NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: ENWRA Groundwater Recharge Mapping and Focus Area Assessments

SPONSOR'S *PRIMARY CONTACT INFORMATION* **(Not Consultant's)**

Sponsor Business Name: Lower Platte South Natural Resources District (LPSNRD) on behalf of the Eastern Nebraska Water Resources Assessment (ENWRA)

Sponsor Contact's Name: Katie Cameron, ENWRA Coordinator

Sponsor Contact's Address: 3125 Portia Street, Lincoln, NE 68521

Sponsor Contact's Phone: 402.476.2729

Sponsor Contact's Email: kcameron_enwra@lpsnrd.org

1. **Funding** amount requested from the Water Sustainability Fund:

   Grant amount requested. $144,000

   - If requesting less than 60% cost share, what %?

   If a loan is requested amount requested. $

   - How many years repayment period?
   - Supply a complete year-by-year repayment schedule.

2. **Neb. Rev. Stat. § 2-1507 (2)**

Are you applying for a **combined sewer overflow project**? YES☐ NO☒

If yes:

- Do you have a Long Term Control Plan that is currently approved by the Nebraska Department of Environmental Quality? YES☐ NO☐
- Attach a copy to your application.
- What is the population served by your project?
- Provide a demonstration of need.
- **Do not complete the remainder of the application.**

3. **Permits Required/Obtained** Attach a copy of each that has been obtained. For those needed, but not yet obtained (box **"NO"** checked), 1.) State when you will apply for the permit, 2.) When you anticipate receiving the permit, and 3.) Your estimated cost to obtain the permit.

(N/A = Not applicable/not asking for cost share to obtain)
(Yes = See attached)
(No = Might need, don't have & are asking for 60% cost share to obtain)

G&P - T&E consultation (required)	N/A☒	Obtained: YES☐ NO☐
DNR Surface Water Right	N/A☒	Obtained: YES☐ NO☐
USACE (e.g., 404/other Permit)	N/A☒	Obtained: YES☐ NO☐
FEMA (CLOMR)	N/A☒	Obtained: YES☐ NO☐
Local Zoning/Construction	N/A☒	Obtained: YES☐ NO☐
Cultural Resources Evaluation	N/A☒	Obtained: YES☐ NO☐
Other (provide explanation below)	N/A☒	Obtained: YES☐ NO☐

4. **Partnerships**

List each Partner / Co-sponsor, attach documentation of agreement:

ENWRA is the lead agency for this proposed Project (coalition of 6 Eastern Nebraska NRDs with LPSNRD designated as the financial and grant handling agency [Figure 1,

Section A, #7]). Attachment A includes Letters of Support from funding partners and the ENWRA Interlocal Cooperative Funding Agreement (Amendment #5). ENWRA plans to enter into a Joint Funding Agreement for Project work with federal cooperative dollars with the U.S. Geological Survey (USGS) and a cooperative agreement for Project work with the Conservation and Survey Division, School of Natural Resources, University of Nebraska-Lincoln (UNL-CSD), state geological survey. The USGS and UNL-CSD agreements depend on the funding of this grant application.

Identify the roles and responsibilities of each Partner / Co-sponsor involved in the proposed project regardless of whether each is an additional funding source.

ENWRA: ENWRA will fund the Project through LPSNRD's financial handling (Kristin Buntemeyer) of the ENWRA account. ENWRA coordinator Katie Cameron will conduct administration and project coordination for reimbursement and reporting to/from WSF.

USGS: USGS will be the technical lead on the Project scope plus provide in-kind funds through the Cooperative Matching Funds toward the Project.

UNL-CSD: UNL-CSD will create updated water level surfaces, aquifer boundary/recharge evaluations, analysis and recommendations for Focus Areas mapped within the region.

5. **Other Sources of Funding**

Identify the costs of the entire project, what costs each other source of funding will be applied to, and whether each of these other sources of funding is confirmed. If not, please identify those entities and list the date when confirmation is expected. Explain how you will implement the project if these sources are not obtained.

Funding source	2022	2023	2024	Totals
WSF (60%)	$73,800	$50,400	$19,800	$144,000
ENWRA (40%)	$49,200	$33,600	$13,200	$96,000
State/Local Project total	$123,000	$84,000	$33,000	$240,000
USGS (federal cooperative dollars)	$40,000	$29,000	$5,000	$74,000
Totals	**$163,000**	**$113,000**	**$38,000**	**$314,000**

The total cost of the Project is $314,000. The USGS, through its Cooperative Matching Funds will provide $74,000 as in-kind funds taking the state and local project total for this grant to $240,000 which will be funded by ENWRA with 60% anticipated back from WSF. The local board of directors for LPSNRD has approved submittal of this application and allocation of the necessary funds on behalf of ENWRA per their local governmental process. Please refer to the tables in Section B Items #4 and #5 for the budget listings and letters of support in Attachment A for reference.

6. **Overview**

In 1,000 words *or less*, provide a brief description of your project including the nature/purpose of the project and its objectives. Do not exceed one page!

Over 18,000 miles of airborne electromagnetic (AEM) geophysical data have been collected throughout the ENWRA area (www.enwra.org). Recharge maps have been delivered for many localized areas of the ENWRA area using shallow sediment resistivities (Figure 2, Section B, Item #1.B.1). The thickness and character of the unsaturated zone varies greatly in Eastern Nebraska because of the glaciated topography. High recharge areas are typically underlain by coarse sediments with relatively thin unsaturated zones where water moves quickly from the land surface to the water table. These areas are vulnerable to agricultural contaminants such as nutrients and pesticides. Low recharge areas typically are till-covered uplands underlain by thick sequences of fine-grained deposits where water moves very slowly from land surface to the water table. These areas are much less vulnerable to contamination from agricultural activities; however, they can be vulnerable to over extraction due to low recharge rates in these areas. The proposed project is a three-phase collaborative effort with the ENWRA sponsors, UNL-CSD, and the USGS. Phase I will focus on the reinterpretation of historical water-quality data conjunctively with an improved hydrostratigraphic framework to determine the effectiveness of using AEM as a tool to assess groundwater vulnerability. Phase I of this work will also include updates to the 1995 state-wide water-level maps for selected aquifers in Eastern Nebraska. Greater detail and contour density will be included for unconfined, alluvial aquifers within the ENWRA area. The updated water-level maps will be used to create refinements to the current recharge classifications by examining the minimum resistivity value and thickness of the unsaturated zone. The resulting map will be uploaded to the Nebraska GeoCloud. Available water-quality data (USGS and Agrichemical Clearinghouse), vadose zone data (Nebraska Vadose Zone network) and water-level data (UNL-CSD and prior ENWRA vadose/episodic recharge work) will be grouped within the High, Moderate, and Low (H, M, L) recharge areas, by aquifer, or land use. Statistical tests will be performed to determine if significant differences exist between the sample groups for a variety of constituents, including nitrate, pesticides, or trace elements like arsenic or manganese. The reinterpretation of historical water-quality, vadose zone, and water-level data conjunctively will allow an assessment of the effectiveness of the H, M, L recharge area map to assess groundwater vulnerability.

Phase II of the Project will look at the H, M, and L recharge classifications and focus on five specific areas in the ENWRA area, crossing NRD boundaries, where project sponsors need additional information to guide groundwater management decisions. ENWRA's early pilot sites installed at three representative eastern Nebraska settings have demonstrated that various degrees of confinement exist in glaciated settings within the ENWRA area (results from clustered wells with screens and monitoring equipment installed at different zones - https://www.dropbox.com/sh/kuq64jl1eqk27gh/AAB3PVFTBsK9_iLZ2_8Z-KZCa?dl=0). The water-level maps from Phase I will be re-evaluated and altered to reflect the degree of confinement, potential perched conditions, and areas of little/no saturated thickness in the Focus Areas. Phase II will also assess the water quality evaluation and potential vertical and horizontal boundaries of the aquifer units below the H, M, L recharge

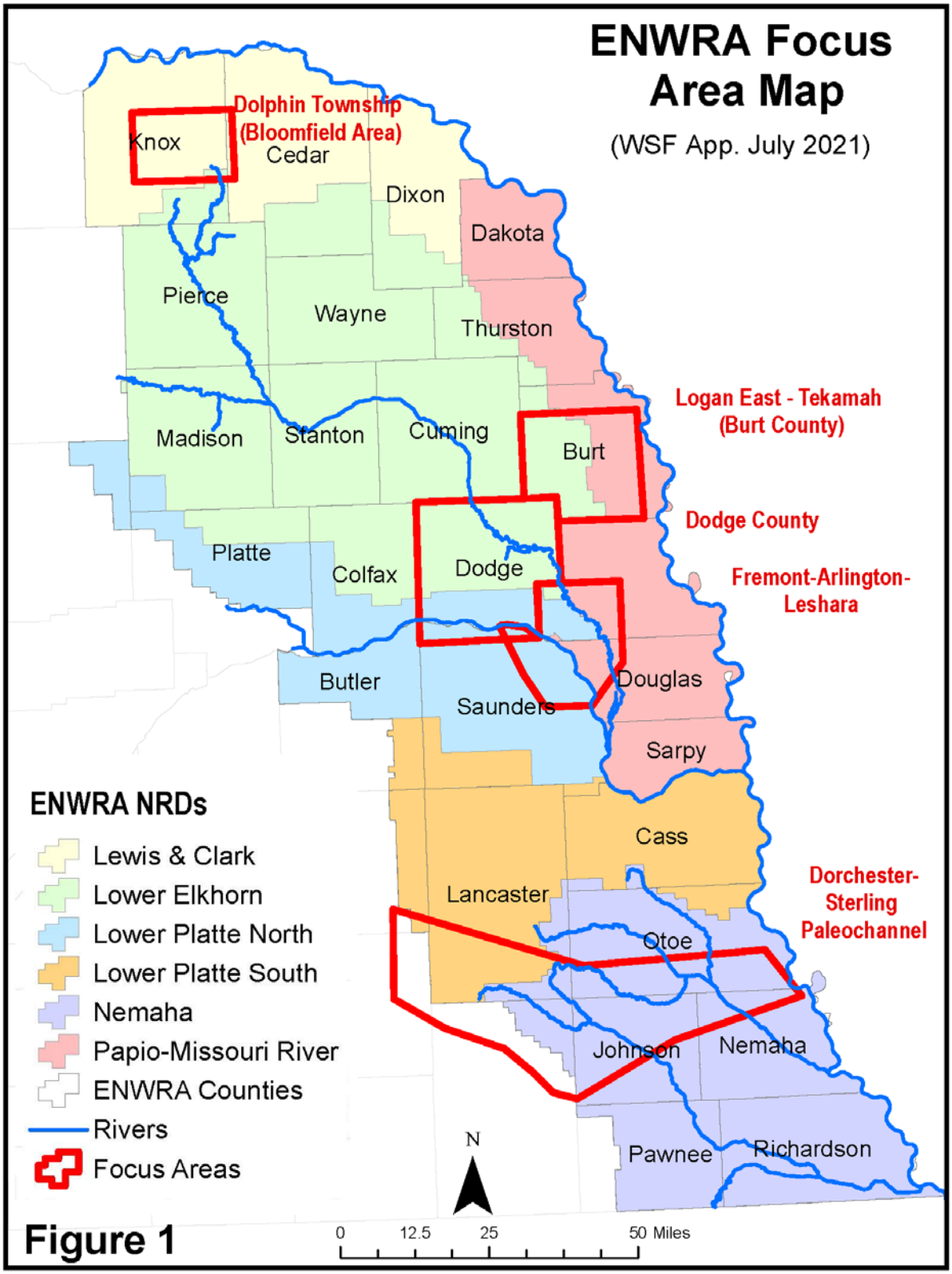
areas. Evaluation discussions and recommendations for each Focus Area will be tailored to meet specific management needs (ex: in Platte River valley vs. confined till covered area will have totally different discussion points regarding recharge and quality and quantity management concerns). Based on the wholistic regional picture from Phase I and Phase II activities and evaluation of separate, but related, ongoing ENWRA partner projects (specific NRD geological model and vadose assessment projects are already in progress), a further refined H, M, and L recharge map will be generated. A report will accompany the map, discussing the statistical analyses results, recommendations for Focus Areas, and the updated refinements. Phase III of the Project will also include development of a work plan to address potential water level, water quality and/or further refinement data gaps based on the regional management concerns. The vadose mapping and evaluation Project would provide eastern Nebraska water resource managers, scientists, regulators, and the public another GIS layer for use in their water related projects/interest areas as well as road map for several specific Focus Areas in eastern Nebraska regarding recharge and groundwater sustainability.

7. **Project Tasks and Timeline**

Identify what activities will be conducted to complete the project, and the anticipated completion date.
For multiyear projects please list (using the following example):

- What activities (Tasks) are to be completed.
- An estimate of each Tasks expenditures/cost per year.
- Activities in years 4 through project completion under a single column.

Activity	Year 1 (2022)	Year 2 (2023)	Year 3 (2024)	Costs
Phase I: AEM resistivity, water-quality, water-level data compilation and review. Water-level map updating and H M L map development for ENWRA area (includes brief version 1 map description write-up)	$114,000 (USGS, includes $40,000 in-kind)			**$163,000** ($123,000 ENWRA/WSF)
	$49,000 (UNL-CSD)			
Phase II: Evaluation and recommendations for the Focus Areas (Figure 1 and separate table below), H M L boundary adjustments and bottom of vadose/top of water under your feet refinements.		$83,000 (USGS, includes $29,000 in-kind)		**$113,000** ($84,000 ENWRA/WSF)
		$30,000 (UNL-CSD)		
Phase III: Generate an updated map write up with statistical analyses results, recommendations for Focus Areas, and a workplan for further refined regional recharge mapping (reference Section B #9 discussions).			$28,000 (USGS includes $5,000 in-kind)	**$38,000** ($33,000 ENWRA/WSF)
			$10,000 (UNL-CSD)	
TOTAL				**$314,000** **($240,000 ENWRA/WSF + $74,000 USGS in-kind)**


ENWRA Focus Area Map
(WSF App. July 2021)
Dolphin Township (Bloomfield Area)
Knox
Cedar
Dixon
Dakota
Pierce
Wayne
Thurston
Madison
Stanton
Cuming
Burt
Logan East - Tekamah (Burt County)
Dodge County
Platte
Colfax
Dodge
Fremont-Arlington-Leshara
Butler
Saunders
Douglas
Sarpy
Cass
Lancaster
Dorchester-Sterling Paleochannel
Otoe
Johnson
Nemaha
Pawnee
Richardson
ENWRA NRDs
Lewis & Clark
Lower Elkhorn
Lower Platte North
Lower Platte South
Nemaha
Papio-Missouri River
ENWRA Counties
Rivers
Focus Areas
N
0
12.5
25
50 Miles
Figure 1

Focus Area name	Counties or towns	NRD(s) involved	Hydrogeology	Water resource issue
Dorchester-Sterling Paleovalley	Hickman, Talmage, Brock, Burr, Denton	Lower Platte South and Nemaha	Confined and unconfined buried paleovalley aquifer	Additional and proposed development has stressed water supplies. Declines prevalent on edges of aquifer, nitrate an issue for some towns
Dodge County	Dodge County	Lower Platte North, Lower Elkhorn	Northern edge of Platte River alluvial aquifer and glacial outwash	Nitrate contamination in northern Dodge County, effects of shallow groundwater on flooding near Fremont
Dolphin Township (Bloomfield Area)	Bloomfield and Crofton	Lewis and Clark	Edge of High Plains aquifer, unconfined and confined	Expansion of the Cedar-Knox Rural Water District. Possible water source within Dolphin Township. Highly variable groundwater quality and quantity within township
Logan East-Tekamah (Burt Co.)	Oakland, Tekamah	Lower Elkhorn, Papio-Missouri River	Confined glaciated aquifer and Dakota Sandstone	Expansion of Logan-East Rural Water District and nitrate contamination of Dakota near Tekamah
Fremont/Arlington/Leshara	Dodge and Douglas Counties	Lower Platte North and Papio Missouri River	Platte/Elkhorn River alluvial aquifer, glacial outwash aquifer, and Dakota Sandstone	Examining feasibility of streamflow augmentation project where groundwater could be pumped from previously unmapped glacial outwash deposits to mitigate low flows in Lower Platte River

Description of focus areas.

8. **IMP**

Do you have an **Integrated Management Plan** in place, or have you initiated one? YES☒ NO☐ Sponsor is not an NRD☐

The ENWRA NRDs have approved Integrated Management Plans (IMPs) and/or have entered the development process with NeDNR.

Section B.

DNR DIRECTOR'S FINDINGS

Prove Engineering & Technical Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 004)

1. Does your project include physical construction (defined as moving dirt, directing water, physically constructing something, or installing equipment)?
YES☐ NO☒

If you answered "YES" you must answer all questions in section 1.A. If you answer "NO" you must answer all questions in section 1.B.

If "YES", it is considered mostly structural, so answer the following:

1.A.1 Insert a feasibility report to comply with Title 261, Chapter 2, including engineering and technical data;

1.A.2 Describe the plan of development (004.01 A);

1.A.3 Include a description of all field investigations made to substantiate the feasibility report (004.01 B);

1.A.4 Provide maps, drawings, charts, tables, etc., used as a basis for the feasibility report (004.01 C);

1.A.5 Describe any necessary water and/or land rights including pertinent water supply and water quality information (004.01 D);

1.A.6 Discuss each component of the final plan (004.01 E);

1.A.7 When applicable include the geologic investigation required for the project (004.01 E 1);

1.A.8 When applicable include the hydrologic data investigation required for the project (004.01 E 2);

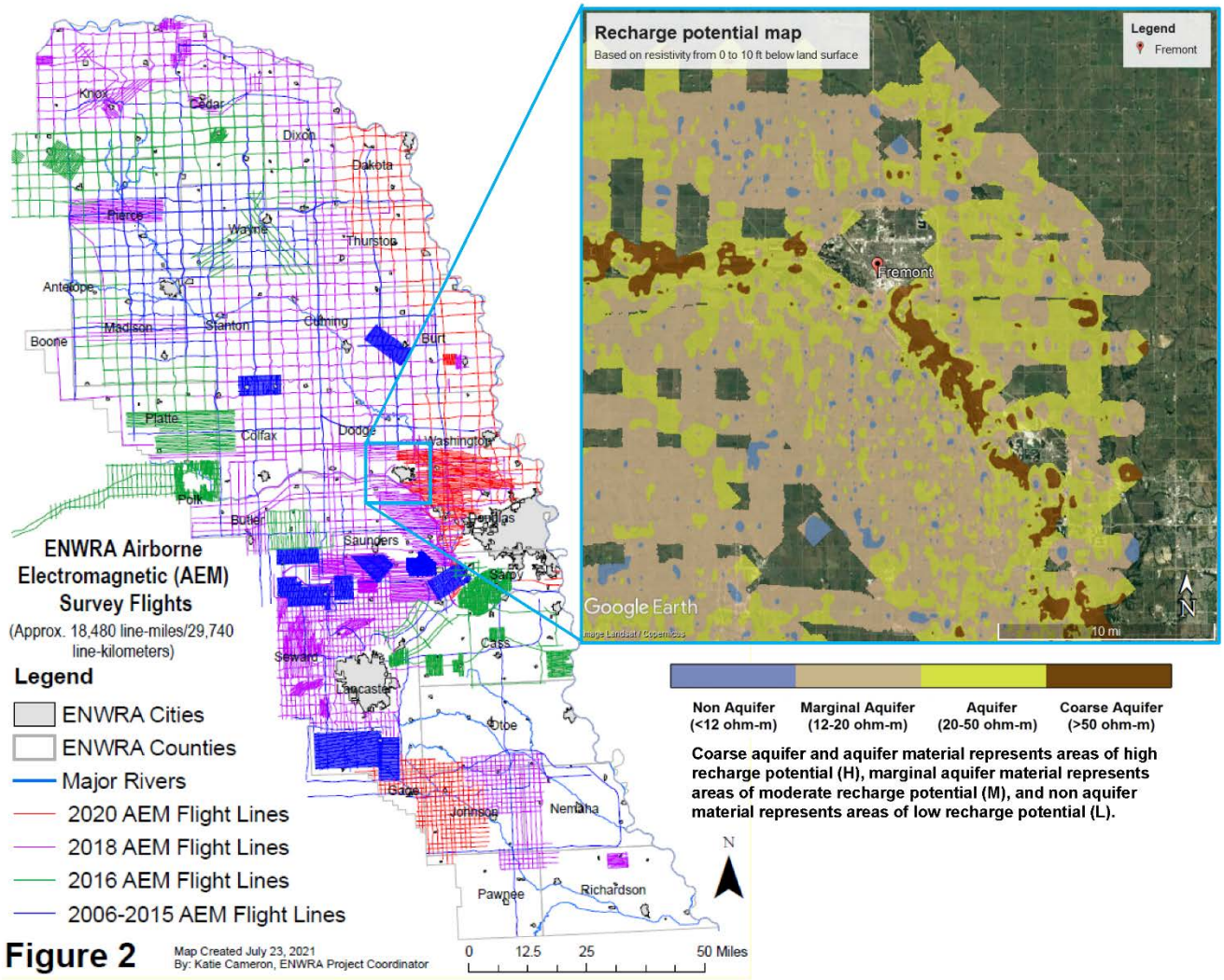
1.A.9 When applicable include the criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria (004.01 E 3).

If "NO", it is considered mostly non-structural, so answer the following:

1.B.1 Insert data necessary to establish technical feasibility (004.02);

The Eastern Nebraska Water Resources Assessment (ENWRA) started research activities in 2006 as a coalition of six Natural Resources Districts (NRDs) partnered with federal, state and local agencies and experts to develop a three-dimensional geologic framework and water budget for eastern Nebraska (https://enwra.org/media/enwra_overview.pdf). ENWRA and its partners recognized

recharge as a complex major component of the ultimate goal and recharge has been included as a specific study objective in ENWRA's Long Range Plan since 2010 (Table excerpt in Section B, #1.B.3). Between 2006 and 2020, the ENWRA NRDs also conducted various AEM surveys (please refer to https://enwra.org/ website for history of airborne applications and other technical links) with recharge .kmzs for use in Google Earth (Figure 2 example below).



This Project will employ a diverse team from ENWRA's Geological Survey advisory agencies familiar with eastern Nebraska and applying their technical backgrounds to groundwater management concerns such as: evaluation of drought mitigation actions;

potential re-evaluation of management area boundaries/rules; positioning new geologic test holes, network monitoring locations and/or screen intervals; evaluation of recharge areas; updates and/or refinements to areas of hydrologically connected groundwater and surface water; and groundwater modeling projects in progress/planned. Please refer to Section B, #1.B.3 for additional technical background regarding ENWRA's recharge assessment history.

This Project is the next step now that the AEM data coverage has afforded us a substantial framework to start, in coordination with our technical advisory agencies, to go beyond our pilot work as referenced in the Annual Report and Plan of Work for the State Water Planning and Review Process submitted to the Governor and Legislature dated September 2019 which indicated:

"The Department continued to assess potential advancements in the best available science and methods that could be incorporated into these modeling tools by supporting efforts of the Eastern Nebraska Water Resources Assessment (ENWRA) organization. To accomplish this, Department staff attended ENWRA meetings and workshops to stay up-to-date on study progress and developments, and technical expertise pertaining to ENWRA data. A portion of ENWRA's work involves utilization of airborne geophysical studies to assist in mapping of subsurface geology/hydrogeology in Eastern Nebraska. The Department's primary interest in this work is to increase understanding the effectiveness of airborne geophysical studies in assessing hydrologic connection of aquifers and streams through groundwater modeling tools."

1.B.2 Discuss the plan of development (004.02 A);

The Project is broken out into three primary phases to accomplish three outcomes: A) creating and improving maps of recharge potential, B) updating water-level maps for aquifers in eastern Nebraska, and C) examining available hydrogeologic data within the five Focus Areas and issue recommendations for future study. Prior to the start of Phase I, the team will conduct a project kick-off meeting to assign tasks, coordinate cooperative agreements, and review timelines for the Phased approach. Other potential parallel projects and/or recent developments relative to this grant scope and workplan with UNL-CSD, USGS and ENWRA will also be discussed and finalized (may include plans for targeted synaptic water level measurements, refined scopes from the team based on their area of research, or other coordinated actions).

Phase 1 will begin with AEM, water-quality, and water-level data compilation and review. An initial map of groundwater recharge potential (groundwater vulnerability) will be created. Groundwater-level mapping of aquifers in Eastern Nebraska will also be completed. Greater detail and contour density will be included for unconfined, alluvial aquifers within the ENWRA area. The updated water-level maps will be used to create refinements to the current recharge classifications by examining the minimum resistivity value and thickness of the unsaturated zone. The resulting map will be uploaded to the Nebraska GeoCloud (mapping and modeling conducted in accordance with the Guidelines and Standards accessible online at: https://snr.unl.edu/csd/geology/nebraskageocloud.aspx). Available water-quality data

(USGS and Agrichemical Clearinghouse), vadose zone data (Nebraska Vadose Zone network) and water-level data (UNL-CSD and prior ENWRA vadose/episodic recharge work) will be grouped within the High, Moderate, and Low (H, M, L) recharge areas, by aquifer, or land use. Statistical tests will be performed to determine if significant differences exist between the sample groups for a variety of constituents, including nitrate, pesticides, or trace elements like arsenic or manganese. The reinterpretation of historical water-quality, vadose zone, and water-level data conjunctively will allow an assessment of the effectiveness H, M, L recharge area map to assess groundwater vulnerability.

Phase II will interpret the results of statistical tests to determine the efficacy of using AEM geophysical data to determine groundwater recharge potential and vulnerability and a final map will be produced. Phase II of the Project will look at the H, M, and L recharge classifications and focus on five specific areas in the ENWRA area, crossing NRD boundaries, where project sponsors need additional information to guide groundwater management decisions. The water-level maps from Phase I will be re-evaluated and altered to reflect the degree of confinement, potential perched conditions, and areas of little/no saturated thickness in the Focus Areas. Phase II will also assess the water quality evaluation and potential vertical and horizontal boundaries of the aquifer units below the H, M, L recharge areas. At the end of Phase II, the team will review the results of specific NRD geological model, groundwater model and/or vadose zone assessment projects that may be completed or in progress in the ENWRA area. Evaluation discussions and recommendations for each Focus Area will be tailored to meet specific management needs.

Phase III will include writing up results of statistical analyses. The written report will also include description of water resource issues, available data, and recommendations and a future workplan for Focus Areas. Proposed project products include a USGS Scientific Investigations report summarizing the revised maps of groundwater recharge potential and vulnerability, statistical analyses to assess the efficacy of AEM to map groundwater recharge potential, and description and plan of study for Focus Areas. Supporting data sets, such as maps of recharge areas (H M L maps) will be available as a citable USGS data release and will be made available on the Nebraska GeoCloud. Water-level maps will made available as a citable UNL-CSD publication, in an online digital interactive format and as downloadable GIS files. All products will be served online to ensure broad dissemination with water-resource managers, scientists, and consultants. Phase III of the Project will also include development of a work plan to address potential water level, water quality and/or further refinement data gaps based on the regional management concerns.

Based on the wholistic regional picture from Phase I through Phase III activities, the Project will have made huge strides toward ENWRA's recharge and groundwater/surface water interaction Long Range Plan objectives and goals mentioned in NeDNR's annual report and Plan of Work for the State Water Planning and Review Process (Section B, #1.B.1 above). The vadose mapping and evaluation Project would provide eastern Nebraska water resource managers, scientists, regulators, and the public valuable GIS/Geological Survey layers for use in their water related projects/interest areas as well

as road map for several specific Focus Areas in eastern Nebraska regarding recharge and groundwater sustainability.

1.B.3 Describe field or research investigations utilized to substantiate the project conception (004.02 B);

Between 2006 and 2020, the ENWRA NRDs conducted various AEM surveys (please refer to https://enwra.org/ website for history of airborne applications and results and links in the news column for the Nebraska GeoCloud [WSF #4164]). AEM has been proven over the past 15 years and Nebraska has become one of the international leaders in coordinated use of AEM for groundwater management purposes with over 25,000 line-miles flown in approximately 15 of Nebraska 23 NRDs (AEM-related WSF awards to NRDs: #4132, #4133, #4140, #4141, #4142, #4143, #4144, #4164, #5189, #5193, #5206, #5238, #5243, #5249, #5255, #5303). Areas of high, moderate, and low recharge have been delineated for parts of the ENWRA area using the shallow resistivity data from AEM flights (2013, 2016, 2018 and 2020 AEM flight report Google Earth .kmz data shown in Figure 2 Section B, #1.B.1– Note: 2014 AEM data and 2006 to 2009 AEM data were not delivered with recharge .kmz files representing the top layers).

High recharge areas are typically underlain by coarse sediments with relatively thin unsaturated zones where water moves quickly from land surface to the water table. Shallow coarse sediments show up readily in the AEM results with high apparent resistivity values and contrast strongly with clay dominant fine grain sediments with low resistivity values. However, the recharge products generated for the AEM survey deliverables, much like the Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA) Hydric Soils Map representing the top 60 inches of soil across the region Figure 3:

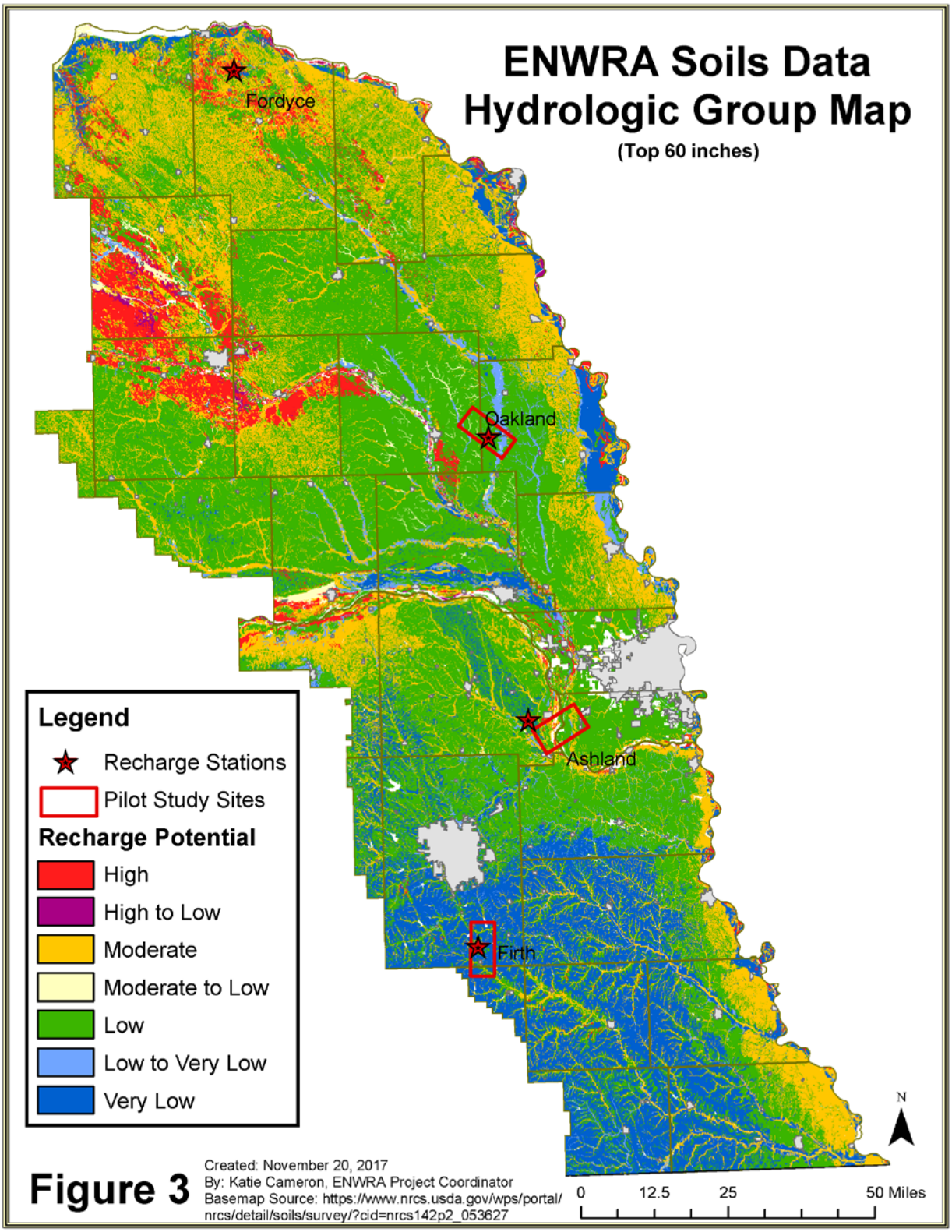

ENWRA Soils Data
Hydrologic Group Map
(Top 60 inches)
Fordyce
Oakland
Ashland
Firth
Legend
Recharge Stations
Pilot Study Sites
Recharge Potential
High
High to Low
Moderate
Moderate to Low
Low
Low to Very Low
Very Low
N
0
12.5
25
50 Miles
Created: November 20, 2017
By: Katie Cameron, ENWRA Project Coordinator
Basemap Source: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627

Figure 3

require additional data below those top layers to fill in additional vadose information above the water table to demonstrate a more complete understanding of recharge to multiple aquifers, particularly in the upland areas.

As mentioned previously, ENWRA started research activities in 2006 with three pilot study sites: Oakland, Ashland and Firth employing a variety of hydrogeologic assessment tools specific to the complex assemblage of glaciated sediments present in eastern Nebraska. ENWRA and its partners recognized recharge as a complex major component of the water budget, the development of which is our over-arching goal for eastern Nebraska. Recharge has been included as a specific study objective in its Long Range Plan since 2010 (#3 in Table Excerpt below).

Objective/Project		Management Concern	Sponsor	Area (mi^2 / line km)	Potential Funding Sources	Fiscal Years	Estimated Cost*	Notes
3. Estimate Recharge Areas and Rates								
A.	**Map recharge areas**	recharge/ sustainability/ quality	all 6 NRDs	--	ENWRA Dues/NRDs/ NET/WSF/USGS	2021-2031	--	evaluate AEM and existing data (potential UNL vadose, NGC, USGS, CSD, DNR collaborations) to identify recharge areas and target study areas
B.	**Maintain and add/re-evaluate vadose zone stations & recharge projects**	recharge/ sustainability	all 6 NRDs	--	ENWRA Dues/USGS/ NET/WSF	2021-2031	$400,000	assume 10 stations at $40,000 per station, requires Technical Advisor to direct and evaluate
4. Assess Potential Connections Between Groundwater & Surface Water								
A.	**Continue to evaluate HCAs and unidentified HCAs**	interrelated water	all 6 NRDs	--	USFWS/ENWRA Dues/WSF/CSD/ NET/county/NRDs	2021-2031	--	update CSD datasets; work with DNR to get Lower Platte Missouri River Tribs model (LPMT) updated with AEM and NGC frameworks
B.	**Map saline groundwater**	interrelated water, quality	LPS/LPN	--	NRDs/ENWRA Dues/NET/ WSF/USFWS	2021-2031	--	map salt spring & stream reaches and salt/fresh (Maha) boundary in Dakota formation using variety of methods
C.	**Review/incorporate ongoing work in alluvial aquifers**	interrelated water	all 6 NRDs	--	ENWRA Dues/NET/ WSF/NRDs	2021-2031	--	identify gaining/losing reaches, streambed characteristics, potential cross aquifer connections

In 2008 through 2013, ENWRA installed vadose zone monitoring sites and collected data to estimate recharge at the profile, aquifer, and regional scales (Gates and others, 2014 - refer to ENWRA Recharge Studies under the media and downloads tab of the ENWRA website: https://enwra.org/downloads.html#Recharge). Regional recharge estimates were 30% greater than upscaled profile and aquifer estimates, suggesting that the more locally-based estimates, sensitive mainly to diffuse flow, failed to detect certain recharge components, such as focused (ditches, low-lying ground slopes) or episodic recharge. While the recharge study greatly improved the understanding of aquifer recharge in eastern Nebraska, its interpretations relate primarily to the station locations and to some but not all of the locally-active recharge pathways, indicating potentially 40% of the picture was missing for regional water balance approaches.

In 2017, ENWRA teamed with the USGS to review the recharge station data and evaluate the Episodic Master Recession (EMR) method (Nimmo and others, 2015, https://wwwrcamnl.wr.usgs.gov/uzf/EMR_Method/EMR.method.html) which provides recharge estimates based on water level data and precipitation events. Shallow aquifers act as natural collectors that respond to both the matrix and preferential flow components of recharge. The EMR method is sensitive to the larger preferential flows that the profile-scale recharge estimates may have missed. USGS evaluated readily available transducer water level data in 2017 to find data from wells unaffected by pumping or surface water and wells that responded to individual precipitation events or showed a seasonal climatic response for use in running the EMR method. The resulting EMR evaluations indicated 11 wells that met those stringent criteria and provided reliable

estimates of annual groundwater recharge rates. These estimates, which can serve as calibration points represented recharge rates at 11 locations across the region. Some locations had higher rates than those reported for the recharge station heat dissipation probes, accounting for some of that missing recharge input to the water budget.

The profile scale data, the episodic recharge data and the near surface AEM resistivity data have gotten us technically speaking to this next step of attacking this difficult recharge question: where in the region are the high recharge areas, moderate recharge areas and low recharge areas that are critical for groundwater management and how can we get that translated appropriately to input parameters for groundwater/surface water/recharge modeling.

1.B.4 Describe any necessary water and/or land rights (004.02 C). NA

1.B.5 Discuss the anticipated effects, if any, of the project upon the development and/or operation of existing or envisioned structural measures including a brief description of any such measure (004.02 D).

Although updated maps of recharge potential and water levels will not be created specifically for this purpose, they will provide water managers, consultants, and engineers with possible areas for intentional recharge projects. Areas identified as being high recharge are underlain by coarse sediments where excess surface water or runoff could be stored to allow for infiltration to the aquifer.

Prove Economic Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 005)

2. Provide evidence that there are no known means of accomplishing the same purpose or purposes more economically, by describing the next best alternative.

The closest alternative to the Project scope would be installing individual equipment stations with sufficient regional spacing and ancillary monitoring sensors at multiple depths (heat dissipation probes or similar equipment). The cost for installing 10 recharge stations similar to the previous stations installed at ENWRA pilot sites would be $400,000 (approximately $40,000 per station). This cost alternative does not include the monitoring points/wells needed for the surrounding area water level measuring, nor is 10 station locations enough (installing 2 at each Focus Area identified for this Project would still be excluding the remaining areas this grant scope is addressing with Phase I using the AEM data). Even if you could locate and install instruments at every representative recharge area setting, including the hard to pinpoint preferential flow paths, 10 would not be enough to cover the region. Recharge and surface water/groundwater interaction objective excerpts from ENWRA's Long Range Plan Appendix B Project Matrix Table ($40,000/station has been estimated in the Matrix Table since 2010 – refer to the Table insert in Section B, #1.B.3 above and #3C below).

One major part of this Project involves updating the 1995 statewide water-level map and by providing updated water-level maps for major aquifers across the state. The 1995 water table contours have been widely used in AEM reports and other aquifer volume calculations and 3D models as the best regional information available. However, problems are known regarding the relationship between the depth to water in wells and the true water table, and what the potentiometric surface contouring represents when not using discrete aquifer measuring points, especially in eastern Nebraska. The AEM fills in the framework between borehole information but adequate measuring points (GIS located/quality assured) in the correct units are still required to get a complete picture of recharge. An alternative to the water level evaluation and contouring approach proposed in this Study, would be locating, obtaining permission for, and measuring thousands of wells all within a few weeks across the region, processing the data and then trying to make sense of the resulting contours. A serious drawback to this method is the assumption that all wells are screened in a single homogeneous aquifer. In reality, many wells are screened in different aquifer units, varying stratigraphy with complex flow paths. This mass measurement approach would entail coordination of multiple agencies with more complicated time-consuming data processing and contouring costing more than this effort: $95,000 = $35,000 (1,200 wells, an hour of time plus 10 miles per well) + $60,000 (processing and mapping [75% of FTE]). All three stages of this Project will help target current and future monitoring (inform annual spring and fall measuring plans and refined reporting to constituents).

3. Document all sources and report all **costs** and **benefit data** using current data, (commodity prices, recreation benefit prices, and wildlife prices as prescribed by the Director) using both dollar values and other units of measurement when appropriate (environmental, social, cultural, data improvement, etc.). The period of analysis for economic feasibility studies is the project life, up to fifty (50) years; *or*, with prior approval of the Director up to one hundred (100) years, (Title 261, CH 2 - 005).

The total cost of the Project is $314,000 (including $74,000 federal cooperative dollars) and involves desktop work and coordination with NRDs that will benefit/improve water sustainability datasets for eastern Nebraska through recharge study. When considering the costs of flooding (March 2019 event was estimated over 1 billion dollars) and drought (estimated 250 million dollars) to every sector, study of the potential flow paths and rates of infiltration from the land surface to the groundwater that could potentially improve future losses through proper management strategies, would be worth even a fraction of a percent for eastern Nebraska. Since the definition/determination of recharge is one of the main objectives of ENWRA toward a water budget of all eastern Nebraska, this Study will hopefully be a more regional foundation of understanding for years to come similar to the pilot study station work revealed the missing percent when evaluated with other studies. Drought conditions affected approximately 80 percent of U.S. agricultural land in the summer of 2012. Export corn prices rose 32.5 percent from June to August 2012 as drought conditions worsened. This rise coincided with a 13-percent decrease in corn supplies from the previous year, and beginning stocks following the 2011 season were already low. The export corn price index finished the third quarter of 2012 with a 29.8-

percent gain. That was the largest quarterly rise in the index since a 30.5-percent advance during the first quarter of 2008.

Droughts in the United States are not unprecedented. Most recently, the nation experienced droughts in 1988, 1995 and 2012. The 1988 drought resulted in a 30-percent drop in corn production that year, and export corn prices surged 31.4 percent in the third quarter. With relatively small beginning corn stocks leading into the 1995 drought, export corn prices rose 45.2 percent overall for the year.

The above drought data are from the BLS International Price program. To learn more, see "Impact of the drought on corn exports: paying the price" (https://www.bls.gov/opub/btn/volume-1/pdf/impact-of-the-drought-on-corn-exports-paying-the-price.pdf), by Will Adonizio, Nancy Kook, and Sharon Royales in Beyond the Numbers, volume 1, number 17, November 2012.

3.A Describe any relevant cost information including, but not limited to the engineering and inspection costs, capital construction costs, annual operation and maintenance costs, and replacement costs. Cost information shall also include the estimated construction period as well as the estimated project life (005.01).

The cost of the Project is $314,000 (including $74,000 federal cooperative dollars) and involves desktop work and coordination with NRDs that will benefit/improve water sustainability datasets for eastern Nebraska through recharge study. The Project does not include construction activities or construction-related costs.

3.B Only primary tangible benefits may be counted in providing the monetary benefit information and shall be displayed by year for the project life. In a multi-purpose project, estimate benefits for each purpose, by year, for the life of the project. Describe intangible or secondary benefits (if any) separately. In a case where there is no generally accepted method for calculation of primary tangible benefits describe how the project will increase water sustainability, in a way that justifies economic feasibility of the project such that the finding can be approved by the Director and the Commission (005.02).

The Project costs are for hydrogeologic data collection, processing, presenting (H M L mapping) and recommendations for specific Focus Areas (see cost/benefit table of this Section, Section B #3.C).

3.C Present all cost and benefit data in a table to indicate the annual cash flow for the life of the project (005.03).

Cost Activity	Y1 Phase I	Y2 Phase II	Y3 Phase III	Cost TOTAL	Benefits -
WSF Grant	$73,800	$50,400	$19,800	**$144,000**	potential cost installing 10 recharge stations at $40,000 per station) $400,000
Local Match	$49,200	$33,600	$13,200	**$96,000**	
State/Local Project total	$123,000	$84,000	$33,000	**$240,000**	
USGS (Federal In-kind Dollars)	$40,000	$29,000	$5,000	**$74,000**	
TOTALS	**$163,000**	**$113,000**	**$38,000**	**$314,000**	**>$400,000***

Note: Installing two stations at each Focus Area identified for this Project would still be excluding the remaining areas this grant scope is addressing with Phase I using the AEM data and would not be enough

3.D In the case of projects for which there is no generally accepted method for calculation of primary tangible benefits and if the project will increase water sustainability, demonstrate the economic feasibility of such proposal by such method as the Director and the Commission deem appropriate (005.04). (For example, show costs of and describe the next best alternative.)

The Project could also assist each NRD on making decisions that limit future water allocations or identify areas better suited for managed aquifer recharge, thus safeguarding the use of groundwater for irrigation and supporting the agricultural economy of Nebraska. This Project takes full advantage of the millions of dollars invested into AEM data, test holes, and monitoring wells by the six NRDs, NRC, and NeDNR.

Prove Financial Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 006)

4. Provide evidence that sufficient funds are available to complete the proposal.

The local board of directors for LPSNRD has approved allocation of the necessary funds on behalf of ENWRA per their local governmental process. Fiscal Year 2022 Long Range Implementation Plan (LRIP) Draft #2 Budget detail for ENWRA dated July 14, 2021:

SUBCOMMITTEE: Water Resources
PROGRAM AREA: Eastern Nebraska Water Resources Assessment (ENWRA)
VISIONS: A

FISCAL YEAR 2022

ACTIONS	DRAFT BUDGET EXPENDITURE	DRAFT BUDGET OTHER FUNDS	FINAL BUDGET EXPENDITURE	FINAL BUDGET OTHER FUNDS	BUDGET CODE EXPENDITURE	BUDGET CODE OTHER FUNDS
Eastern Nebraska Water Resources Assessment (ENWRA) ENWRA Financial Management figures below include LPSNRD $30,000 in annual dues to ENWRA account and the $3,400 in LPSNRD dues to the Nebraska GeoCloud. ^ - funded by ENWRA by or paid out of reserve funds.						
Studies						
• Continue ENWRA weather station contract with UNL Nebraska State Climate Office (NSCO) for Oakland, Fordyce and Firth stations	$7,800	$7,800			419185	302705
• Continue routine annual groundwater sampling for pilot study sites: Ashland, Oakland and Firth	$9,000	$9,000			419185	302705
• 5 additional nitrate samples to confirm sentinel monitoring equipment	$130	$130			419185	302705
• Select expanded list of non-routine metals at select wells based on FY21 evaluation - additions to the routine testing list for pilot sites	^$4,500	^$4,500			419185	302705
• Continue routine transducer / monitoring well / recharge station maintenance and / or equipment replacements	$15,000	$15,000			419185	302705
• Continue ENWRA test hole installation in locations where Airborne Electromagnetic (AEM) survey data indicates the lithology needs to be resolved and/or use for other hydrogeologic assessment related costs (3 NRDs in FY21 @ $9,150 each -PMRNRD, LCNRD & LPSNRD)	$27,450	$27,450			419185	302705
• ENWRA Grant Project Submittal of recharge and/or AEM related grant application(s) for ENWRA objectives for potential award in FY22 and starting expenses in FY22 (potential WSF 60% reimbursement and 40% from ENWRA banked funds.)	$240,000	$144,000 ^$96,000			419186	302701 302705
• 3D Projects and Partnerships Contracts and/or agreements (with or without grant funds) supporting regional 3D projects (quantity, quality, water budget, aquifer boundary delineations, support of partner entity geological mapping and/or GIS product buildouts)	$100,000	$50,000 ^$50,000			419185	302701 302705
Data Management						
• Continue Nebraska GeoCloud (NGC) Project Continue the data management / collaboration efforts for AEM data integration in cooperation with USGS and UNL Conservation and Survey Division (CSD). Provide coordination for LPSNRD (contract and finance representative for 10 NRDs under NGC) year 2 of 2.	$53,612	$24,413 $29,199			419185	302705 302705

Water Resources - Eastern Nebraska Water Resources Assessment (ENWRA)

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace).

Page 1 of Draft #2 July 14, 2021 of the Fiscal Year 2022 LRIP Budget for ENWRA displays the ENWRA account has over $350,000, enough to cover the Project costs:

ANTICIPATED REVENUES		
	FY 2021	FY 2022
Cash and Investments (LPSNRD)	9,677,966	10,399,289
Cash and Investments (LPRCA)	531,360	533,635
Cash and Investments (ENWRA)	352,964	352,392
Deadmans Run Sinking Fund	4,989,977	5,095,607
Infrastructure Sinking Fund	195,267	323,251
Mopac East Trail Sinking Fund	208,109	258,202
County Treasurers' Balance	125,000	125,000
Investment Income	60,000	20,000
Federal Funds	3,706,280	3,392,265
State Funds	1,086,968	1,045,520
Local Funds	2,507,771	2,196,666
Miscellaneous	0	0
(County Treasurers' Commission)	(100,000)	(100,000)
Total	23,341,662	23,641,827
NRD Property Taxes	10,156,870	10,156,870
	33,498,532	33,798,697

Additional to the ENWRA bank account, ENWRA's interlocal agreement (Amendment #5 in Attachment A) outlines annual dues totaling $147,000 from the 6 ENWRA NRDs.

6. If a loan is involved, provide sufficient documentation to prove that the loan can be repaid during the repayment life of the proposal. NA

7. Describe how the plan of development minimizes impacts on the natural environment (i.e. timing vs nesting/migration, etc.). NA. There is no construction associated with proposed Project.

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds.

The NRDs have the authority under the Nebraska Groundwater Management and Protection Act, Chapter 46 Article 7 regarding groundwater to enter into contracts or agreements, budget and expend levied property taxes, own and operate property and equipment, and conduct investigations relative to the protection and management of groundwater. Nebraska State Statute Chapter 2 Article 32 gives the NRDs authority to carry out projects related to the development, management, utilization and conservation of groundwater and surface water. The NRD staff members have local knowledge of the

area and groundwater resources. The ENWRA staff and technical advisors/partner agencies (USGS, UNL-CSD, NeDNR) have the expertise and/or regulatory background in hydrogeology and the Project aligns with their core missions.

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state.

All NRDs are statutorily required to have a completed Groundwater Management Plan (GMP) which includes information about the aquifers of the NRD, supplemental supplies, integrated and coordinated use, and the boundaries of management areas. Each of the ENWRA NRDs has an adopted GMP and results of this Project specifically meet the objectives of the GMPs to increase the NRDs' general knowledge of the hydrogeologic characteristics of their Districts, and to preserve and conserve groundwater quality and quality.

Each of the ENWRA NRDs has an Integrated Management Plan (IMP) in place, or has initiated one. Several of the ENWRA NRDs are also participating in the Lower Platte River Basin Management Plan (LPRB Plan). Additional recharge maps, UNL-CSD datasets and recommendations for the Focus Areas will provide valuable information as those individual plans continue to be implemented (please refer to detailed breakdown of Plan goals the Study supports and/or satisfies in Section C, question #2).

Additional to the formal state Plans with the NeDNR, WSF Projects #5243 and #5303 (LENRD and LPNNRD/P-MRNRD modeling efforts) are designed to improve upon the geologic representation of data within the Lower Platte Missouri Tributaries model, so they can be used for a future 5-year comprehensive plan review. The current anticipated timeline for these projects should coincide with the Phase I activities potentially benefiting both Project efforts. The Focus Area efforts for this Project will also assist and bolster USGS Nebraska Water Science Center goals:

- Provide timely and relevant science to local water resource managers
- Apply novel approaches and methods to assess groundwater vulnerability and groundwater recharge potential
- Collaborate with NRDs to develop recommendations and work plans to solve local water resource issues within Focus Areas.

And UNL-CSD service area goals and efforts:

- aquifer boundary mapping and county atlas efforts (example: northeast Nebraska work in the LCNRD and LENRD)
- updating the aquifer extent maps for select regions of eastern Nebraska to reflect the reviewed and cataloged information for this Study
- Provide further refinements to UNL-CSD regional elevation of groundwater-level maps
- USGS and UNL-CSD WSF award (#4164) goals to populate the Nebraska GeoCloud
- evaluate Nebraska Department of Environment and Energy (NDEE) defined boundaries for several WHPAs in the Focus Areas (example: Logan East Rural Water)

10. Are land rights necessary to complete your project? YES☐ NO☒

If yes:

10.A Provide a complete listing of all lands involved in the project.

10.B Attach proof of ownership for each easements, rights-of-way and fee title currently held.

10.C Provide assurance that you can hold or can acquire title to all lands not currently held.

11. Identify how you possess all necessary authority to undertake or participate in the project.

The participating NRDs have the authority under Nebraska State Statute Chapter 2 Article 32 to carry out this Project under its authorized purposes relating to the development, management, utilization, and conservation of groundwater and surface water. This includes the NRDs' authorities (furthered under the Nebraska Groundwater Management and Protection Act Chapter 46 Article 7 regarding groundwater) to enter into contracts or agreements, budget and expend levied property taxes, own and operate property and equipment, and conduct investigations relative to the protection and management of groundwater. ENWRA is the lead agency for this proposed Project, a coalition of 6 Eastern Nebraska NRDs with LPSNRD designated as the financial and grant handling agency.

12. Identify the probable consequences (environmental and ecological) that may result if the project is or is not completed.

The Project will assist NRD water managers in addressing issues within focused areas including identifying areas with high recharge and are vulnerable to groundwater contamination and improved water-level maps will help assess the amount of water in storage for paleovalley aquifers. Phases II and III will begin to develop work plans to address specific issues within Focus Areas where there are known issues with water quantity and water quality. If this Project is not completed, area water managers will not be able to utilize AEM data to the fullest potential. Assessing groundwater recharge potential and groundwater vulnerability will assist groundwater managers in understanding current groundwater conditions and inform future groundwater management decisions such as future water allocations or with nitrate management plans. Within the ENWRA area many of the area NRDs still utilize the 1995 UNL-CSD water-level map for water resource decisions. In some locations, such as the LCNRD for example, the 1995 is out of date and inaccurate for some of the aquifers they manage. In the 26 years since the 1995 water-level contour map was created, water levels have change significantly in some locations. Furthermore, since the introduction of GPS technology, well locations can be located with a greater level of precision, allowing the data to be used with modern large-scale map layers to address local conditions. Through numerous studies in eastern

Nebraska, we have also realized that aquifers are complicated, and regional geology can have a profound impact on depth to water values. Continued reliance on this basic data set may result in poor estimates of groundwater in storage, groundwater flow directions, and degree of confinement for a given area. Focus Areas describe hydrologic conditions, assemble existing data, and outline course of for future study. Many of the Focus Areas (table Section A, #6) are examining the feasibility of future water management actions, such increase capacity of a rural water system, or a streamflow augmentation project. These types of actions would require a significant investment of tax dollars on already financially stressed local economies. If future investment in water infrastructure is completed without the best available science, the result could potentially lead to significant inaccuracies, be very costly to the local taxpayer and fail to solve the underlying problem.

Section C.

NRC SCORING

In the NRC's scoring process, points will be given to each project in ranking the projects, with the total number of points determining the final project ranking list.

The following 15 criteria constitute the items for which points will be assigned. Point assignments will be 0, 2, 4, or 6 for items 1 through 8; and 0, 1, 2, or 3 for items 9 through 15. Two additional points will be awarded to projects which address issues determined by the NRC to be the result of a federal mandate.

Notes:

- The responses to one criterion ***will not*** be considered in the scoring of other criteria. Repeat references as needed to support documentation in each criterion as appropriate. The 15 categories are specified by statute and will be used to create scoring matrixes which will ultimately determine which projects receive funding.

- There is a total of 69 possible points, plus two bonus points. The potential number of points awarded for each criteria are noted above. Once points are assigned, they will be added to determine a final score. The scores will determine ranking.

- The Commission recommends providing the requested information and the requests are not intended to limit the information an applicant may provide. An applicant should include additional information that is believed will assist the Commission in understanding a proposal so that it can be awarded the points to which it is entitled.

Complete any of the following (15) criteria which apply to your project. Your response will be reviewed and scored by the NRC. Place an N/A (not applicable) in any that do not apply, an N/A will automatically be placed in any response fields left blank.

1. Remediates or mitigates threats to drinking water;

    - Describe the specific threats to drinking water the project will address.
    - Identify whose drinking water, how many people are affected, how will project remediate or mitigate.
    - Provide a history of issues and tried solutions.
    - Provide detail regarding long-range impacts if issues are not resolved.

This Project addresses threats to domestic and municipal drinking water supplies in Well-Head Protection Areas (WHPAs) within the ENWRA area. WHPAs are designed to mitigate threats to municipal water supplies, but often the hydrogeology of these areas is

not well-defined due to sparse data. By the end of 2020, AEM surveys will have been flown over many of the WHPAs throughout eastern Nebraska. Recharge potential maps, which differentiate the surficial sediments based on their resistivity have been created for these surveys. The maps can be interpreted in the context of groundwater vulnerability because surficial sediments with increased clay content restrict the downward movement of water to the drinking water aquifer. The Project will benefit wellhead protection planning and action efforts for over 150 WHPAs, including those serving 7 of Nebraska's top 10 most populous cities: Omaha, Lincoln, Bellevue, Norfolk, and Columbus, totaling nearly 900,000 people, or ~50% of the population of the State. This Project provides direct and indirect benefits to those remediation efforts by supplying data and methods to map the recharge potential over various spatial scales and provide critical information about vulnerability of groundwater resources and drinking water supplies. WHPAs are typically characterized with soil maps, soil coring, and vadose zone sampling for specific contaminants such as nitrate. These data sets are valuable for a first level assessment for evaluating possible groundwater quality threats near a municipal well supply, but are not continuous, and may lack the detail needed in complex glacial settings. This Project will also create new water-level maps for much of the ENWRA area with the most recent data. The most recent water-level maps available are from the UNL-CSD 1995 statewide map, which in many areas is out of date and inadequate for resource management planning. Updated water-level maps will help determine groundwater flow directions at the WHPAs and identify possible upgradient sources of contamination.

2. Meets the goals and objectives of an approved integrated management plan or ground water management plan;

    - Identify the specific plan that is being referenced including date, who issued it and whether it is an IMP or GW management plan.
    - Provide the history of work completed to achieve the goals of this plan.
    - List which goals and objectives of the management plan the project provides benefits for and how the project provides those benefits.

The **LCNRD** Groundwater Management Plan (GMP) was adopted in 1986. The plan was amended in 1995 to address water-quality concerns and an attachment was added in 2014 detailing water-quantity concerns with six designated sub-areas that are considered geologically/hydrogeologically different. The six designated sub-areas are: Niobrara Chalk Bedrock Reservoir, Dakota Sandstone Bedrock Reservoir, Area of Limited Aquifer Development Potential, Remaining Areas, Missouri River Groundwater Reservoir, and Community Water System Project Areas. The sub-areas necessitate different methods of management and permitting to effectively monitor and manage them. On September 5, 2016, the LCNRD finalized a Voluntary IMP with the NeDNR (https://lcnrd.nebraska.gov/sites/lcnrd.nebraska.gov/files/doc/water-resources/20160808_IMPfinal.pdf). The LCNRD has a monitoring well network of approximately 60 monitoring wells designed by UNL-CSD as part of the GMP activities and IMP Goal #1 to develop and maintain a district-wide water inventory. A biennial

review of the IMP was last conducted by LCNRD and NeDNR in October 2019 https://lcnrd.nebraska.gov/sites/lcnrd.nebraska.gov/files/doc/water-resources/2019%20LCNRD%20FINAL%20IMP%20REPORT%20LCNRD.pdf. The review indicates "In the future AEM survey data could be utilized to identify areas of potential hydrogeologic connectivity and to identify where aquifer recharge occurs." This Project will provide both the LCNRD and NeDNR identification of H M L recharge areas using statistical analysis on the AEM data together with groundwater quality data. The Project will also map water level contours for alluvial and Dakota Bedrock aquifers for use with the LCNRD sub-areas. This Project also addresses four of the jointly identified action items for the next two years which the Project directly benefits:

- continue working with ENWRA and to define the hydrogeologic framework in eastern Nebraska
- continue working with UNL-CSD to investigate groundwater resources and hydrogeologic connection in the district.
- Continue to utilize AEM surveys to evaluate the geology and geologic framework of the district to benefit knowledge and management of ground and surface water resources of the district.
- Identify with directors, staff, and/or stakeholders the need for additional projects and/or studies.

The Project is being coordinated through ENWRA with part of the scope dedicated to the recommendations for groundwater quantity and quality management for the Dolphin Focus Area in Knox County as well as digitizing data, water table contouring and further AEM evaluation in the LCNRD. The AEM survey and groundwater quality data will be evaluated by the USGS and UNL-CSD specific to recharge in the H M L map products.

The LCNRD also has a Water Quality Management Plan (WQMP) accepted by the EPA October 2019 (https://lcnrd.nebraska.gov/sites/lcnrd.nebraska.gov/files/doc/LCNRD%20WQMP%20FINAL.pdf). The WQMP Monitoring and Evaluation Section 4.3 identifies data needs and uses addressing data gaps in water quality data, in terms of spatial coverage and tested parameters to allow resource managers to utilize current monitoring efforts to meet the intended use of the data. One of the primary purposes of the WQMP this Project study benefits:

4) Maintain long term data sets for trend assessments. An evaluation of multi-year water quality data sets allows the identification of emerging resource concerns, provides a basis for assessing basin-wide improvements or declines, and is a method to evaluate the impact of implementation strategies

The WQMP acknowledges that current monitoring networks may not provide enough information to evaluate, screen, prioritize and design future implementation strategies. In other cases, current data sets may not be sufficient to evaluate the effectiveness of conservation practices that have already been implemented in the WQMP Area. The required data for these needs can be gathered through larger-scale, ongoing monitoring

networks and targeted, project-specific monitoring which directly aligns with the outcomes of this Project.

The **LENRD** has an adopted GMP, last revised in 2018. Results of this Project increase general knowledge of the hydrogeologic characteristics in LENRD and assist LENRD to meet the following objectives in the GMP:

- Establish a baseline of data and monitor trends in groundwater quality and quantity
- Improve groundwater conservation practices
- Maintain and improve groundwater quality
- Cooperate with other agencies and organizations to develop and provide educational materials and programs to promote public support for and participation in management of groundwater resources
- Minimize pumping conflicts
- Protect municipal and domestic groundwater supplies
- Obtain Funding for Groundwater Management Activities

This Project also aligns with the goals and priorities of the LENRD Voluntary IMP and the Lower Platte River Basin Management Plan (LPRB Plan) finalized in 2018:

Goal 1 of the LENRD Voluntary IMP
Gain a Better Understanding of Water Resources. The plan states: "The purpose of this goal is to continually improve our understanding of the local and regional water resources system, using the best available science and data as a guiding principle. The District and Department will collect and analyze information including water use, land use, surface water flow, groundwater elevation, hydrogeologic data, and other information relevant to water resources management to enhance our understanding of water supply and use in the District and region."

Goal 1 of the LPRB Plan:
Develop and maintain a water supply and use inventory based on the best available data and analysis. Objective 1.1: Develop and maintain a comprehensive inventory of the location and source of the Basin's current and future water supplies, water uses and outflows.

This Project employs the two advisory agencies of ENWRA, the UNL-CSD and USGS, to look at the AEM data with groundwater level and quality data to generate a H M L map of recharge for the region and management recommendations for Focus Areas in Burt and Dodge Counties in the LENRD fitting with goal #1 of the IMP and LPRB Plan. Additionally LENRD also has a Drought Mitigation Plan (https://static1.squarespace.com/static/54be71a0e4b096702d519464/t/586fc48f6a496365d57d2c9a/1483719880310/LENRD+Drought+Management+Plan+Draft+12_21.pdf) which according to LENRD staff, has antiquated groundwater level triggers that need refining to minimize the impacts of in-season groundwater level declines. This Project will benefit that deficiency by providing additional data collected by UNL-CSD and USGS related to groundwater management and recommendations for scenarios of when specific

actions should be taken will be addressed for the Focus Areas in Burt and Dodge Counties.

The LENRD also has a Quality Management Plan (QMP) in place (EPA Accepted 3-11-2019) that the Project supports:

Goal 1, Objective 1 of the QMP:
Sound data and effective resource management will guide all decision-making about natural resources management activities. Task 1. To review and revise, as necessary, monitoring, assessment methods, and protocols to ensure that threats and impairments to natural resources are precisely measured and quantified.

The LENRD continues to devote resources towards the development of a Hydrogeologic Groundwater Model that will assist the LENRD in evaluating the impacts of new uses of groundwater. This effort is scheduled to be completed in 2021, and the availability of this new tool will allow the LENRD to capitalize on the wealth of geologic information that has been acquired in stages. The LENRD has also initiated the formal process of a proposed groundwater management area in portions of Cuming, Colfax, and Dodge Counties due to the detection of elevated levels of nitrate as part of its routine and annual groundwater monitoring. This Project supplements LENRD's efforts under the various plans, objectives and collaborative projects with the NeDNR by adding hydrogeologic maps, information and recommendations generated by experts for the region and specific Focus Areas within the LENRD.

The **LPNNRD** completed a Voluntary IMP which went in effect in June 2018 and updated their Groundwater Rules and Regulation to coincide with the IMP. The LPNNRD is also a member of the LPRB Coalition which finalized the LPRB Plan in 2018 and a member of the Lower Platte River Drought Consortium which finalized a Lower Platte River Drought Contingency Plan in October 2019 (approved by NRDs in December 2019). Current management strategies are being addressed under the GMP last updated in 1995. More specifically, Section B, Goal #2 - Management Systems Development, under the "Plan for Groundwater Management in LPNNRD" is being targeted. The overall objective of this goal is to provide a system of groundwater management to support the groundwater reservoir life goal, based upon an adequate technical foundation and public awareness of groundwater issues. Goal #2 has provided a framework for LPNNRD to implement several programs that have led to a greater understanding of the various aquifer systems throughout the District and the ways to address the issues realized through communication and data acquisition. LPNNRD has commissioned studies to map the aquifer characteristics on a macro scale to allow more specific controls on a localized level. It has also provided a network of monitoring wells and sample sites to monitor groundwater quantity and quality. Further work has been done to quantify water usage through the acre certification process which looks at the actual number of acres being irrigated throughout the LPNNRD. Annual informational classes have been held to keep groundwater users updated on the most recent data gathered by the District as well as any updates to the current management policies or LPNNRD Rules and Regulations. The Focus Area work in Dodge County and the Leshara area of Saunders County will continue

the data acquisition objectives of the current GMP as well as future management strategies. The LPNNRD has identified the following future actions/concerns/plans:

- additional information might need to be gathered, like a geological model (currently in progress, WSF #5303)
- water management could include siting of potential recharge sites, storage reservoirs (both surface and ground water, potential water reuse projects) to enhance the water supply
- additional monitoring wells, stream flow gauging, and precipitation sites will likely be necessary
- effects of climate change will also need to be considered as part of integrated water management.
- conduct intensive analysis of the groundwater quality and especially in identified Water Quality Management Areas.
- A series of chemical analysis will be conducted along with GIS mapping utilizing AEM information, to attempt to identify what Best Management Practice will be the most effective in curbing the contamination

The Project fits well with many of the objectives above and the timing of WSF award #5303. The Project will be coordinated with the LPNNRD to maximize potential water level gathering efforts, groundwater quality data review and AEM evaluations for both LPNNRD project goals and the H M L map and Focus Area work for the Project. This Project employs the two advisory agencies of ENWRA, the UNL-CSD and USGS, to look at the AEM data with groundwater level and quality data to generate a H M L map of recharge for the region and management recommendations for Focus Areas satisfying the items in Goal #3 of the IMP [*Action Item #3.2.2: Use new, and existing, studies and data to establish specific guidelines for sustainable development of major, minor, and pocket aquifers]* and Goal #1 of the LPRB Plan previously mentioned. The UNL-CSD and USGS work in the Dodge County and Fremont-Arlington-Leshara Focus Areas will also assist in the data sharing that is necessary between neighboring NRDs in order to retain consistency in general rules that help groundwater users and NRDs manage aquifers that cross political boundaries.

This Project will meet goals and objectives of both the **LPSNRD's** Ground Water Management Plan (GWMP, equivalent to GMP acronym) approved by NeDNR in 1995 and the NRD's voluntary IMP adopted May 5, 2014. For the GMP, the data provided by H M L Map and water contour efforts will provide a more detailed and defensible understanding of the highly variable aquifer units of the LPSNRD. In addition, it will provide a much-improved understanding of the recharge to the Crete-Princeton-Adams (CPA) Groundwater Reservoir which is part of the Dorchester-Sterling paleochannel Focus Area (Section A, #7, Figure 1). The voluntary IMP identifies three major Goal Areas: Water Inventory, Water Supply Management, and Water Use Management. This Project employs the two advisory agencies of ENWRA, the UNL-CSD and USGS, to look at the AEM data with groundwater level and quality data to generate a H M L map of recharge for the region and management recommendations for Dorchester-Sterling Focus Area fitting with Goals #1 and #2 of the IMP and Goal #1 of the LPRB Plan that

LPSNRD is also a part of. The Project supports the following IMP and LPRB Plan (previously mentioned) goals and objectives through the Study coordination and water contour, recharge and vulnerability products/understandings it will provide:

Goal #1 Water Inventory area:
Ensure the District has sufficient data to enable the achievement of a water supply that is in balance with current and future water demands.

Objective 1: Develop and maintain a comprehensive inventory of the location and source of the District's water supplies, water use, and outflows,
Objective 5: Evaluate potential effects on water inventory if additional water supplies are accessed through coordination, innovation, and technology
Objective 6: Determine the extent of hydrologically connected ground and surface waters in the District.

Goal #2 Water Supply Management:
Ensure a sustainable water supply is available in the amounts and location of the demand through management actions that meet the District's long term needs.

Objectives 1: Ensure to the extent possible, that wells are located and designed to reflect the ground water geology and water supplies in accordance with aquifer characteristics
*Objective 3: Evaluate the potential benefits of regional supply and distributio*n systems and, where warranted, facilitate discussions with impacted entities.

Most recently in 2020, the LPSNRD developed detailed plan and process for dealing with large-scale industrial water use in southern portion of District within the Dorchester Sterling paleochannel Focus Area and completed and implemented revisions to Groundwater Rules and Regulations. Additionally, the following future goals were indicated by LPSNRD which relate and compliment the recharge study goals of this Project, the LPSNRD will continue to implement and expand its vadose zone monitoring program emphasizing advanced techniques used by UNL and coordinate that program with its ongoing groundwater monitoring and test hole drilling. The LPSNRD will begin utilizing the completed AEM data by initiating efforts for District-wide geologic and groundwater models. All of the above LPSNRD actions, plans, and goals are benefitted by the improved water level contouring, statistical analysis of AEM with groundwater quality, generation of the H M L recharge map and Focus Area recommendations for groundwater management concerns proposed under this Study.

The **NNRD** took action on March 9, 2017 to begin the development of a voluntary IMP and entered into an agreement with the NeDNR and HDR Engineering to develop a Voluntary IMP in 2020. This Project will address objectives and action items related to the IMP goals by: (1) utilizing the best available data and analysis tools [including recharge evaluation with AEM and groundwater quality in this Study] to estimate consumptive water use, (2) assess the need for additional monitoring [Dorchester-Sterling Focus Area recommendations], (3) continue to gather and analyze hydrogeologic data [this Study's goal], and (4) coordinate with public water supplies to enhance education and conservation. In addition to developing the Voluntary IMP, the NNRD has an adopted

GWMP, last revised in December of 2014 (NNRD GWMP 1985). Results of this Project meet the objectives of the GWMP to address specific problems of groundwater quality. The NNRD has a history with addressing groundwater quantity/quality concerns demonstrated though the following example management actions:

- Updating their Groundwater Rules and Regulations (February 2020)
- Measures groundwater levels twice a year in over 130 wells
- Regularly collects samples from over 100 wells throughout the District
- Has installed approximately 34 monitoring wells in the groundwater monitoring network (18 were installed in 2019)
- Groundwater quality monitoring conducted by NNRD staff has shown the northwest portion of Richardson County to have elevated levels of nitrates. This area has been designated a Phase II GWMA for groundwater quality and requires the NNRD to conduct annual sampling of wells.
- In 2017 Legette, Brashears and Graham (LBG) completed a hydrogeologic assessment report of the entire NRD. This is the most comprehensive review and assessment of the basin's groundwater resource ever completed. It better defines aquifer boundaries and the potential for future development within those areas. Data from the report will be used to develop aquifer risk area boundaries and update present groundwater rules and regulations.
- In 2018 and 2020 conducted AEM survey flights (WSF #5189 and #5255). Over 1,500 miles were flown in total within the NNRD between 2007 and 2020. The data collected clearly delineates the geology from the ground surface down to (and past) the bedrock.
- Has a private water supply well sampling plan which ties directly to the groundwater sustainability data gathering scope of this Project
- Continues to promote and encourage routine private water well sampling and analysis
- Educates District residents on the health risks associated with groundwater contamination, on methods to treat the problem, and on actions to reduce or eliminate the reoccurrence
- Developed a new scoring system for evaluating new well permits
- Looks for opportunities to expand the water analysis programs

The NNRD is also in the process of delineating risk management aquifer areas in order to apply specific rules and this Study will assist with that effort. Along with the AEM efforts, this Study's evaluation of the recharge, water contouring and recommendations for the paleochannel will help NNRD determine areas with development potential and help determine maximum development limitations.

The **P-MRNRD** has a Voluntary IMP for the portion of the District within the LPRB (https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/lower-platte/papio-missouri-NRD/PMRNRD_IMP_20140801.pdf) dated August 2014, adopted by both the P-MRNRD Board of Directors and the NeDNR with the following Goals :

- Goal 1 is to develop and implement water use policies and practices which better protect existing surface and groundwater uses while allowing for future development.

Objectives – Utilize existing policies, manage invasive vegetation, evaluate conjunctive management projects.

- Goal 2 is to maintain a water supply and use inventory. Objectives – Develop and implement data gathering, monitoring, and evaluation, coordinate with water suppliers.
- Goal 3 is to implement water use education programs to promote urban and rural water conservation. Objectives – Promote water use education, conservation, and reuse.
- Goal 4 is to work with upstream NRDs to develop the Lower Platte River Basin Water Management Plan. Objectives – Participate in Lower Platte Basin water management, evaluate conjunctive management alternatives, evaluate additional water resource supplies, maintain stream flows to protect and maintain public water supply.

The P-MRNRD is also a member of the LPRB Coalition which finalized the LPRB Plan in 2018 and a member of the Lower Platte River Drought Consortium which finalized a Lower Platte River Drought Contingency Plan in October 2019 (approved by NRDs in December 2019).

The data collected and reviewed as a result of this Project will address objectives and action items that support Goals 2 and 4 in the IMP and Goal #1 of the LPRB Plan by: (1) utilizing the best available data and analysis tools to estimate recharge with groundwater quantity, quality and the AEM, (2) assess the need for additional monitoring data or study [recommendations for Tekamah and Arlington Focus Areas], (3) continue to gather and analyze hydrogeologic data, (4) evaluate the needs new rural water systems, and/or coordinate with public water suppliers [the village of Tekamah and the Logan East Rural Water System proposed expansions in Burt County are Focus Areas for the Project].

In addition to the above plans, the P-MRNRD has a new GMP (https://www.papionrd.org/wp-content/uploads/2018/03/180209-P-MRNRD-170724-Final_GMP_Vol-I-adopted_180208.pdf) adopted February 2018. Since the last update to the GMP in 1994, the P-MRNRD has supported significant data collection and research efforts across the district to better understand the complicated hydrogeology, aquifer distribution, groundwater quality, and supply. The new GMP cites ENWRA as one of the most important collaborations. The new GMP continues the goal of keeping groundwater quantity and quality sustainable forever, sets new triggers for groundwater quality phases and quantity levels, and recommends various actions for designated groundwater management areas. The P-MRNRD also has new Groundwater Management Rules and Regulations effective March 1, 2018 which reflect the GMP recommended actions. Rules and Regulations designate Phase I and Phase II Groundwater Quality Management Areas and a Level I Groundwater Quantity Management Area throughout the entire NRD. Groundwater quality monitoring conducted by USGS in the P-MRNRD has shown portions of the proposed Burt County and Fremont-Arlington-Leshara Focus Areas of the Project to have elevated levels of nitrates. Results of this Project specifically meet the objectives of the GMP to address specific problems of groundwater quality and contouring alluvial aquifers that are hydrologically connected to the Platte and Elkhorn rivers and includes the portion of the P-MRNRD that contributes surface water runoff to the Platte

and Elkhorn rivers. The Project will also further define the extent of the Dakota aquifer, one of the four aquifers significant to the P-MRNRD featured in the GMP.

Improved recharge interpretation and water level contouring from this Study will also be essential as the P-MRNRD completes the following future actions:

- Water quality monitoring is done through a partnership with the USGS on a rotating schedule of four different aquifer areas; the Missouri River alluvium, the Platte and Elkhorn River alluvium, the Upland areas, and the Dakota Aquifer.
- The District has in place 45 dedicated monitoring wells at 16 locations (12 in Wellhead Protection Areas) that are sampled at least biannually. Monitoring results show a majority of the P-MRNRD with nitrate levels well below the 10 ppm MCL. However, areas of concern with nitrate levels between 5 and 8 ppm have been detected in Tekamah's WHPA and south of Springfield, NE.
- The P-MRNRD also recently worked with the City of Tekamah and City of Springfield to map wellhead protection areas and develop draft Drinking Water Protection Management Plans (still under review by NDEE and EPA). These projects used AEM in limited amounts, but with the new recharge understandings and Focus Area recommendations, the NRD can better assist these areas and beyond in the future.

3. Contributes to water sustainability goals by increasing aquifer recharge, reducing aquifer depletion, or increasing streamflow;

   List the following information that is applicable:

   - The location, area and amount of recharge;
   - The location, area and amount that aquifer depletion will be reduced;
   - The reach, amount and timing of increased streamflow. Describe how the project will meet these objectives and what the source of the water is;
   - Provide a detailed listing of cross basin benefits, if any.

This Project will facilitate access to improved AEM-derived maps of recharge potential and updated water-level maps which can improve future water supply management plans and projects which include intentional groundwater recharge, flow augmentation, and other projects aimed at increasing streamflow. As an example, if an NRD choses to divert excess surface-water for the purposes of intentional recharge, the specific location of recharge could be determined from recharge potential maps in order to provide the maximum benefit. By publicly serving AEM-based maps of recharge potential and updated groundwater level maps through the Nebraska GeoCloud, water managers will make well-informed decisions that will limit aquifer depletions. The primary cross-basin benefit of Nebraska GeoCloud is that the shared data sets will be available for water resource managers, consultants, and professionals across the state. Benefits from this effort described herein are not limited to one specific project area. Rather, shared maps of recharge potential and groundwater levels will improve statewide water planning projects and management plans providing benefits to all 1.25 million residents of eastern

Nebraska (Table in Section C, #12). An example of how this Project contributes to water sustainability and reducing aquifer depletions is within the Dorchester-Sterling paleovalley aquifer in the LPSNRD and NNRD. Within this area the demand for additional high-capacity wells for industrial purposes has increased, as well as the demand for domestic wells. The updated maps of recharge potential and groundwater levels will assist the management efforts of the LPSNRD and NNRDs to understand the available water supply, identify monitoring needs, develop management controls and programs, and reduce depletions. Another example of how this Project contributes to water sustainability goals is that the feasibility of using intentional recharge or streamflow augmentation will be examined within the valley between the Platte and Elkhorn Rivers south of Arlington. Within this location AEM surveys have mapped an untapped aquifer interpreted to be older glacial outwash underlying modern alluvium. The P-MRNRD and the LPNNRD wish to examine the feasibility of this aquifer to augment streamflow in the Elkhorn River during periods of low flow in the lower Platte River. This Project will compile and examine existing data sets and provide a detailed plan of study which may include test hole drilling, groundwater quality sampling, and aquifer testing to determine if streamflow augmentation is a viable drought mitigation strategy.

4. Contributes to multiple water supply goals, including, but not limited to, flood control, agricultural use, municipal and industrial uses, recreational benefits, wildlife habitat, conservation of water resources, and preservation of water resources;

    - List the goals the project provides benefits.
    - Describe how the project will provide these benefits
    - Provide a long range forecast of the expected benefits this project could have versus continuing on current path.

The value of AEM data has been demonstrated numerous times within the state of Nebraska to address a variety of water resource issues including identifying areas of high groundwater recharge, mapping buried paleovalley aquifers in glacial terrain, and assessing secondary bedrock aquifers for drinking water supply. The Project will assist NRD water managers in addressing issues within focused areas including identifying areas with high recharge that are vulnerable to groundwater contamination. Improved water-level maps will help improve the amount of water in storage for paleovalley aquifers. Phases 2 and 3 will begin to develop work plans to address specific issues within Focus Areas where there are known issues with water quantity and water quality. A specific example of how this Project will provide those benefits is with the town of Oakland who receives their water with the Logan East Rural Water District who is seeking to increase capacity in anticipation of future water demands. The Logan East Rural Water District is examining the area east of Oakland to tie into existing pipelines. This Project will examine the improved maps of recharge potential and water-level maps to understand the amount of saturated aquifer material within their target area. A plan of study which may include additional test hole drilling, water-level monitoring and aquifer testing will be recommended to allow the Logan East Rural Water District to fully characterize the possible area of expansion. This approach could serve as a blueprint for future

assessments and expansions of rural water systems including Lancaster County Rural Water District 1, the Cedar Knox Rural Water Project in LCNRD, Washington County Rural Water system in P-MRNRD, and the City of Hickman. If this Project is not completed, area water managers will not be able to utilize AEM data to the fullest potential. Assessing groundwater recharge potential and groundwater vulnerability will assist groundwater managers in understanding current groundwater conditions and inform future groundwater management decisions such as future water allocations or with nitrate management plans. Many of the Focus Areas (table Section A, #6) are examining the feasibility of future water management actions, such as increasing the capacity of a rural water system or designing a streamflow augmentation project. These types of actions would require a significant investment of tax dollars on already financially stressed local economies. If future investment in water infrastructure is completed without the best available science, the result could potentially lead to significant inaccuracies, be very costly to the local taxpayer and fail to solve the underlying problem.

5. Maximizes the beneficial use of Nebraska's water resources for the benefit of the state's residents;

   - Describe how the project will maximize the increased beneficial use of Nebraska's water resources.
   - Describe the beneficial uses that will be reduced, if any.
   - Describe how the project provides a beneficial impact to the state's residents.

To date, over 25,000 miles of AEM data have been collected in Nebraska for a variety of purposes which include assessing groundwater vulnerability to surface contamination. This Project will maximize beneficial use by creating and improving AEM-derived maps of recharge potential/groundwater vulnerability and update groundwater-level maps for selected aquifers. The completed data sets will be served to the Nebraska GeoCloud to make this information accessible to the state of Nebraska and its 1.9 million residents they can be used for other purposes beyond their original intent. Publishing the data sets and products will give water managers the ability to assess threats to their current water supply from overexploitation and surface contamination and fully characterize potential areas needed to expand rural water system capacity. This Project will also update groundwater level maps, which for parts of Eastern Nebraska have not been updated since 1995. In many areas, the older 1995 map is inaccurate and does not provide the level of detail needed for groundwater management decisions including determining the available groundwater in storage or determine the connectivity of groundwater and surface water. The Project will also examine 5 specific problem areas that focus on specific issues that are of interest to the project sponsors. The focused project areas concentrate on assessing the feasibility for new water sources to increase drinking water supplies, potential future streamflow augmentation projects, and mapping recharge in areas where high nitrate in groundwater is an issue. The plans devised within this Study could be used as blueprints for similar issues across the state. The proposed Project

would not directly lead to reductions in beneficial uses.

6. Is cost-effective;

   - List the estimated construction costs, O/M costs, land and water acquisition costs, alternative options, value of benefits gained.
   - Compare these costs to other methods of achieving the same benefits.
   - List the costs of the project.
   - Describe how it is a cost effective project or alternative.

The cost of the Project is $314,000 (including $74,000 federal cooperative dollars) and involves work that benefits not only the ENWRA NRDs but accomplishes efforts toward both UNL-CSD's groundwater level mapping program goals and USGS water science center's study objectives. The closest alternative to the Project scope would be installing individual equipment stations with sufficient spacing and auxiliary monitoring points. The cost for installing 10 recharge stations similar to the previous stations installed at ENWRA pilot sites would be $400,000 (approximately $40,000 per station). This cost alternative does not include the monitoring points/wells needed for the surrounding area, nor is 10 station locations enough (installing 2 at each Focus Area identified for this Project would still be excluding the remaining areas this grant scope is addressing with Phase I). Even if you could locate and install instruments at every representative recharge area setting including the hard to pinpoint preferential flow paths, 10 would not be enough to cover the region. Recharge and surface water/groundwater interaction objective excerpts from ENWRA's Long Range Plan Appendix B Project Matrix Table ($40,000/station has been estimated in the Matrix Table since 2010):

Objective/Project		Management Concern	Sponsor	Area (mi^2 / line km)	Potential Funding Sources	Fiscal Years	Estimated Cost*	Notes
3. Estimate Recharge Areas and Rates								
A.	**Map recharge areas**	recharge/ sustainability/ quality	all 6 NRDs	--	ENWRA Dues/NRDs/ NET/WSF/USGS	2021-2031	--	evaluate AEM and existing data (potential UNL vadose, NGC, USGS, CSD, DNR collaborations) to identify recharge areas and target study areas
B.	**Maintain and add/re-evaluate vadose zone stations & recharge projects**	recharge/ sustainability	all 6 NRDs	--	ENWRA Dues/USGS/ NET/WSF	2021-2031	$400,000	assume 10 stations at $40,000 per station, requires Technical Advisor to direct and evaluate
4. Assess Potential Connections Between Groundwater & Surface Water								
A.	**Continue to evaluate HCAs and unidentified HCAs**	interrelated water	all 6 NRDs	--	USFWS/ENWRA Dues/WSF/CSD/ NET/county/NRDs	2021-2031	--	update CSD datasets; work with DNR to get Lower Platte Missouri River Tribs model (LPMT) updated with AEM and NGC frameworks
B.	**Map saline groundwater**	interrelated water, quality	LPS/LPN	--	NRDs/ENWRA Dues/NET/ WSF/USFWS	2021-2031	--	map salt spring & stream reaches and salt/fresh (Maha) boundary in Dakota formation using variety of methods
C.	**Review/incorporate ongoing work in alluvial aquifers**	interrelated water	all 6 NRDs	--	ENWRA Dues/NET/ WSF/NRDs	2021-2031	--	identify gaining/losing reaches, streambed characteristics, potential cross aquifer connections

The Focus Areas will cover a range of hydrogeological areas typical in eastern Nebraska including: Ogallala/High Plains aquifer, alluvial aquifers, glacial aquifers, paleochannel aquifers and secondary bedrock aquifers (Dakota Sandstone, Niobrara Chalk). These areas are known to have significant differences in recharge flow pathways and rates and have been problematic when using a singular statewide contouring approach using potentiometric readings. The goal of Phase I would be to have a better understanding

compared to the 1995 potentiometric contours for statistical analysis, groundwater quality gathering and recharge mapping. The 1995 water table contours have been widely used in AEM reports and other aquifer volume calculations and 3D models as the best regional information available. However, problems are known regarding the true depth to/elevation of extractable water and its relationship to potentiometric surface contouring.

7. Helps the state meet its obligations under interstate compacts, decrees, or other state contracts or agreements or federal law;

    - Identify the interstate compact, decree, state contract or agreement or federal law.
    - Describe how the project will help the state meet its obligations under compacts, decrees, state contracts or agreements or federal law.
    - Describe current deficiencies and document how the project will reduce deficiencies.

The Project adds to the use of the Nebraska GeoCloud (WSF #4164, agreements with UNL-CSD, USGS) platform because the resulting maps and contours are planned for upload. The Nebraska GeoCloud has been supported by NRDs for the last two years but only consultant project data and UNL-CSD Project data has been uploaded. This Project will take a step toward populating the Nebraska GeoCloud with hydrogeologic information by NRDs.

Federally endangered species such as the Pallid Sturgeon, Topeka Shiner, Salt Creek Tiger Beetle, and Western Prairie Fringed Orchid exist within the ENWRA NRD watersheds and are susceptible to their health and function. By better understanding the aquifer resources, the ENWRA NRDs can make responsible decisions that will reduce potential negative impacts to its local endangered species. As an example, this Project will assist the state and ENWRA NRDs in managing groundwater and surface water to meet its obligation under the instream flow appropriation permit granted to the Nebraska Game and Parks Commission for the central and lower Platte River on June 26, 1998 (with an instream flow priority date of November 30, 1993).

The Project area in the LCNRD, P-MRNRD and NNRD are each part of the Missouri Tributaries Watershed which contributes to the health of the down-gradient river. Fifty-nine miles of the Missouri River from Gavin's Point Dam to Ponca State Park were designated as the Missouri National Recreational River in 1978. A better understanding of how the geology in this area impacts the river including potential groundwater connections can assist decision making on a local, state, and/or national level, further protecting the river. The river supports abundant wildlife and is home to three species listed under the federal Endangered Species Act: the *endangered* pallid sturgeon and least tern, and the *threatened* piping plover. The work undertaken by this Project will contribute to the health and function of the Missouri National Recreational River watershed through increased understanding of the highly variable, diverse aquifers of the

northern portion of Knox and Cedar Counties in the LCNRD as well as aquifer sources exiting the state through the NNRD.

Lastly, information gained from this Study can benefit Nebraska's drinking water program which has 1,319 public water systems, 599 of which are community water systems serving 1.58 million of Nebraska's 1.9 million residents (Nebraska Public Water System Capacity Development Program Report to the Governor September 2020). Water regulators and managers in compliance with the Safe Drinking Water Act, including the establishment of well-head protection areas (Part C, section 1428), use UNL-CSD data for making their decisions. UNL-CSD has immediate plans to incorporate the Project data (Ongoing County Atlas work and Nebraska GeoCloud WSF award #4164) into their mapping and geologic data integration efforts. Additionally, the information provided by this Project would assist water managers/regulators with science based information to comply with Nebraska Title 118-Ground Water Quality Standards and Use Classifications, which states "It is the public policy of the State of Nebraska to protect and improve the quality of groundwater for human consumption, agriculture, industry and other productive, beneficial uses."

8. Reduces threats to property damage or protects critical infrastructure that consists of the physical assets, systems, and networks vital to the state or the United States such that their incapacitation would have a debilitating effect on public security or public health and safety;

    - Identify the property that the project is intended to reduce threats to.
    - Describe and quantify reductions in threats to critical infrastructure provided by the project and how the infrastructure is vital to Nebraska or the United States.
    - Identify the potential value of cost savings resulting from completion of the project.
    - Describe the benefits for public security, public health and safety.

Water security and public health and safety for Nebraskans is directly tied to clean and sustainable groundwater resources. About 88% of the state's population uses groundwater as drinking water (http://dee.ne.gov/Publica.nsf/%24%24OpenDominoDocument.xsp?documentId=C3C47F71DBDA83338625863100728C51&action=openDocument). Groundwater is also a major source of irrigation water for much of the state's agriculture. However, decades of crop production have allowed fertilizers and some agricultural chemicals to reach the groundwater in some parts of the state and unsustainable groundwater pumping has caused depletions to many of the state's aquifers adversely affecting drinking water supplies. The Project will benefit public security, health, and safety by improving maps of groundwater recharge potential and groundwater levels that will allow water managers to better assess the amount of groundwater in storage in Nebraska's aquifers, evaluate selected areas to increase drinking water supplies, and mitigate potential threats to groundwater quality. Critical infrastructure for public water supply systems in these areas

are threatened by elevated nitrate concentrations in groundwater and water shortages due to periodic drought. Protecting this infrastructure is critical to Nebraska because the cost of replacing these systems is enormous and would likely incur significant financial burdens on small communities with limited tax base. Additional water-level and groundwater vulnerability mapping is needed prior to investment in the additional municipal wells needed to increase capacity of rural water systems or siting irrigation or domestic wells. For example, installing a municipal, irrigation, or domestic well in a poor aquifer location that would then later need to be replaced or modified can save an additional expenditure of $200,000 - $500,000, $40,000 - $80,000, or $900 - $8,750 respectively. The Focus Areas of the Project also include more detailed evaluations for parts of Knox, Burt (including Logan East RWD Burt County expansion, Tekamah, Oakland and Craig), Dodge-Saunders Counties (Fremont-Arlington-Leshara), and municipal well head protection areas (WHPAs) for towns from Crete to Peru (including Burr, Lancaster RWD#1 and Johnson County RWD#1). Specific recommendations regarding the groundwater management concerns will come from the Focus Area evaluations which could also benefit public health and safety if emergency wells or lines needed to be planned and installed.

9. Improves water quality;

- Describe what quality issue(s) is/are to be improved.
- Describe and quantify how the project improves water quality, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- Describe other possible solutions to remedy this issue.
- Describe the history of the water quality issue including previous attempts to remedy the problem and the results obtained.

This project will benefit the groundwater quality in eastern Nebraska for approximately 1,250,000 residents. Groundwater in many areas of eastern Nebraska has been degraded due to non-point source contamination from agricultural fertilizers and pesticides. The Project will make available improved maps of groundwater level and groundwater recharge potential, which can be viewed as groundwater vulnerability. The dissemination of these products will improve our ability to predict contaminant movement and long-term fate of contaminants in aquifers. In addition to the maps that cover Eastern Nebraska, 5 focused studies will evaluate the groundwater quality, vulnerability of groundwater resources to contamination, and assess aquifer characteristics. Previous studies have not conjunctively examined and interpreted recently collected AEM data, as well as AEM-derived products such as recharge potential or groundwater vulnerability maps, historical groundwater quality data, and groundwater level recorder data within the Focus Areas. From this initial assessment, future detailed studies will be recommended to address specific groundwater quality issues for each specific Focus Area. An example of a comprehensive interpretation of AEM derived products and historic water-quality and water-level data from the Bazile Groundwater Management Area can be found in Hobza and Steele (2020; https://doi.org/10.3133/sir20205113).

10. Has utilized all available funding resources of the local jurisdiction to support the program, project, or activity;

- Identify the local jurisdiction that supports the project.
- List current property tax levy, valuations, or other sources of revenue for the sponsoring entity.
- List other funding sources for the project.

Letters of support from the supporting jurisdictions are provided in Attachment A. The table below lists the 2020-2021 property tax levies, valuations, and sources of revenue for the 6 ENWRA project sponsors (**Nebraska Auditor of Public Accounts https://www.nebraska.gov/auditor/reports/index.cgi?budget=1 accessed June 14, 2021)*:

Name of NRD	Tax Levy (per $100 valuation)*	Valuation*	Total Resources Available*	Annual Dues to ENWRA
Lewis and Clark	$0.027	$4,019,104,543	$4,075,916	$7,000
Lower Elkhorn	$0.024	$18,519,441,146	$16,632,934	$30,000
Lower Platte North	$0.034	$10,288,708,813	$9,257,893	$30,000
Lower Platte South	$0.030	$33,829,513,202	$33,498,532	$30,000
Nemaha	$0.027	$7,394,957,663	$4,646,605	$20,000
Papio Missouri River	$0.036	$75,544,549,868	$110,873,773	$30,000

Additional to the local NRD funding, the USGS, through Cooperative Matching Funds will provide $74,000 as in-kind funds for this grant.

11. Has a local jurisdiction with plans in place that support sustainable water use;

- List the local jurisdiction and identify specific plans being referenced that are in place to support sustainable water use.
- Provide the history of work completed to achieve the goals of these plans.
- List which goals and objectives this project will provide benefits for and how this project supports or contributes to those plans.
- Describe and quantify how the project supports sustainable water use, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- List all stakeholders involved in project.
- Identify who benefits from this project.

The NRDs have the authority under the Nebraska Groundwater Management and Protection Act, Chapter 46 Article 7 regarding groundwater to enter into contracts or agreements, budget and expend levied property taxes, own and operate property and

equipment, and conduct investigations relative to the protection and management of groundwater. Nebraska State Statute Chapter 2 Article 32 gives the NRDs authority to carry out projects related to the development, management, utilization and conservation of groundwater and surface water.

The **LCNRD** would like to continue quantity and quality study in Focus Areas that warrant increased investigation as they relate to several sustainability goals and objectives identified in the LCNRD GMP and IMP (refer to Section B, Question #2, first paragraph for details) as well as the Bazile Groundwater Management Area Plan developed jointly by the Nebraska Department of Environment and Energy, LCNRD, LENRD, Lower Niobrara (LNNRD) and Upper Elkhorn (UENRD) to address water quality concerns within Antelope, Knox, and Pierce counties. In response to significant irrigation development and drought conditions of 2012, the LCNRD enacted Groundwater Quantity Rules and Regulations, adopted by the LCNRD in August of 2014. The rules include the requirement of permits for high capacity well development and expansion of irrigated acres. The rules also establish required irrigation management in times of sustained groundwater decline. Over the last 9 years, LCNRD has been working with UNL-CSD advancing test holes and installing observation wells (Nebraska Environmental Trust award and smaller reimbursements from the ENWRA partnership) to establish further study of the LCNRD aquifer systems in tandem with the 2014-2018 AEM results (WSF #4143 and #5189). The LCNRD groundwater monitoring network now includes approximately 60 monitoring wells, many of which are in ideal locations for use in this project. This project will provide new District-wide understanding using deeper AEM analysis greater than the top 10 feet with better targeted water level information specific to recharge (H M L map) for the following:

- areas where the geology is diverse and complicated
- WHPAs at quantity and quality risk
- locations where well interference occurs impacting agricultural or domestic uses
- regions where nitrate or other contaminants are impacting groundwater resources
- additional target areas where future development may be possible or alternatively, not recommended

The Project will also address the Dolphin Focus Area (Figure 1, Section A #7) with more detailed evaluation of recharge in a setting of Knox County where hydrogeologic connections between ground and surface water systems as well as the High Plains Aquifer extent and connection to younger deposits is poorly understood. Additionally, this Project will bolster the UNL-CSD aquifer boundary mapping efforts including the Knox County priority area, USGS and UNL-CSD WSF award (#4164) goals to populate the Nebraska GeoCloud, and evaluate NDEE defined boundaries for WHPAs. The stakeholders for the LCNRD areas of the Project are the individual owners of domestic and agricultural water supply wells, campgrounds, and municipal and local NRD water managers.

The **LENRD** has an adopted GMP which details the management actions of the District regarding groundwater quantity and quality. LENRD also has a Drought Mitigation Plan

(https://static1.squarespace.com/static/54be71a0e4b096702d519464/t/586fc48f6a496365d57d2c9a/1483719880310/LENRD+Drought+Management+Plan+Draft+12_21.pdf) and is part of the Lower Platte River Basin Management Plan (LPRB Plan) finalized in 2018. This Project aligns with the goals and priorities of those plans and the LENRD Voluntary IMP, the development of which was overseen by a stakeholder group composed of 23 individuals. Both the GMP and the IMP were developed under the authority granted through the Groundwater Management and Protection Act (GMPA) and both have the overarching intent to plan for and maintain water sustainability across the entire LENRD, and this Project will assist in fulfilling those responsibilities. One of the goals listed in the IMP developed by the LENRD in collaboration with NeDNR is to "Develop and maintain a water supply and use inventory based on the best available data and analysis." In addition to fulfilling the overall goal of water sustainability, the Project will also help achieve many objectives within the LENRD's Long Range Implementation Plan, such as:

- Increase our general knowledge of the hydrogeologic characteristics of the district.
- Protect municipal and domestic groundwater supplies
- Utilize all land within the district for its most suitable purposes, with consideration given to conserving the resources and their continued productivity for future generations.
- Monitor groundwater to detect changes, trends, or problems
- Improve groundwater conservation practices through education and information dissemination.
- To ensure public awareness of the district's responsibilities, programs, projects and goals, and to increase public concern for the proper management and conservation of our natural resources.

The LENRD has also delineated groundwater quality and groundwater quantity management areas when such an area is deemed necessary for protection. The LENRD is working with ENWRA and the UNL-CSD targeting all of Cuming County and portions of Dixon, Dakota, Wayne, Thurston, Stanton, Burt, Dodge, and Colfax Counties with a combined population greater than 26,000. Water in the Project area is utilized for residential, industrial, agricultural, and recreational uses.

When this Project is complete, all citizens within the LENRD will benefit from the information obtained through the use of AEM for recharge and water level mapping. The information is an enduring source of information that supports the efforts of the LENRD and UNL-CSD to catalogue the geology and groundwater of eastern Nebraska (example: Nebraska GeoCloud WSF #4164).

Direct benefits to the communities include: a better understanding of their source water, drought planning, and better well siting capabilities using the new water contour and recharge category maps. The Logan East Rural Water system which is based in Oakland, Nebraska serves around 3,000 customers from three active wells and is exploring potential options to increase capacity and distribution in Burt County, which will require the construction of an additional well and other water delivery infrastructure. The Burt County Focus Area efforts for this project will assist and bolster the UNL-CSD aquifer

boundary mapping efforts including the Logan East priority area, USGS and UNL-CSD WSF award (#4164) goals to populate the Nebraska GeoCloud, and evaluate areas of rural water potential before making important management decisions. This method of decision making will enable the LENRD to manage ground water use in a manner that achieves and sustains a balance between water uses and water supplies. This will provide environmental benefits to the residents of the LENRD by maintaining adequate groundwater/surface water supplies and minimizing conflicts between water users in the future.

The **LPNNRD** has applied the following management considerations for sustainable water use:

- GMP Rules and Regulations Implemented in 1997, the District has required permitting of all water wells which exceed a pumping rate of 50 gallons per minute (gpm).
- Since 2008 flowmeters have been required on all wells that have approved permits for flowrates greater than 50 gpm.
- Cost-share is provided for soil moisture sensors and Evapotranspiration (ET) gauges with local University of Nebraska-Lincoln (UNL) Extension working directly with producers for installations.
- Cost-share provided for flowmeters in two Special Quantity Areas designated in 2015 because of concerns of in-season water decline. A rolling allocation of 27 inches in a 3-year period was implemented for these areas.
- A ranking system is utilized for well permits and expanding of irrigation acres for the Restricted Development and Hydrologically Connected Areas.

The Project H M L map and groundwater contouring as well as the recommendation s for Focus Areas helps support test hole data submitted, thickness of the aquifer and depth to bedrock. This information will be invaluable in determining future water use as more housing development is being expanded in groundwater restricted areas. Demand for drinking water will continue to increase and the need to find potable water sources will be needed in the different geological formations.

The **LPSNRD** has several programs in place to support sustainable water use. Since the adoption of its GMP in 1995, the District has required permitting of all water wells which exceed a pumping rate of 50 gallons per minute (gpm). LPSNRD has required additional actions for these permits (such as water quality sampling, and, under certain circumstances, aquifer testing) to ensure that the groundwater resource is of adequate quality and quantity for the intended use. Since 2011, the District has required all water wells pumping more than 50 gpm to have a properly installed water meter, and the owners of those meters are required to report their water use on an annual basis. At that same time, the District required all irrigated fields larger than one acre to be certified as irrigated with the LPSNRD. Due to concerns over in-season water declines, the District designated the Dwight-Valparaiso-Brainard Special Management Area (DVB SMA) covering about 100 square miles in the northwestern portion of the District in 2013. LPSNRD has not allowed any additional irrigated acres in that area, and portions of it are under a three-year allocation of 21 inches for both sprinkler and gravity systems. Additionally, LPSNRD has delineated the Salt Creek Groundwater Reservoir and seven WHPAs as groundwater

quality management areas for nitrate concerns. Further, the LPSNRD partnered with P-MRNRD, LPNNRD and other agencies on the Lower Platte River Drought Contingency Plan (WSF Award #4151). This Project, by updating groundwater level maps and providing more information on recharge areas, will help LPSNRD and local public water suppliers better manage their water resources. Regarding the Dorchester Sterling paleochannel Focus Area, given the current and new commercial and industrial uses, understanding the recharge will be increasingly important to municipal and irrigation users if management actions are needed in the future. All of these actions help to ensure that groundwater use in the District is managed responsibly and sustainably.

More recently in January 2020, LPSNRD implemented revisions to Groundwater Rules and Regulations. The following future goals were indicated by LPSNRD which relate and compliment the recharge study goals of this project: the LPSNRD will continue to implement and expand its vadose zone monitoring program emphasizing advanced techniques used by UNL and coordinate that program with its ongoing groundwater monitoring and test hole drilling. The LPSNRD will begin utilizing the completed AEM data by initiating efforts for District-wide geologic and groundwater models. All of the above LPSNRD actions, plans, and goals are benefitted by the improved water level contouring, statistical analysis of AEM and groundwater quality, generation of the H M L map of recharge and Focus Area study with recommendations for groundwater management concerns proposed under this Study.

The **NNRD** developed a voluntary IMP with the NeDNR in 2017, which establishes measurable goals and targets for managing the District's aquifers. The results of this Project will support sustainable water use by identifying recharge areas, providing updated water level contours and recommendations to better manage domestic, municipal, agricultural, and industrial water supplies and water quality. Benefits of the Project will address the threat of nitrate contamination for an estimated population of around 20,000 (https://sdwis-dhhs.ne.gov:8443/DWW/index.jsp populations served for rural water systems). Stakeholders involved in the Project will include the Board and staff of the NNRD, NeDNR, UNL-CSD, and local landowners. The NNRD has an adopted GWMP, last revised in 2014. Results of this project specifically meet the objectives of the GWMP to address specific problems of groundwater quality. Groundwater quality monitoring by NNRD staff, as part of the GWMP, has shown a parts of the Project area to have elevated levels of nitrates.

Since May of 2013 the NNRD has applied the following management considerations for sustainable water use:

- Flowmeters have been required on all new or replacement wells that have approved permits for flowrates greater than 50 gpm
- Cost-share provided for flowmeters and soil moisture monitoring equipment
- Developed a well permit scoring system that requires a test hole be submitted along with the application which takes in account aquifer thickness and transmissivity. The density of registered wells within 6,000 feet of a proposed high capacity well is also considered in the permit scoring system.

The Project will help support the NNRD's evaluation of the test hole data submitted, thickness of the aquifer, and the depth to bedrock.

P-MRNRD: The P-MRNRD has a new GMP (https://www.papionrd.org/wp-content/uploads/2018/03/180209-P-MRNRD-170724-Final_GMP_Vol-I-adopted_180208.pdf) adopted February 2018. Since the last update to the GMP in 1994, the P-MRNRD has supported significant data collection and research efforts across the district to better understand the complicated hydrogeology, aquifer distribution, groundwater quality, and supply. The new GMP cites ENWRA as one of the most important collaborations. The new GMP continues the goal of keeping groundwater quantity and quality sustainable forever, sets new triggers for groundwater quality phases and quantity levels, and recommends various actions for designated groundwater management areas. The P-MRNRD also has new Groundwater Management Rules and Regulations effective March 1, 2018 which reflect the GMP recommended actions. Rules and Regulations designate Phase I and Phase II Groundwater Quality Management Areas and a Level I Groundwater Quantity Management Area throughout the entire NRD. Groundwater quality monitoring conducted by USGS in the P-MRNRD has shown portions of the proposed Burt County and Fremont-Arlington-Leshara Focus Areas of the Project to have elevated levels of nitrates. Results of this Project specifically meet the objectives of the GMP to address specific problems of groundwater quality and contouring alluvial aquifers that are hydrologically connected to the Platte and Elkhorn rivers and includes the portion of the P-MRNRD that contributes surface water runoff to the Platte and Elkhorn rivers. The Project will also further define the extent of the Dakota aquifer, one of the four aquifers significant to the P-MRNRD featured in the GMP.

The P-MRNRD is one of the NRDs participating in the Lower Platte River Drought Contingency Plan and the LPRB Plan. Improved geologic data and interpretation from this Study will also be essential as the P-MRNRD completes the following future actions:

- Water quality monitoring is done through a partnership with the USGS on a rotating schedule of four different aquifer areas; the Missouri River alluvium, the Platte and Elkhorn River alluvium, the Upland areas, and the Dakota Aquifer.
- The District has in place 45 dedicated monitoring wells at 16 locations (12 in Wellhead Protection Areas) that are sampled at least biannually. Monitoring results show a majority of the P-MRNRD with nitrate levels well below the 10 ppm MCL. However, areas of concern with nitrate levels between 5 and 8 ppm have been detected in Tekamah's WHPA and south of Springfield, NE.
- The P-MRNRD also recently worked with the City of Tekamah and City of Springfield to map wellhead protection areas and develop draft Drinking Water Protection Management Plans (still under review by NDEE and EPA). Both projects have used AEM in limited amounts, but with the new recharge understandings and updated water level, the NRDs can better assist these areas and beyond in the future without town by town or GWMA by GWMA individual assessment efforts.

The results of this Project will support sustainable water use by improving the placement, installation and long-term use of water supply wells. Local WHPA plans will also benefit

from the enhanced recharge data, water contouring and recommendations for the Tekamah and Fremont-Arlington Focus Areas.

12. Addresses a statewide problem or issue;

- List the issues or problems addressed by the project and why they should be considered statewide.
- Describe how the project will address each issue and/or problem.
- Describe the total number of people and/or total number of acres that would receive benefits.
- Identify the benefit, to the state, this project would provide.

Recharge is a major component of the water budget and contributes to groundwater sustainability throughout the state, as having sufficient recharge prevents depletion in any freshwater setting. This Study covers eastern Nebraska, the most populated portion of the state (refer to table below for benefit impact populations/acres https://www.nrdnet.org/nrds/find-your-nrd) with complicated glaciated hydrogeology where assessment and understanding of the recharge is especially difficult due to the hydrogeological setting (https://enwra.org).

NRD	Population	Acres
Papio-Missouri River NRD	725,250	1,116,800
Lewis and Clark NRD	15,018	938,880
Lower Elkhorn NRD	89,256	2,526,700
Lower Platte North NRD	64,500	1,031,000
Lower Platte South NRD	314,722	977,525
Nemaha NRD	44,560	1,537,460
TOTAL	**1,253,306**	**8,128,365**

Having accurate hydrogeologic data (geologic framework from AEM and boreholes, groundwater quality data, water level contours) and using that to map where in the region are the high, moderate and low recharge areas is key to appropriate input parameters for the current groundwater/surface-water/recharge modeling efforts underway for NRDs and the NeDNR. This Project provides more understanding of recharge for the eastern region of the state promoting scientifically based water management of groundwater quality and quantity in a coordinated manner.

The AEM-derived maps of groundwater recharge potential that will be created as part of this project can also be viewed as maps of groundwater vulnerability to contamination. Groundwater quality is a statewide issue for Nebraskans and is directly tied to clean and sustainable groundwater resources. About 88% of the state's population uses

groundwater as drinking water. Groundwater is also a major source of irrigation water for much of the state's agriculture. However, decades of crop production have allowed fertilizers and some agricultural chemicals to reach the groundwater in some parts of the state and unsustainable groundwater pumping has caused depletions to many of the state's aquifers adversely affecting drinking water supplies. The Project will address statewide issues of public security, health, and safety by improving maps of groundwater vulnerability and groundwater levels that will allow water managers to better assess the amount of groundwater in storage in Nebraska's aquifers, evaluate selected areas to increase drinking water supplies, and mitigate potential threats to groundwater quality. Protecting groundwater resources and related infrastructure is critical to Nebraska because the cost of replacing these systems is enormous and would likely incur significant financial burdens on small communities with limited tax base.

13. Contributes to the state's ability to leverage state dollars with local or federal government partners or other partners to maximize the use of its resources;

- List other funding sources or other partners, and the amount each will contribute, in a funding matrix.
- Describe how each source of funding is made available if the project is funded.
- Provide a copy or evidence of each commitment, for each separate source, of match dollars and funding partners.
- Describe how you will proceed if other funding sources do not come through.

The cost of the Project is $314,000. The USGS, through its Cooperative Matching Funds will provide $74,000 as in-kind funds taking the state and local project total for this grant to $240,000 which will be funded by ENWRA with 60% anticipated back from WSF. The local board of directors for LPSNRD has approved submittal of this application and allocation of the necessary funds on behalf of ENWRA per their local governmental budget process. Please refer to Section B #4 and #5 for budget commitments and letters of support in Attachment A for reference.

Funding source	2022	2023	2024	Totals
WSF (60%)	$73,800	$50,400	$19,800	$144,000
ENWRA (40%)	$49,200	$33,600	$13,200	$96,000
State/Local Project total	$123,000	$84,000	$33,000	$240,000
USGS (federal cooperative dollars)	$40,000	$29,000	$5,000	$74,000
Totals	**$163,000**	**$113,000**	**$38,000**	**$314,000**

The Project builds on previous state dollar investments as it is considered a follow-up, expansion, regional coverage of additional data piloted by ENWRA's multi partner (NRDs, NeDNR, NDEE, UNL-CSD, USGS) hydrogeologic assessment efforts and Long

Range Planning efforts (Table in Section C question #6) specific to recharge, groundwater - surface water interaction and water budget since 2006. NeDNR was a funding partner on ENWRA data collection in 2006-2007 with the ENWRA pilot projects (NeDNR IWMPP Contracts 294 and 359), reconnaissance flights in 2014 and 2015 (NeDNR Contract #789), and various subsequent AEM related WSF grant funding to help provide regional datasets to support numerical models for eastern parts of Nebraska (LPMRT). This Project will support updates to UNL-CSD's statewide water level monitoring network (now linked to USGS and National Groundwater Monitoring Network) and support aquifer and groundwater mapping efforts in eastern NE. Portions of the Project will likely move forward without this grant funding but the cooperative science would not be coordinated to accomplish the recharge mapping and Focus Area recommendations proposed with this Study.

14. Contributes to watershed health and function;

- Describe how the project will contribute to watershed health and function in detail and list all of the watersheds affected.

Groundwater is a critical component of stream function and watershed health. The data resulting from this Project will benefit several watersheds and two major NeDNR managed basins (Missouri Tributaries and Lower Platte) and will be vital for making informed decisions regarding management within the watersheds/basins. AEM data will identify areas of groundwater recharge and can serve as the basis for various NRD projects which enhance such recharge (e.g. recharge basins). The proposed Project is a cooperative effort to improve the understanding of groundwater recharge and vulnerability and water-level maps for Nebraska's major aquifer systems in Eastern Nebraska. As part of the Project, focused studies will address specific issues raised by project sponsors to address emerging water management issues. One specific Focus Area that is of interest to the P-MRNRD and the LPNNRD will examine the feasibility of streamflow augmentation on the Lower Platte River. Increased streamflow is critical to sustain wildlife populations especially on the lower Platte River system where instream flow requirements must be met. Recent AEM surveys have mapped glacial outwash aquifer and a sandstone rich interval of the Dakota Formation that is currently unused near Arlington, Nebraska. The aquifer appears to be in hydrologic connection to the overlying Elkhorn River alluvial aquifer and could serve as a source of water for streamflow augmentation during periods of short-term water shortages. This water source would likely get recharged during periods of higher flow in the Elkhorn River. Retiming the release of water will increase streamflow and improve the overall health of aquatic and riparian habitats needed for threatened or endangered species, particularly during periods of drought. This type of active management action could alleviate the need for additional pumping restrictions upstream of the Lower Platte River basin. These actions, while supporting sustainable groundwater and surface water resources, will also benefit the many animal and plant species (some of them threatened or endangered) which depend on these ecosystems. For example, Lewis and Clark Lake in the LCNRD is part of the Missouri River Recovery Program (MRRP) protecting pallid sturgeon, least

tern and piping plover habitats (https://www.nwo.usace.army.mil/MRRP/).

15. Uses objectives described in the annual report and plan of work for the state water planning and review process issued by the department.

    - Identify the date of the Annual Report utilized.
    - List any and all objectives of the Annual Report intended to be met by the project
    - Explain how the project meets each objective.

The Annual Report and Plan of Work for the State Water Planning and Review Process submitted to the Governor and Legislature dated September 2019 indicated:

The Department continued to assess potential advancements in the best available science and methods that could be incorporated into these modeling tools by supporting efforts of the Eastern Nebraska Water Resources Assessment (ENWRA) organization. To accomplish this, Department staff attended ENWRA meetings and workshops to stay up-to-date on study progress and developments, and technical expertise pertaining to ENWRA data. A portion of ENWRA's work involves utilization of airborne geophysical studies to assist in mapping of subsurface geology/hydrogeology in Eastern Nebraska. The Department's primary interest in this work is to increase understanding the effectiveness of airborne geophysical studies in assessing hydrologic connection of aquifers and streams through groundwater modeling tools.

This project addresses objectives mentioned in the Annual Report related to Water Planning and Fully Appropriated Basins (FAB) Evaluation, predominantly the Lower Platte River Basin-Wide Water Management Plan. This project supports Goal 1, which is to develop and maintain a water supply and use inventory based on the best available data and analysis. Towards that end, the Project will enhance the understanding of groundwater recharge characteristics across Eastern Nebraska and update groundwater level maps. Recommendations for focused studies will assess current water-level and water-quality data and identify data gaps to address specific water supply issues. Furthermore, this project will also create new water-level maps for major aquifers within the state to replace the 1995 statewide map. Updated water-level maps could be used as an input to future versions of the recently completed Lower Platte Missouri Tributary Model and other modeling efforts. The Lower Platte Missouri Tributary Model will likely be updated at the current 5-year increment and the Hydrologically Connected Areas (HCAs) will be reevaluated.

16. Federal Mandate Bonus. If you believe that your project is designed to meet the requirements of a federal mandate which furthers the goals of the WSF, then:

    - Describe the federal mandate.
    - Provide documentary evidence of the federal mandate.

- Describe how the project meets the requirements of the federal mandate.
- Describe the relationship between the federal mandate and how the project furthers the goals of water sustainability.

The Safe Drinking Water Act of 1947 (SDWA; Pub.L.93-523 88 Stat. 1660 42 U.S.C. §300) discusses the protection of groundwater sources from contaminants identified as threats to public health and quantifies the acceptable levels of these contaminants in public systems. Public water suppliers are required to provide drinking water that meets various federal standards or Maximum Contaminant Levels (MCLs), with the most applicable being the 10 parts per million MCL for nitrate-nitrogen. The SDWA also discusses the designation of a sole source aquifer (section 1427) and the establishment of wellhead protection areas (section 1428). This project will help communities meeting the standards set forth by the SDWA. The Project would create and improve maps as recharge potential that could be used to assess groundwater vulnerability of drinking water aquifer from surface contamination. Historic groundwater quality data will be evaluated, and statistical testing will be used to improve maps of groundwater recharge potential or groundwater vulnerability. Updated water-level maps could be used by municipalities to delineate groundwater capture zones and update or create well head protection areas for newly drilled wells. In addition, the Project will provide ENWRA NRDs with additional information to promote agricultural best management practices (BMPs) in these areas so as to minimize the occurrence and likelihood of nitrate contamination of groundwater supplies.