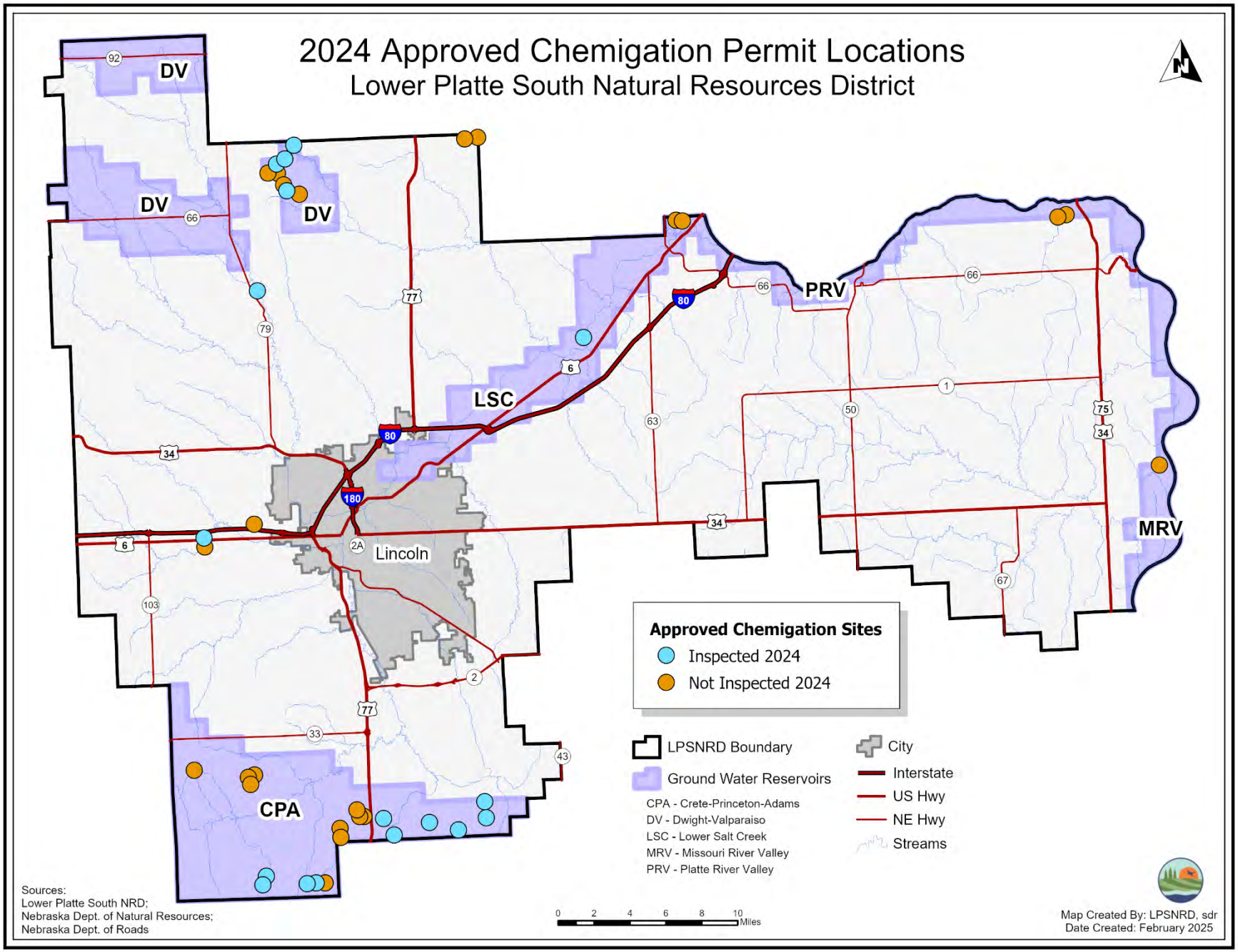


Figure 53– Water Usage Reports

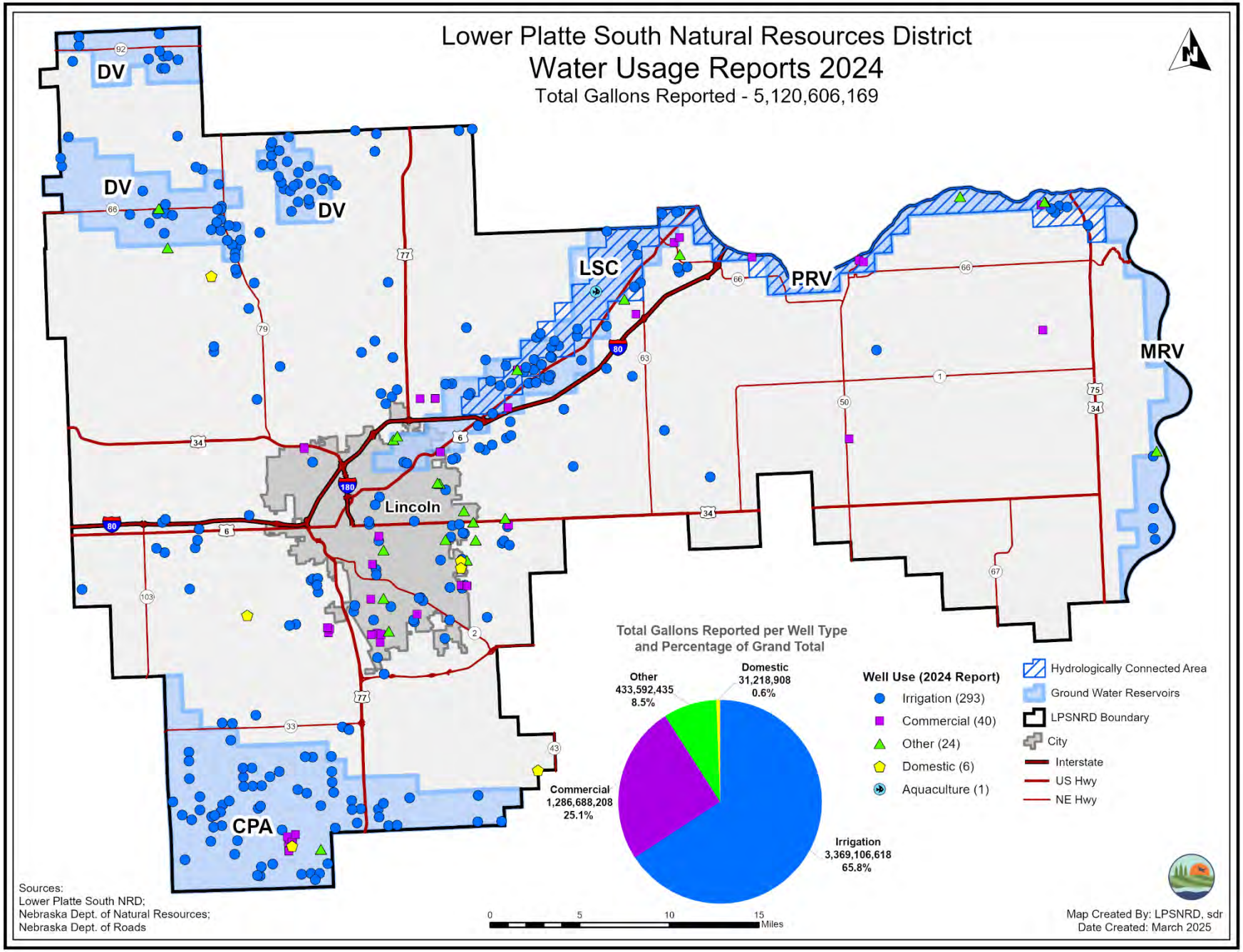


Figure 54 – Water Meter Cost Share Locations

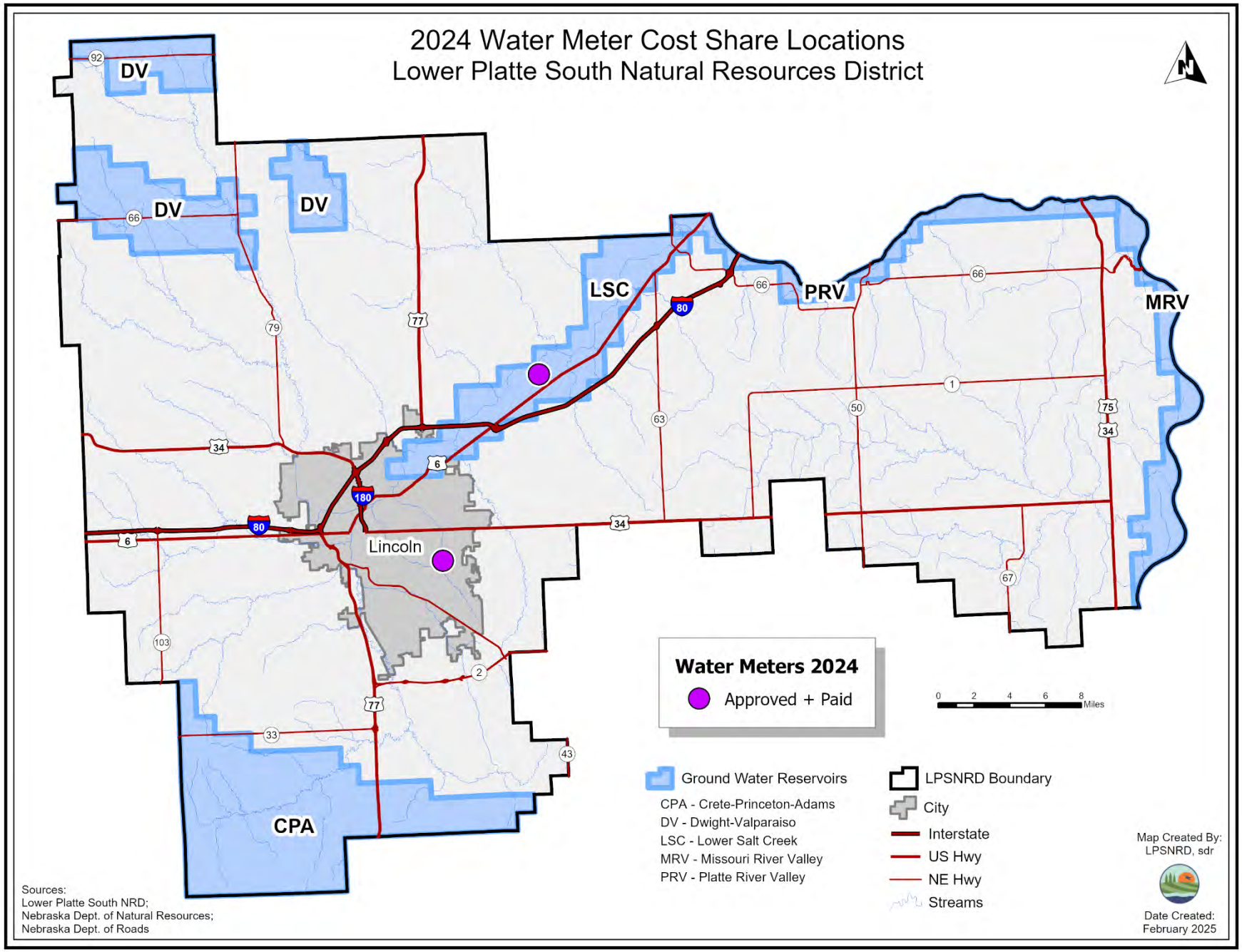


Figure 55 – Soil Sampling Cost–Share Locations

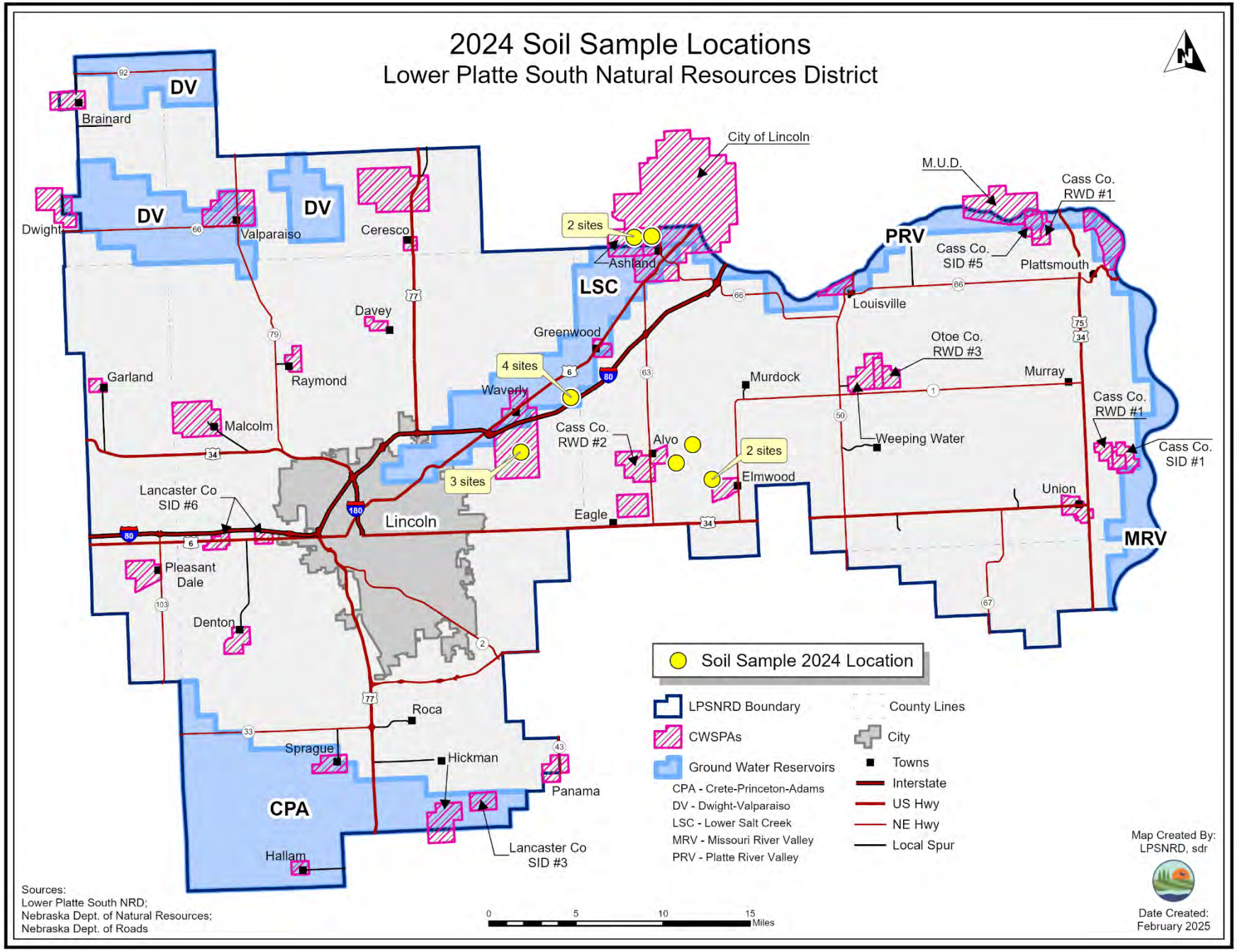


Figure 56 – Fertilizer Meter Cost–Share Locations

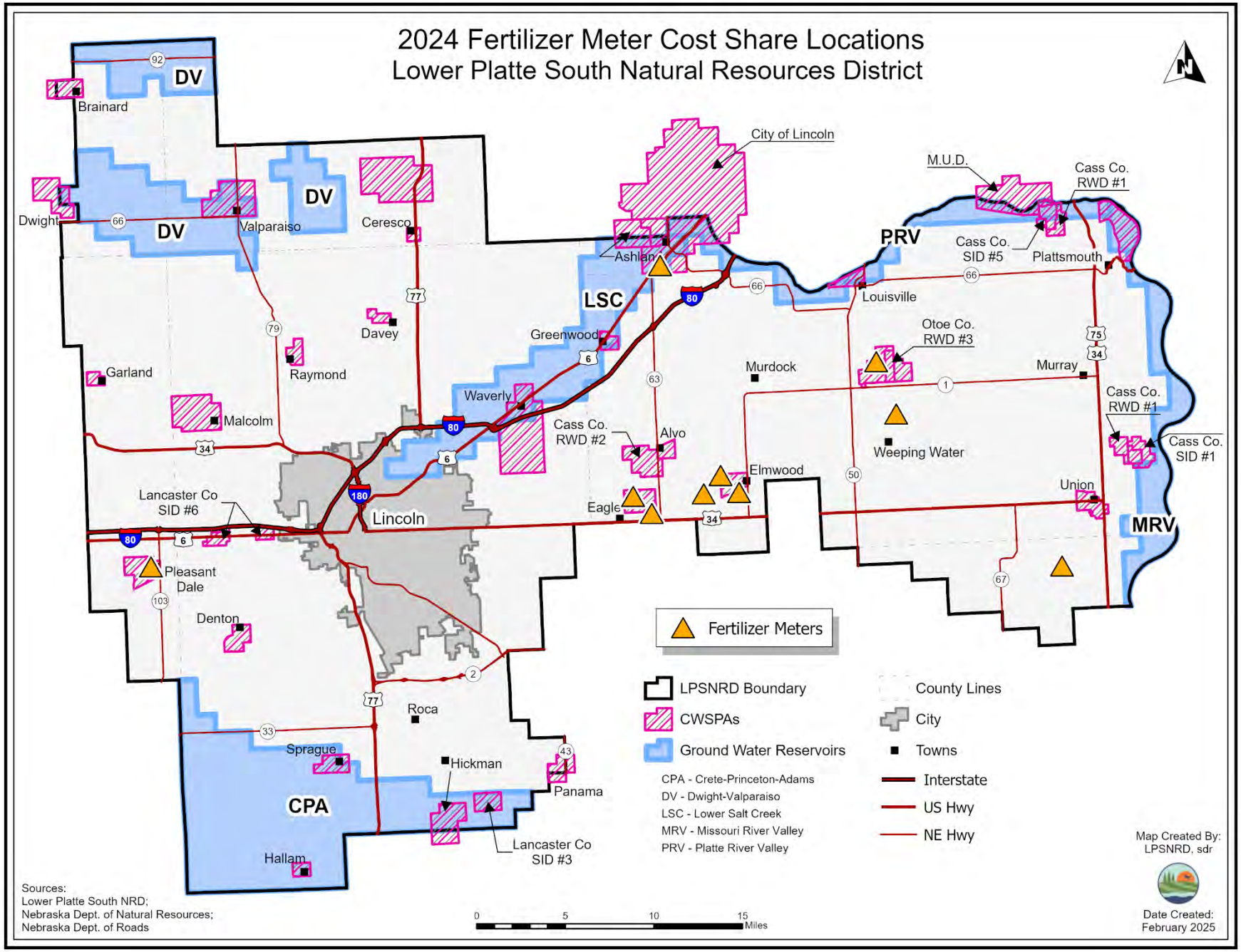
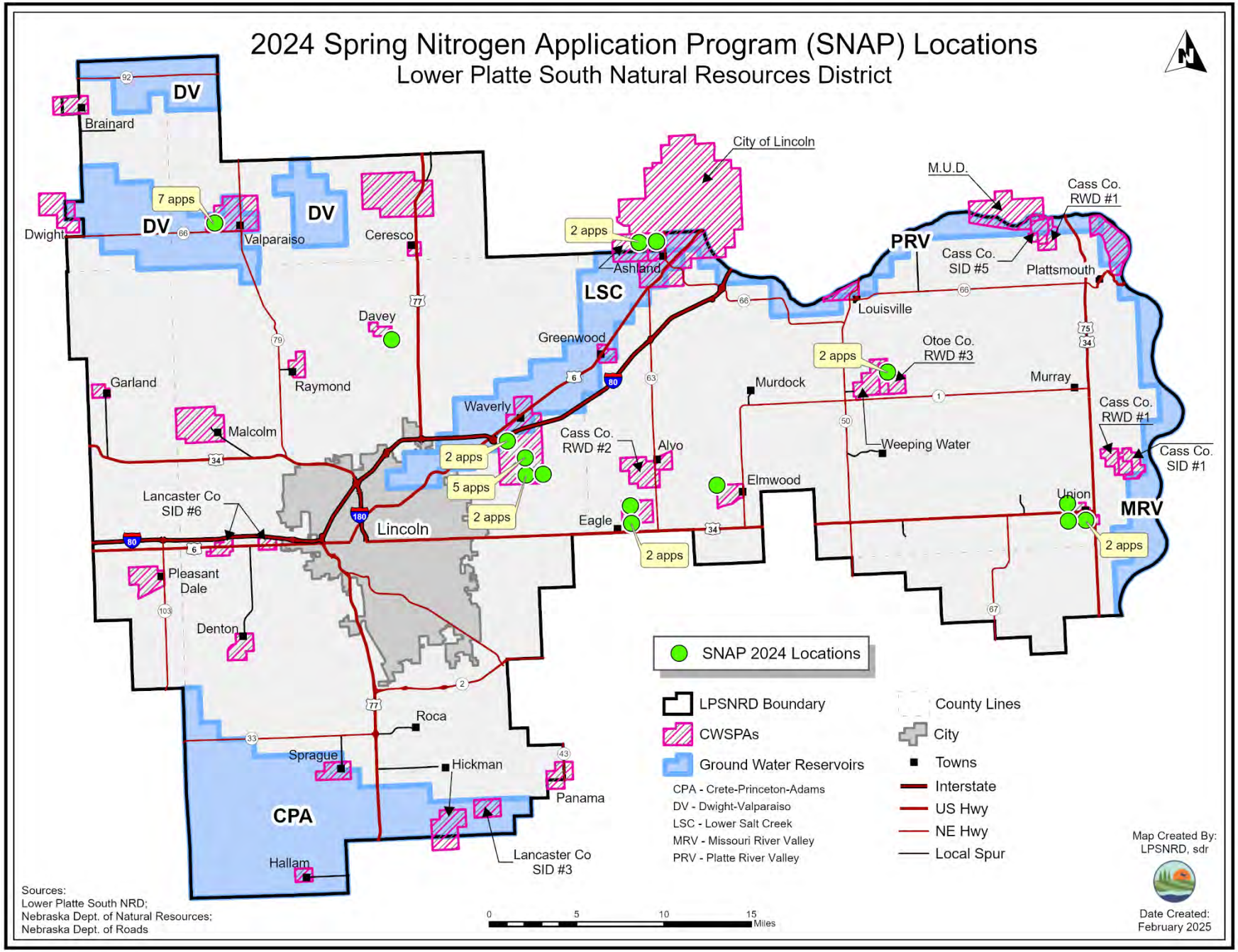


Figure 57 – Spring Nitrogen Application Program (SNAP) Locations



Appendix B

Table 1 – Status of Groundwater Monitoring Networks

Groundwater Reservoir	# Network Wells Needed	# Quality Network Wells/% Complete	# Quantity Network Wells/% Complete
Crete-Princeton-Adams	33	33/100%	26/79%
Dwight-Valparaiso	23	24/104%	24/104%
Lower Salt Creek	19	20/89%	25/131%
Missouri River Valley	10	6/60%	4/33%
Platte River Valley	12	9/75%	4/33%
Remaining Area	58	57/98%	57/98%

Table 2 – Phase Determinations for Nitrate-Nitrogen

Groundwater Reservoir	# Network Wells Needed	# Quality Network Wells/% Complete	# Quantity Network Wells/% Complete
Crete-Princeton-Adams	34	12%	6%
Dwight-Valparaiso	24	17%	13%
Lower Salt Creek	20	**50% (Phase II Area)**	30%
Missouri River Valley	5	0%	0%
Platte River Valley	10	0%	0%
Remaining Area	49	29%	24%

** MCL = Maximum Contaminant Level; the MCL for nitrate-nitrogen is 10 parts per million*

Phase II trigger is 50% of network wells ≥ 50% of MCL

Phase III trigger is 80% of network wells ≥ 80% of MCL

Table 3 - Results of Quality Assurance/Quality Control Sampling

Quality Assurance/Quality Control Check	Relative Percent Difference		
	Midwest Labs (Primary Lab)	NDHHS/UNL-WSL (QA/QC Labs)	Comments
Inter-lab Comparability	-1.10%	1.10%	Acceptable; excellent comparability
Precision	-0.06%	N/A	Acceptable; excellent precision
Accuracy	-1.91%	N/A	Acceptable; excellent accuracy

Table 4 – Phase Determinations for Quantity

Groundwater Reservoir	Percentage of wells below Phase II %* reduction in average saturated thickness	Percentage of wells below Phase III%* reduction in average saturated thickness	Average change in Water levels, Spring 2023-2024 (ft.)
Crete-Princeton-Adams	5%	0%	-1.21
Dwight-Valparaiso	0%	0%	-1.81
Lower Salt Creek	0%	0%	-2.06
Missouri River Valley	0%	0%	-3.84
Platte River Valley	0%	0%	-0.08
Remaining Area	0%	0%	-1.15

Table 5 – Chemigation Permits and Acreage by Ground Water Reservoir or Area

Groundwater Reservoir	# of Chemigation Permits	# of Acres
Crete-Princeton-Adams	19	1,784
Dwight-Valparaiso	7	862
Lower Salt Creek	1	53
Missouri River Valley	1	95
Platte River Valley	5	229
Remaining Area	7	592

Table 6 – Municipality Usage Information

System Name	Population Served	2024 Usage/Gallons
Alvo, Village of	142	6,337,301
Ashland, City of	3,086	189,872,000
Brainard, Village of	361	15,593,400
Cass County Rural Water District 1	3,263	169,433,000
Cass County Rural Water District 2	1,860	109,928,000
Cass County SID 1 – Lake Waconda	420	21,792,230
Cass County SID 5 – Buccaneer Bay	1,417	64,397,600
Ceresco, Village of	919	31,126,900
Davey, Village of	160	3,083,821
Denton, Village of	190	6,656,400
Eagle, Village of	1,065	40,017,223
Elmwood, Village of	654	38,544,000
Garland, Village of	210	7,040,830
Greenwood, Village of	568	21,360,700
Hallam, Village of	266	12,954,600
Hickman, City of	2,832	163,138,000
Lancaster SID 6 (Emerald)	100	1,149,000
Lincoln, City of	292,000	2,325,356,540*
Louisville, City of	1,301	143,537,700
Malcolm, Village of	457	16,311,282
Metropolitan Utilities District	600,000	2,980,469,000*
Middle Island Lake Association	92	3,193,340
Omaha Fish and Wildlife Club	850	4,258,310
Otoe County Rural Water District 3	2,500	12,981,000
Panama, Village of	250	8,646,928
Plattsmouth, City of	6,503	308,747,000
Pleasant Dale, Village of	205	6,507,000
Raven's Nest	70	8,019,851
Raymond, Village of	220	12,102,330
Sprague, Village of	150	7,877,000
Union, Village of	233	16,739,000
Valparaiso, Village of	600	21,918,000
Waverly, City of	4,279	226,494,351
Weeping Water, City of	1,107	81,084,000
	TOTAL: 7,086,667,637	

*- Pumping usage information derived only from the wells located within the LPSNRD geographic boundary.