NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Nebraska GeoCloud and Airborne Electromagnetic (AEM) Data Integration

PRIMARY CONTACT INFORMATION

Entity Name: *Lower Platte South Natural Resources District (NRD)*

Contact Name: *Katie Cameron*

Address: *3125 Portia St, Lincoln NE 68521*

Phone: *402-476-2729*

Email: *kcameron_enwra@lpsnrd.org*

Partners / Co-sponsors, if any: *ENWRA group (Lower Platte North NRD, Lower Platte South NRD, Lower Elkhorn NRD, Lewis and Clark NRD, Papio-Missouri River NRD, Nemaha NRD), Twin Platte NRD, Central Platte NRD, Lower Loup NRD, Upper Elkhorn NRD, U.S. Geological Survey, UNL School of Natural Resources, Conservation and Survey, Department of Environmental Quality*

1. Dollar amounts requested: (Grant, Loan, or Combination)

   Grant amount requested. $ *247,437.60*

   Loan amount requested. $ Click here to enter text.

   If Loan, how many years repayment period? Click here to enter text.

   If Loan, supply a complete year-by-year repayment schedule.
   Click here to enter text.

2. Permits Needed - Attach copy for each obtained (N/A = not applicable)

Nebraska Game & Parks Commission (G&P) consultation on Threatened and Endangered Species and their Habitat	N/A☒	Obtained: YES☐	NO☐
Surface Water Right	N/A☒	Obtained: YES☐	NO☐
USACE (e.g., 404 Permit)	N/A☒	Obtained: YES☐	NO☐
Cultural Resources Evaluation	N/A☒	Obtained: YES☐	NO☐
Other (provide explanation below) Click here to enter text.	N/A☒	Obtained: YES☐	NO☐

3. Are you applying for funding for a combined sewer over-flow 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☒

   If yes attach a copy to your application. Click here to enter text.

   If yes what is the population served by your project? Click here to enter text.

   If yes provide a demonstration of need. Click here to enter text.

   If yes and you were approved for funding in the most recent funding cycle, then resubmit the above information updated annually but you need not complete the remainder of the application.

4. If you are or are representing an NRD, do you have an Integrated Management Plan in place, or have you initiated one?

   N/A☐ YES☒ NO☐

5. Has this application previously been submitted for funding assistance from the Water Sustainability Fund and not been funded?

   YES☐ NO☒

   If yes, have any changes been made to the application in comparison to the previously submitted application? Click here to enter text.

   If yes, describe the changes that have been made since the last application.

Click here to enter text.

No, I certify the application is a true and exact copy of the previously submitted and scored application. (Signature required) Click here to enter text.

6. Complete the following if your project has or will commence prior to next July 1st 2017.

As of the date of submittal of this application, what is the Total Net Local Share of Expenses incurred for which you are asking cost share assistance from this fund? $0. *No costs have been incurred to date.*

Attach all substantiating documentation such as invoices, cancelled checks etc. along with an itemized statement for these expenses. *NA*

Estimate the Total Net Local Share of Expenses and a description of each you will incur between the date of submittal of this application and next July 1st for which you are asking cost share assistance from this fund.

We will incur costs of $20,382 between August 1, 2016 and December 15, 2016, for the pilot GeoCloud project and GeoScene 3D software license. We are requesting reimbursement of these prior costs. These are the only costs that will be incurred prior to July 1, 2017. See signed contract and official quote from consultant (Attachment 5). The balance of the direct project costs will be $227,055.6, incurred after July 1, 2017. Please refer to Table 3 in Section D for a detailed breakdown of the timeline and costs.

Section B.

DNR DIRECTOR'S FINDINGS

Does your project include physical construction (defined as moving dirt, directing water, physically constructing something, or installing equipment)?

YES☐ NO☒

1(a). If yes (structural), submit a feasibility report (to comply with Title 261, CH 2) including engineering and technical data and the following information:

A discussion of the plan of development (004.01 A);
Click here to enter text.

A description of all field investigations made to substantiate the feasibility report (004.01 B); Click here to enter text.

Maps, drawings, charts, tables, etc., used as a basis for the feasibility report (004.01 C); Click here to enter text.

A description of any necessary water and land rights and pertinent water supply and water quality information, if appropriate (004.01 D);
Click here to enter text.

A discussion of each component of the final plan including, when applicable (004.01 E);

Required geologic investigation (004.01 E 1); Click here to enter text.

Required hydrologic data (004.01 E 2); Click here to enter text.

Design criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria (004.01 E 3). Click here to enter text.

1(b). If no (non-structural), submit data necessary to establish technical feasibility including, but not limited to the following (004.02):

A discussion of the plan of development (004.02 A);
Airborne Electromagnetic (AEM) surveys have greatly advanced hydrogeologic mapping and groundwater management efforts by providing cost-effective, high-resolution subsurface information. By 2017, Nebraska will have invested nearly $10 million in more than 13,400 line-miles of AEM. Despite the large investments in data collection, there has been no large-scale effort to assemble, inventory, and manage the data for long-term preservation in a centralized digital network. Furthermore, data reporting requirements have not been standardized and

hydrogeologic mapping methods have not been investigated. As a result, using the results of separate AEM surveys together in one study area remains challenging. Much scientific work remains to be done to understand how AEM can be effectively used to map hydrogeologic units in a variety of hydrogeologic settings. To protect taxpayer investments in AEM and realize maximum benefit of these data, it is critical that Nebraska undertakes a program of data management and research aimed at understanding the best use of AEM for groundwater sustainability efforts. The participating Natural Resources Districts (NRDs) are requesting funds for the University of Nebraska's Conservation and Survey Division (CSD) and US Geological Survey (USGS) to implement an AEM data preservation and research program. This request for funding will be matched by local funds from partnerships with NRDs. The project will have long-lasting, State-wide benefits. The project will develop metadata standards for AEM data, facilitate data archiving and public access to information, provide standards and guidelines that will maximize cost-effectiveness of future AEM studies, and provide improved methods for using AEM data for hydrogeologic characterization. The CSD is the appropriate lead partner for this effort, as it is mandated by State Statute to "serve the citizens as an information bureau in regard to the resources, industries and development of Nebraska." CSD maintains several Statewide databases, including those for borehole logs and groundwater-level monitoring data. These databases are in high demand by our stakeholders, including the NRDs, but there is a rapidly growing demand for AEM data, which CSD hasn't yet developed a data management infrastructure. CSD is centrally positioned to facilitate the archiving and distributing of geological and geophysical data, but financial resources are needed to carry out collection inventories and build the infrastructure to manage these growing datasets into the future. This project will assemble geological and geophysical data in GeoCloud, an internet storage network designed specifically for airborne electromagnetic (AEM) data and supporting geologic information. GeoCloud will permit seamless data integration and sharing of results between the Conservation and Survey Division, U.S. Geological Survey, and Nebraska's NRDs aimed at mapping the bedrock surface and other hydrostratigraphic units to improve estimation of groundwater in storage. In order to develop best scientific approaches to using AEM for hydrogeologic mapping, it is first necessary to carry out a series of case studies to investigate how spatial scale, vertical resolution, geologic setting, and hydrogeologic characteristics influence the ways in which AEM can be used any particular area. It is also necessary to evaluate different methods for mapping subsurface layers in different hydrogeologic settings. For example, mapping methods for the Ogallala portion of the High Plains aquifer are likely to be very different than methods for glacial aquifers. Therefore, it is necessary to choose case study areas that span several different hydrogeologic settings. Two such areas are the Bazile Groundwater Management Area (Knox, Antelope, Pierce Counties) and the Platte-Colfax County area. Both areas overlie portions of the High Plains aquifer as well as glacial aquifers. Geologists will complete hydrogeologic maps for these areas to investigate best methods for mapping and for achieving balance between sounds results and minimal investment. The results of these studies will inform the planning of future studies and will lead to better data collection and decision making.

A description of field or research investigations utilized to substantiate the project conception (004.02 B); *The value of AEM data has been demonstrated numerous times within the state of Nebraska to address a variety of water resource issues including improving estimates of groundwater in storage (Abraham and others, 2012), mapping buried paleovalley aquifers in glacial terrain (Korus and others, 2013; 2016), assessing secondary bedrock aquifers for drinking water supply (Abraham and others, 2013), and assessing the connectivity of groundwater and surface water (Abraham and others, 2012).*

A description of the necessary water and/or land rights, if applicable (004.02 C); NA

A discussion of 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). *This project will make all AEM data collected with taxpayer dollars within the state of Nebraska available to all water resource managers, consultants, and other professionals tasked with water resource planning to develop and manage water supplies needed for agricultural, municipal, industrial uses and to maintain water supplies needed for wildlife and recreation.*

2. Provide evidence that there are no known means of accomplishing the same purpose or purposes more economically, by describing the next best alternative. *Currently AEM and supporting geologic data are stored in multiple locations that are often not easily accessible. In some cases data are available online, but often water managers or other water resource professionals may not know the data exist for given project area. By creating an AEM-equivalent to the CSD test-hole database (snr.unl.edu/data/geologysoils/NebraskaTestHole/NebraskaTestHoleIntro.aspx) AEM and supporting geologic data can be accessed, archived, and preserved for future use within Nebraska GeoCloud. If we continue down the current path where data have not been properly archived and stored electronically on secured servers, there is a risk of data loss in future years; furthermore, storing data in multiple locations increases the likelihood that water resource managers or other professionals may miss key opportunities to make use of these datasets for water resource planning projects.*

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 shall be fifty (50) years or with prior approval of the Director, up to one hundred (100) years [T261 CH 2 (005)].

- 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 costs of the pilot Nebraska GeoCloud and full implementation is estimated in table 3 in section D of this application, and in Attachment 5.*
- 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 any intangible or secondary benefits 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, such that the economic feasibility of the project can be approved by the Director and the Commission (005.02). *The primary tangible benefit from this project is the preservation of AEM data for future water planning needs and for purposes beyond a given survey's original intent. Below is a table that summarizes the costs of AEM data collection and processing for past and planned AEM surveys. Creating a way to archive and maintain these data sets for future use will eliminate the risk of data loss. A secondary intangible benefit to this work is by archiving and storing data in one location rather than storing data in multiple locations reduces the likelihood that water resource managers or other professionals would miss key opportunities to make use of these datasets for water resource planning projects. Other tangible benefits are the hydrogeologic framework models that will be developed for the case studies of the Bazile Groundwater Management Area and the Platte-Colfax Counties area. These products will be used by water resources managers to make management decisions regarding water sustainability and protection of groundwater quality.*
- All benefit and cost data shall be presented in a table form to indicate the annual cash flow for the life of the proposal, not to exceed 100 years (005.03).

TABLE 1					
Site	**year**	**Method used**	**miles**	**km**	**Investment Amount***
ASHLAND	2007	HEM Fugro Resolve	240	386	$494,000
OAKLAND	2007	HEM Fugro Resolve	239	385	
FIRTH	2007	HEM Fugro Resolve	247	398	
NP/SPNRD	2008	HEM Fugro Resolve	854	1,375	$582,000
SPRAGUE	2009	HEM Fugro Resolve	674	1084	$459,000
SWEDEBURG	2009	HEM Fugro Resolve	191	307	$130,000
SAND HILLS	2009	unknown to applicant	355	571	$242,000
NP/SPNRD	2009	HEM Fugro Resolve	582	937	$396,000
NP, SP, TPNRD	2010	TDEM SkyTem 304(?)	1200	1933	$817,000
NP, SP, TPNRD	2010	Geotech (test flights)	932	1,500	$635,000
USACE at MEAD	2012	HEM Fugro Resolve(?)	293	471	$200,000
CRESCENT LAKES	2012	Fugro Resolve	359	578	$244,000
CLARKSON-HOWELLS	2013	TDEM SkyTem 304	249	400	$170,000
DWIGHT-VALPARAISO-BRAINARD	2013	TDEM SkyTem 304	823	1325	$560,000
ENWRA RECON/LENRD 3-mile	2014-15	TDEM SkyTem 508	2205	3548	$1,502,000
COLUMBUS (LLNRD)	2016	Planned survey	608	978	$414,000
LENRD	2016	Planned survey	608	978	$414,000
UENRD/LCNRD /LNNRD (BAZILE area)	2016	Planned survey	560	901	$346,000
LCNRD	2016	Planned survey	149	240	$101,000
LPNNRD	2016	Planned survey	608	978	$414,000
P-MRNRD	2016	Planned survey	590	950	$402,000
LPSNRD	2016	Planned survey	608	978	$414,000
TPNRD+NCOPRE area	2016	Planned survey	760	1,223	$518,000
CPNRD	2016	Planned survey	596	959	$406,000
PRRIP	2016	Planned survey	103	165	$70,000
Total					$9,930,000

*based on 2015 costs, assumes $681 per line mile

- *The cost of data collection for the 13,400 line miles of AEM data spanning 9 years of data collection cost approximately $10 million to the Nebraska taxpayer. The total requested amount of funding is $247,437.60 and would ensure preservation of AEM data for future use.*
- 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, the economic feasibility of such proposal shall be demonstrated by such method as the Director and the Commission deem appropriate (005.04). Click here to enter text.

4. Provide evidence that sufficient funds are available to complete the proposal. *The participating NRDs have budgeted funds of $164,958.40 for this project. Letters of support and evidence of ENWRA funding commitments are provided in Attachments 6, 7, and 8. The USGS, through its Cooperative Water Program, is able to put money in the amount of $55,000 towards the proposed work.*

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace).
The combined tax revenue for the participating NRDs is roughly $189,578,180 (see Table 2 in Section C), which could cover the anticipated annual maintenance cost of $7,500 of the Nebraska GeoCloud. Long-term maintenance costs will be covered under a Cooperative Agreement (Attachment 9).

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.
The proposed project will have little impact on the environment. No construction or field work is planned; furthermore, full implementation of this project would reduce the potential for unsustainable development of water supplies and would lead to improved groundwater management.

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds.
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' authority to enter into contracts or agreements, budget and expend levied property taxes, and own and operate property or equipment.

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

The Nebraska Department of Natural Resources, in its annual report (dated September 2015) states that for the effective conservation and management of Nebraska's water resources the State of Nebraska must develop and maintain data and information regarding water supplies across the state to support a base for water planning and management of groundwater. This project would also enhance the state's ability to plan and design future water resource projects and would also enhance the Department's ability to conjunctively manage groundwater and surface-water resources. This will be achieved by improving access to AEM and supporting geologic data and creating data quality standards for future AEM surveys. Providing a means to serve the data publicly would provide consultants, engineers, water resource planners, water managers, and other scientist and researches access to previously published AEM data and interpretations for future resource assessments or water planning projects intended to increase aquifer recharge or enhance streamflows, provide improved estimates of groundwater in storage, and to assess the connection between groundwater and surface water and will complement the Department's INSIGHT online database.

10. Are land rights necessary to complete your project?

YES☐ NO☒

If yes, provide a complete listing of all lands involved in the project.
Click here to enter text.

If yes, attach proof of ownership for each easements, rights-of-way and fee title currently held.
Click here to enter text.

If yes, provide assurance that you can hold or can acquire title to all lands not currently held.
Click here to enter text.

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 purposed 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.*

12. Identify the probable environmental and ecological consequences that may result as the result of the project*. The proposed project is a*

statewide effort to serve all historic and future AEM and supporting geologic data for water managers and other water planning professionals can access the data for projects aimed at increasing streamflows across the state. Increased streamflow in critical to sustain wildlife populations especially on the lower Platte River system where instream flow requirements must be met. As an example, if an NRD chose to divert excess surface-water into an irrigation canal the purposes of intentional recharge, the exact location of recharge could be determined from AEM data in order to provide the maximum benefit. Increased streamflows will improve the overall health of aquatic and riparian habitats needed for threatened or endangered species, particularly during periods of drought.

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 in parenthesis. 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) and groundwater contamination sites. 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 2016, AEM surveys will have been flown over portions of approximately 150 WHPAs throughout Nebraska. This project provides a data network and protocols, standards, and methods for hydrogeologic mapping, which can be applied to those WHPAs for which AEM data is available. These data can be used to develop improved groundwater models to delineate the capture zones of municipal wells. Improving the spatial resolution of aquifers and confining units within these zones improves the prediction of potential impacts to wells. The project will benefit wellhead protection planning and action efforts in ~150 WHPAs, including 7 of Nebraska's top 10 most populous cities: Omaha, Lincoln, Bellevue, Kearney, North Platte, Norfolk, and Columbus, totaling nearly 900,000 people, or ~50% of the population of the State. This project also benefits the remediation and mitigation of contamination in groundwater supplies under industrial sites. These efforts require an understanding of the complex, three-dimensional architecture of aquifers and confining units. The aquifer framework determines the fate and movement of contaminants, especially those that sink in the subsurface, known as dense, non-aqueous phase liquids (DNAPL). DNAPLs migrate downward through an aquifer until they come into contact with an impermeable surface, commonly bedrock, which significantly alters the direction and rate of plume migration. As a result, DNAPLs are among the most difficult contaminants to remediate. Large DNAPL plumes consisting of chlorinated solvents, polycyclic aromatic hydrocarbons (PAHs), and other industrial chemicals, are present beneath manufacturing and degreasing facilities, dry cleaners, former manufactured gas facilities, and former military facilities throughout Nebraska. DNAPLs threaten municipal and domestic groundwater supplies under the cities of Norfolk, Hastings, Beatrice, and Grand Island, among others (total population of more than 100,000). The disposal of chemical wastes at the former Nebraska ordinance plant near Mead has resulted in several large contaminant plumes that are migrating in the direction of municipal well fields for Omaha and Lincoln, which supply water to more than 670,000 people. Hydrogeologic mapping aids in the remediation and mitigation of DNAPL plumes by locating those areas where contaminants may reside in bedrock lows or migrate along the bedrock surface. Failure to accurately locate these areas can result in the continued release of dissolved chemicals into the surrounding aquifer for long periods of time. Hydraulic extraction and treatment methods have been used extensively in an attempt to contain contamination plumes at Mead and Grand Island. These methods are expensive and time-consuming, and in many cases are not cost effective or have limited effectiveness in reducing contaminant concentrations. In situ chemical oxidation (ISCO) treatment of groundwater has also been applied. New methods, including thermal treatment, are being applied in areas where other methods have failed. For any treatment method to be effective, however, a detailed understanding of the spatial extent of the aquifer and confining units is required. This project provides direct and indirect benefits to those remediation efforts by supplying data and methods to map the aquifer framework over various spatial scales and provide critical information about contaminant fate and transport.

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.

Nebraska GeoCloud is a State-wide project, so it meets the goals and objectives of many approved IMPs and GWMPs. Three examples are given here. (1) The.Lower Loup NRD (LLNRD) Integrated Management Plan was approved by NDNR on May 9, 2016. [Goal 1: Promote and support 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 District's current and future water supplies, water uses and outflows. Objective 1.2: Monitor current and future water demands in the basin. Objective 1.3: Use best available science and technology to monitor water supplies.] The LLNRD has established a groundwater monitoring network to monitor water supplies and identify water quantity issues. The NRD sponsored the development of the Elkhorn-Loup Model (ELM), a regional groundwater model aimed at understanding groundwater/surface water interactions in the Loup and Elkhorn basins. In 2015, the LLNRD commissioned a groundwater modeling study of the Columbus area to address concerns about groundwater-level declines east of the city. The proposed project will contribute to the goals and objectives of the IMP by providing access to "best available science" through the Nebraska GeoCloud, which will make Airborne Electromagnetic (AEM) surveys available to water resource managers, scientists, and planners. It will apply updated scientific approaches to bedrock mapping, which was last completed for Nebraska in the late 1970's. This project will apply modern techniques and develop new methods for hydrogeologic mapping using AEM and borehole data. The project will provide hydrogeologic maps of the base of aquifer and an inventory of the groundwater resources in the Platte County portion of the LLNRD, including the Loup River valley near its confluence with the Platte River downstream of Columbus (Attachment 4). The map and inventory will supplement ongoing work in the area by providing a hydrogeologic framework for model improvements and refinement. In addition, because AEM cannot be flown over municipalities, the project will provide documentation of best scientific approaches for mapping the bedrock surface beneath municipalities, including the City of Columbus. The base of aquifer map will supplement ongoing groundwater-level monitoring in the LLNRD, providing assessment of changes in aquifer thickness and storage capacity. The maps can be used to identify areas where drawdown due to over-extraction is excessive. These products will aid the NRD in making decisions on water availability, flow, recharge, and the impacts of development. (2) The Central Platte NRD (CPNRD) Integrated Management Plan was approved by NDNR on May 21, 2012. [Goal 3: Maintain for present and future generations the District's water resources while promoting programs that allow economic growth. Objective 2: Develop rules, regulations, and programs that will strive for a balance between water use and availability.] The CPNRD has initiated a conjunctive management program using rehabilitated canals to store excess water and recharge the aquifer during dry periods. The Nebraska GeoCloud and hydrogeologic mapping methods in the proposed project

will address the goals and objectives of the IMP by providing sound scientific data and analytical tools for quantifying water exchanges between canals and streams in the CPNRD to maximize the efficient use of stored water. The Nebraska GeoCloud will provide a centralized data network to help water managers locate potential recharge zones, map preferential groundwater flow pathways between canals and streams, and determine the best timing for storage of excess water and releases of flows. The AEM data and mapping methods can be used to update groundwater models such as COHYST, which are used to assess water use and availability under various scenarios of conjunctive management. (3) The Lower Elkhorn NRD (LENRD) Groundwater Management Plan was approved by NDNR on December 16, 1994. [Goal 1: Conserve groundwater quality and quantity. Objective 1: Monitor groundwater to detect changes, trends, or problems. Objective 5: Increase our general knowledge of the hydrogeologic characteristics of the District.] The LENRD has developed an extensive groundwater monitoring network and participates in the Eastern Nebraska Water Resources Assessment (ENWRA), which is aimed at providing a comprehensive assessment of groundwater supplies in the glaciated portion of eastern Nebraska. In recent years, NRD monitoring has identified an area of declining groundwater levels in Colfax County. Groundwater levels have declined as much as 30 ft. since predevelopment over an area of more than 120 square miles. The proposed project will compile several AEM surveys to develop hydrogeologic maps of Platte and Colfax Counties that will assist the management efforts of the LENRD (see Attachment 4). The maps will provide key information to understand the available water supply, identify monitoring needs, develop management controls and programs, and reduce depletions.

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.

The Nebraska GeoCloud project will facilitate access to AEM and supporting geologic information (Attachment 2), 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 chose to divert excess surface-water into an irrigation canal for the purposes of intentional recharge, the exact location of recharge could be determined from AEM data in order to provide the maximum benefit. By publicly serving AEM and supporting geologic data through the Nebraska GeoCloud, water managers will make well-informed decisions that will limit aquifer depletions. Water resource managers will also assess the feasibility of developing secondary aquifers to meet future water demands. 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. In addition to providing a permanent repository for AEM data and results, a CSD Bulletin will be published outlining proposed bedrock mapping strategy for various geologic settings in Nebraska, which is intended to inform water resource managers on the proper planning and execution of AEM surveys for a variety of purposes. Benefits from this effort described herein are not limited to one specific project area. Rather, shared AEM and supporting geologic data will improve statewide water planning projects and management plans providing benefits to all 1.8 million Nebraska residents. Aquifer depletion in Colfax County will be directly addressed in this project as part of the hydrogeologic mapping demonstration project. Groundwater levels in northern Colfax County have dropped by as much as 30 ft. since predevelopment over an area of more than 120 square miles. The Lower Platte North NRD recently approved a Special Quantity Subarea for portions of Platte and Colfax Counties to address declining groundwater levels (Attachment 4). The AEM data and mapping efforts will assist the management efforts of the Lower Elkhorn NRD to understand the available water supply, identify monitoring needs, develop management controls and programs, and reduce depletions.

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 improving estimates of groundwater in storage (Abraham and others, 2012), mapping buried paleovalley aquifers in glacial terrain (Korus and others, 2013, 2016), assessing secondary bedrock aquifers for drinking water supply (Abraham and others, 2013), and assessing the connectivity of groundwater and surface water (Abraham and others, 2012). This project will make all taxpayer-funded AEM survey data available to all water resource managers, consultants, and other professionals tasked with water resource planning to develop and manage water supplies needed for agricultural, municipal, industrial uses and to maintain water supplies needed for wildlife and recreation. Currently AEM and supporting geologic data are stored in multiple locations often not easily accessible. In some cases data are available online, but often water managers or other water resource professionals may not know the data exist for given project area. The AEM data system will supplement and build upon the CSD test-hole database (snr.unl.edu/data/geologysoils/NebraskaTestHole/ NebraskaTestHoleIntro.aspx). AEM and supporting geologic data can be accessed, archived, and preserved for future use within Nebraska GeoCloud. By 2017, Nebraska will have invested nearly $10 million in more than 13,400 line-miles of AEM data. Currently, data have not been properly

archived and stored electronically on secured servers. If we continue on the current path, there is a high risk that data will be lost; furthermore, storing data in multiple locations increases the likelihood that water resource managers or other professionals may miss key opportunities to make use of these datasets for water resource planning projects.

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, approximately 13,400 miles of AEM data have been collected for a variety of purposes which include estimating groundwater in storage, understanding the connectivity of groundwater and surface water, groundwater exploration and development, and assessing groundwater vulnerability to surface contamination. This project will maximize beneficial use by creating Nebraska GeoCloud (Attachment 2), which will publicly serve AEM data to the state of Nebraska and its 1.8 million residents where AEM survey data and interpretations can be used for other purposes beyond their original intent. Serving AEM and supporting data will give water managers the ability to assess threats to their current water supply from overexploitation and surface contamination and evaluate the potential of developing secondary aquifers for drinking water supply. 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.

This project is cost-effective and it will improve the cost-effectiveness of future AEM surveys and hydrogeologic mapping efforts in Nebraska. The project will provide a secure archive of AEM data worth at nearly $10,000,000 and make this data available to wide range of users through an internet mapping service. Options for achieving these benefits are described below, followed by rationale for achieving long-term cost-effective solutions for future projects. The storage and use of AEM data requires specialized data processing procedures and unique software designed specifically for 3-D geophysical data. Currently, there are no data management solutions within state or local agencies that are specifically equipped to handle the special requirements of AEM data. Placing the AEM data into an existing system is not an option. Maintaining the status quo (i.e. no centralized data management) is also not an option, since the risk of

lost data could equal the estimated cost of $10,000,000 that Nebraska taxpayers will have invested in data collection by the end of 2016. Therefore, two options exist for managing this valuable data to prevent data loss: (1) build the software and data infrastructure from the ground-up and hire staff with the skills to maintain such data and software, (2) hire outside entity to adapt an existing AEM data system to fit Nebraska's needs. (1.) Build a data management solution from the ground-up. The costs of building a data solution and software from the ground-up would be large, requiring a group of full-time employees including geophysicists, geologists, IT specialists, and computer software engineers over a period of several years. Salaries and benefits for these specialists would likely exceed $1.2 million over three years, based on ~$100,000 each (salaries + benefits) for four employees. The costs of facilities, operations, and maintenance would significantly add to that total, and ongoing maintenance of the data system would be required. As an example, the Danish Geological Survey maintains their own AEM data management system with a minimum of 3 full-time, permanent employees at an estimated cost of $300,000 annually. Personnel with these very specialized skills are in high demand and short supply, and it is highly unlikely that a core group of key experts could be hired on a limited-term basis in Nebraska to build a data system. (2.) Hire outside entity to build customized data solution. There are several companies that specialize in management of geophysical data. Most of them, however, serve the mining and petroleum industries, and their software solutions have in some cases been adapted to groundwater. We are aware of only one company that specializes specifically in groundwater geophysics. I-GIS is a Danish software and database development company that specializes in AEM data for groundwater characterization. The Danish are worldwide leaders in the acquisition of AEM data and its application to groundwater studies. Danish working groups, including the Danish Geological Survey (GEUS), Danish Nature Agency, Aarhus University, and I-GIS, have developed software and database solutions for AEM data in Denmark. The Conservation and Survey Division and the U.S. Geological Survey Nebraska Water Science Center have been working closely with I-GIS to prepare a scope of work for a cost-effective solution for managing, sharing, and using Nebraska AEM data. This solution, named the Nebraska GeoCloud, would involve adapting the Danish model to Nebraska as well as developing some unique capabilities designed specifically for our data. Implementation of this project is estimated to cost $467,396, which is $732,604 less than the estimated cost of building a data management system from the ground-up. Annual maintenance fees are expected to be ~$7,500, which is much less than maintaining permanent employees. Long-term cost-effectiveness will be achieved from this project through the recommendations, standards, and guidelines. The CSD Bulletin will provide recommendations on flight-line spacings and borehole data densities for effective hydrogeological mapping in a variety of settings. The pilot study areas will cover a range of hydrogeological areas, including Ogallala/High Plains aquifer, glacial aquifers, and secondary bedrock aquifers. This will afford the opportunity to examine the use of AEM data to accurately map hydrogeologic units in 3-D. Water managers will use the results of these studies to plan future studies to achieve maximum benefits at minimum cost.

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.

This project will create Nebraska GeoCloud, which is a map-based, searchable database for all Nebraska AEM data (Attachment 2). The project will develop standards and guidelines for future AEM data collection efforts so that water planning projects can achieve maximum benefit from taxpayer-funded studies. Making AEM data publicly available for future water planning projects, which can include intentional groundwater recharge or the development of secondary aquifers for drinking water, would help the state of Nebraska meet interstate compacts and federal laws. Several of Nebraska's NRDs and the state of Nebraska are required to meet the Platte River Program obligations for groundwater depletions, improve flows for endangered and threatened species, and assist the NRDs with regulation and management of groundwater. The results of this project will assist the State in managing water supplies and planning future water projects intended to help 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). Another potential outcome of this project is that the shared information could assist water managers in compliance with the Safe Drinking Water Act, including the establishment of wellhead protection areas (Part C, section 1428). Additionally, this information provided by this project would assist water managers 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 ground water 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 Untied 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 85% 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 has 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. The project will benefit public security, health, and safety by improving access to AEM data and supporting geologic data that will allow water managers to better assess the amount of groundwater in storage in Nebraska's aquifers, plan future water projects to sustain or increase streamflow, and mitigate potential threats to groundwater quality. Immediate and direct benefits to critical infrastructure will be achieved as the result of hydrogeologic mapping in the Bazile Groundwater Management Area (BGMA) and in Platte and Colfax Counties (Attachments 3 and 4). Critical infrastructure for public water supply systems in these areas are threatened by nitrate-nitrogen 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. For example, the public water supply system for the City of Osmond, which lies within the boundaries of the BGMA, is on an Administrative Order (AO) from the Department of Health and Human Services for exceeding the Maximum Contaminant Level (MCL) for nitrate-nitrogen. Mapping efforts in this area will help city officials understand the sources and movement of contaminated groundwater and evaluate the costs and benefits of water treatment versus developing a new water supply. Another example is the Village of Clarkson, which instituted mandatory water restrictions in 2012 due to declining water levels amidst the record-setting drought. The maps will help city officials determine best means of protecting the water supply system from future water shortages. The maps will also assist in protecting critical water supply infrastructure for other public water supply systems in the BGMA and Platte-Colfax areas, including: the Cities of Creighton, Columbus, Plainview, Schuyler, and Clarkson; the Villages of Orchard, Brunswick, Royal, Winnetoon, Wausa, Rogers, Howells, Leigh, Creston, Humphrey, Lindsay, Platte Center, and Monroe; and the West Knox Rural Water District.

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.

The Nebraska GeoCloud will have statewide benefits for improving water quality. Gorundwater in many areas of the state has been degraded due to non-point source contamination from agricultural fertilizers and pesticides. The project will make

hydrogeologic data more readily accessible to a wider range of users, which will allow for rapid response to the best available information for areas of impaired groundwater quality. Users will be able to access 3-D hydrogeologic models to assess potential impacts of pollution and evaluate various options for management, treatment, and locating alternative water supplies. The project will also deliver a CSD Bulletin, which will provide results of findings from the demonstration projects, giving details on the best available scientific approaches to hydrogeologic mapping using integrated AEM and borehole data. The dissemination of these approaches will improve our ability to predict contaminant movement and long-term fate of contaminants in aquifers. Hydrogeologic mapping for the demonstration projects include the Bazile Groundwater Management Area (BGMA) and two groundwater quality management areas in Platte and Colfax Counties (Attachments 3 and 4). These maps will contribute to efforts by the Upper Elkhorn, Lower Elkhorn, Lower Niobrara, Lewis and Clark, Lower Loup, Lower Platte North, and Central Platte Natural Resources Districts to reduce nitrate-nitrogen levels in the groundwater management areas. The BGMA covers an area of 19.5 million acres (753 square miles) and contains 9 public water supply systems serving 5,053 people. Groundwater is also used for domestic, livestock, and irrigation purposes. The average nitrate-nitrogen concentration in groundwater is 12.1 mg/L (the EPA maximum contaminant level is 10 mg/L). Groundwater management areas in Platte and Colfax Counties cover a total area of 3.88 million acres (149 square miles) and include 2 public water supply systems serving 6,508 people. Groundwater is also used for domestic, livestock, irrigation, and industrial purposes. Median nitrate-nitrogen levels are around 19 mg/L in the Lower Loup NRD "Area 28" Phase III management area. Nitrate-nitrogen concentrations exceed 10 mg/L in 60% of the Lower Platte North NRD groundwater quality management area. The Central Platte NRD groundwater management area in Platte County includes areas in which average nitrate-nitrogen levels exceed 15.1 mg/L.

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 6. The table below lists the property tax levies, valuations, and sources of revenue for all project sponsors.

Table 2: Local Jurisdiction Revenue and ENWRA Dues

Name of NRD	Tax Levy (per $100 valuation)*	Valuation*	Total Resources Available*	Annual Dues to ENWRA
Central Platte	$ 0.03842	$ 15,919,152,725	$ 20,367,312	n/a
Lewis and Clark	$ 0.02119	$ 3,983,690,023	$ 3,294,737	$7,000
Lower Elkhorn	$ 0.02406	$ 17,558,520,245	$ 11,842,456	$30,000
Lower Loup	$ 0.03319	$ 14,984,979,216	$ 10,616,354	n/a
Lower Platte North	$ 0.04460	$ 8,709,877,929	$ 8,010,908	$30,000
Lower Platte South	$ 0.03447	$ 26,854,617,912	$ 25,247,907	$30,000
Nemaha	$ 0.03172	$ 6,971,576,949	$ 6,574,356	$20,000
Papio Missouri River	$ 0.03803	$ 57,779,011,332	$ 71,854,171	$30,000
Twin Platte	$ 0.04631	$ 5,684,667,823	$ 28,657,690	n/a
Upper Elkhorn	$ 0.01666	$ 4,772,604,180	$ 3,112,288	n/a

**Source: Nebraska Auditor of Public Accounts www.auditors.nebraska.gov/Budget_Info (accessed July 28, 2016)*

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 Nebraska GeoCloud and hydrogeologic mapping techniques provided in this project will have long-lasting, State-wide benefits for a variety of stakeholders: Natural Resources Districts, community water systems with wellhead protection plans, and other local jurisdictions in Nebraska. Integrated Management Plans (IMPs) and Groundwater Management Plans (GMPs) for Nebraska's NRDs support sustainable water use. This project contributes to the attainment of sustainable water use by

assembling data from 30 Airborne Electromagnetic (AEM) surveys, covering 15,000 line-miles throughout Nebraska (Attachment 1), securing it for long-term preservation and making it available to state and local officials in areas where groundwater is threatened or being depleted. The demonstration projects will deliver standards and guidelines for future AEM data collection, as well as maps for portions of east-central and northeast Nebraska, addressing groundwater quality and quantity concerns for many communities in these areas. The Nebraska GeoCloud and mapping methods developed in this project will provide benefits well beyond the life of the project as AEM data will be useful for many years as a source of information for hydrogeologic mapping, remediation and mitigation of groundwater contamination, and sustainability of groundwater/surface water supplies.

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.

The management, archiving, and dissemination of AEM data is a serious statewide problem. Large investments in data collection have not been matched by investments in data management and scientific studies to determine best approaches to hydrogeologic mapping using new technologies such as AEM. As a result, vast quantities of new data are collected and stored in a wide variety of locations and formats. Without proper inventory and archiving, the data is at risk of being lost. Furthermore, best approaches to using this data to advance our understanding of hydrogeology have not been investigated. Such investigations are required in order to advance understanding of Nebraska's hydrogeology and plan future studies to be cost-effective and scientifically sound. This project will address these problems by 1) creating the Nebraska GeoCloud to archive AEM data and make it available to users, and 2) investigate best scientific approaches to mapping hydrogeologic units using AEM. The project also provides benefits for the goals of Nebraska's statewide water planning and integrated management process, which seeks to ensure a balance between water supplies and uses and to protect the rights of existing users of surface water and groundwater. To conduct a thorough inventory of groundwater supplies, the Department of Natural Resources, along with the Natural Resources Districts, rely on the best available science and information. AEM surveys represent the best available science for quantifying groundwater in storage (Abraham and others, 2011), mapping complex aquifers in glacial terrain (Divine and others, 2012; Korus and others, 2013, 2016), assessing secondary bedrock aquifers for drinking water supply (Abraham and others, 2013), and assessing the connectivity of groundwater and surface water (Abraham and others, 2011). This project will enhance and build upon these efforts. It will provide data on available water supplies and demands, which can be included in the Department of Natural Resources' INSIGHT (Integrated Network of Scientific

Information and GeoHydrologic Tools). These benefits will be extended to other areas of the State because the methods developed in the pilot study will be transferrable to other areas and will provide the foundation for conducting a Statewide assessment of groundwater availability.

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 USGS, through its Cooperative Water Program, will contribute $55,000 towards the proposed work. A letter of support has been included with this application in Attachment 6.

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.

The proposed project is a statewide effort to serve all historic and future AEM data, borehole data, and geologic models built from AEM data (Attachment 2), for water managers and other water planning professionals to access the data for projects aimed at increasing streamflows across the state. Increased streamflow is critical to sustain wildlife populations especially on the lower Platte River system where instream flow requirements must be met. As an example, if an NRD chose to divert excess surface-water into an irrigation canal the purposes of intentional recharge, the location and rate of recharge could be determined by accessing and downloading geologic models in the GeoCloud, reviewing the aquifer framework, and building the data into a groundwater model in order to provide the maximum benefit. Maximizing the beneficial storage and 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. We believe the benefits realized from this project will be statewide and not be limited to the Platte and Elkhorn River systems, but to other watersheds where future AEM surveys could be completed.

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 Nebraska Department of Natural Resources, in its annual report (dated September 2015), states that for the effective conservation and management of Nebraska's water resources the State of Nebraska must develop and maintain data and information regarding water supplies across the state to support a base for water planning and management of groundwater. This project will enhance the state's ability to plan and design future water resource projects and will also enhance the Department's ability to conjunctively manage groundwater and surface-water resources. This benefit will be achieved by improving access to AEM and supporting geologic data and creating data quality standards for future AEM surveys. Providing a means to serve the data publicly would provide consultants, engineers, water resource planners, water managers, and other scientist and researches access to previously published AEM data and interpretations for future resource assessments or water planning projects intended to increase aquifer recharge or enhance streamflows, provide improved estimates of groundwater in storage, and to assess the connection between groundwater and surface water. This information will benefit the Department's INSIGHT database by improving estimates of water supplies and demands.

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 proposed project would help Nebraska meet the requirement of a federal mandate to protect endangered species. Specifically, in 1997, Colorado, Nebraska, Wyoming, and the U.S. Department of the Interior entered into an Interagency Cooperative Agreement (ICA) aimed at addressing issues regarding federally endangered species (such as the whooping crane, piping plover, least tern, and pallid sturgeon) in the Platte River Basin (Platte River Cooperative Hydrology Study, 1998). Critical to the ICA is the provision for maintenance of streamflows in the Platte River and the mitigation of new depletions in the central Platte River area. As a direct result of the ICA, State and local agencies created a Cooperative Hydrology Study [(COHYST), Platte River Cooperative Hydrology Study, 1998] of the Platte River Basin of Nebraska upstream from Columbus, Nebraska. The purpose of COHYST was to assist Nebraska in complying with the ICA through the integrated management of groundwater and surface water. The objectives of COHYST were to develop databases and tools to assist Nebraska in meeting its obligations for streamflow, to analyze proposed activities to improve streamflows for endangered and threatened species, to assist Natural Resources Districts (NRDs) with regulation and management of groundwater, and to

provide a basis for establishing and implementing Nebraska policies and procedures governing groundwater and surface-water resources. The proposed project will be used for future water resource planning projects aimed at increasing streamflow, provide improved estimates of groundwater in storage, and to assess the connection between groundwater and surface water. This information is fundamental knowledge to improve the COHYST groundwater model, and thus helps Nebraska meets its obligation to the ICA and the federal mandate of protecting endangered species.

Section D.

PROJECT DESCRIPTION

1. Overview

In 1,000 characters *or less*, provide a brief description of your project including the nature and purpose of the project and objectives of the project.

Airborne Electromagnetics (AEM) have revolutionized aquifer mapping in Nebraska. In the last 10 years, taxpayers have invested $10,000,000 on 13,000 line-miles of AEM. Despite the large investment in data collection, there has been no statewide effort to inventory the data or to develop a digital archive for long-term data security. Moreover, scientific studies are needed to understand how AEM can be used effectively in different hydrogeologic settings. It is critical that Nebraska undertakes a program of data management and research aimed at maximizing the benefit of AEM for groundwater sustainability efforts. Funds are requested to implement Nebraska GeoCloud, an AEM data service that will have long-lasting, statewide benefits, and a program of targeted hydrogeologic studies (Bazile Groundwater Management Area and Platte-Colfax area) to develop methods for aquifer mapping and characterizing groundwater resources with AEM.

2. Project Tasks and Timeline

Identify what activities will be conducted by the project. For multiyear projects please list what activities are to be completed each year.

August 1, 2016 – October 1, 2016: The consultant (I-GIS) will provide a pilot project (proof of concept) for data solution in GeoCloud, designed for Airborne Electromagnetic (AEM) survey data and related geological data for Nebraska. GeoScence 3D software will be purchased and the free viewer will be downloaded and installed on NRD computers. October 1, 2016 – July 1, 2017: CSD, USGS, and the NRDs will evaluate the pilot project for Nebraska GeoCloud using the software and free viewers. Project partners will provide feedback to the consultant. The feedback will be used to design the full-scale Nebraska GeoCloud, which will include specialized services designed for Nebraska data needs. The contract with I-GIS will be amended to include implementation of the full-scale GeoCloud system. The NRDs will enter into cooperative agreements with CSD and USGS to provide technical assistance and coordinate the implementation of Nebraska GeoCloud.July 1, 2017 – July 1, 2018: I-GIS, with guidance from CSD, USGS, and NRDs, will implement Nebraska GeoCloud. The full-scale project will include data preparation for existing datasets, software integration to develop Nebraska-specific work processes and data types, and server hosting solution for long-term uploading, downloading, archiving, and access to data. CSD and USGS will begin using GeoCloud to assemble datasets for investigation of the Bazile GMA and Platte-Colfax areas, which will serve as case studies for development

of hydrogeologic mapping methods. Borehole logs, groundwater data, and AEM data will be combined, checked for quality, and interpreted by a team of professional geologists. July 1, 2018 – July 1, 2019: CSD and USGS geologists will conduct hydrogeologic mapping of Bazile Groundwater Management Area and the Platte-Colfax County area. Researchers will investigate methods for interpreting AEM in the context of the regional hydrogeological framework. Successful methods will be documented and applied to the area, resulting in aquifer maps and hydrogeological frameworks that can be used by the NRDs for groundwater management. Investigators will upload the resulting maps and models to the Nebraska GeoCloud for review and use by NRD staff. July 1, 2019 – July 1, 2020: CSD and USGS will collaborate on a CSD Bulletin documenting recommended methods for hydrogeological mapping with AEM. The Bulletin will provide recommendations on flight line spacing, required datasets, and procedures for interpreting AEM data, which will benefit the cost-effectiveness of future AEM surveys. CSD and USGS will publish the hydrogeologic maps from the case studies, providing water resources managers with tools for groundwater management. Nebraska GeoCloud will serve as the central repository for data, geological models, and related information about the mapping efforts.

3. Partnerships

Identify the roles and responsibilities of agencies and groups involved in the proposed project regardless of whether each is an additional funding source. List any other sources of funding that have been approached for project support and that have officially turned you down. Attach the rejection letter.

The Lower Platte South NRD will coordinate the project and administer the grant. To assist the participating NRDs, the Conservation and Survey Division, with assistance from the USGS Nebraska Water Science Center, will serve as the technical leads for this project. CSD and USGS will oversee development of Nebraska GeoCloud and will conduct targeted hydrogeologic studies. The goals of this project fall in line with the mission statements of the CSD and USGS who are tasked with investigating and reporting the quantity and quality of Nebraska's water resources. CSD and USGS project personnel from the Conservation and Survey Division and the USGS Nebraska Water Science Center have experience in geologic interpretation of AEM data and substantial expertise in Nebraska's geology and water resources. The participating NRDs have pledged funding amounts given in question 4, Section D of this application (see letters of support in Attachment 6).

4. 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.

TABLE 3A: Total project costs					
Task	**FY17**	**FY18**	**FY19**	**FY20**	**Total**
GeoCloud pilot project	$7,500[a]				$7,500
GeoScene 3D software	$12,882[a]				$12,882
Full Implementation of GeoCloud		$113,368[a]			$113,368
CSD Technical Assistance		$41,167	$54,672	$54,807	$150,646
USGS Technical Assistance		$46,000	$65,000	$72,000	$183,000[b]
Totals	$20,382	$200,535	$119,672	$126,807	$467,396

TABLE 3B: Confirmed sources of local match					
Funding partners and confirmed sources[c]	**FY17**	**FY18**	**FY19**	**FY20**	**Total**
ENWRA	$8,152.8[d]	$45,214.0[d]	$9,268.8[d]	$15,322.8	$77,958.4
Lower Platte South NRD		$4,000	$4,000	$4,000	$12,000
Papio-Missouri R. NRD		$4,000	$4,000	$4,000	$12,000
Lower Elkhorn NRD		$4,000	$4,000	$4,000	$12,000
Nemaha NRD		$4,000	$4,000	$4,000	$12,000
Lower Loup NRD		$3,000	$3,000	$3,000	$9,000
Upper Elkhorn NRD		$2,000	$2,000	$2,000	$6,000
Central Platte NRD		$4,000	$4,000	$4,000	$12,000
Twin Platte NRD		$4,000	$4,000	$4,000	$12,000
Obligated NRD local match subtotal	$8,152.8	$74,214	$38,268.8	$44,322.8	$164,958.4

[a] Rationale for estimated costs are given in Attachment 5
[b] Includes $55,000 in USGS Cooperative Water Dollars (Attachment 6)
[c] All funding sources have been confirmed (Attachment 6)
[d] Confirmation of funding given in Cooperative Agreement (Attachment 7) and budget table in approved long-range plan (Attachment 8)

TABLE 3C: Cost breakdown by funding source					
Sources of funding	**FY17**	**FY18**	**FY19**	**FY20**	**Total**
Total project cost	$20,382	$200,535	$119,672	$126,807	$467,396
USGS Cooperative Water Program (federal dollars)		$15,000	$24,000	$16,000	$55,000
Net total local project cost	$20,382	$185,535	$95,672	$110,807	$412,396
Local match (40%)	$8,152.8	$74,214	$38,268.8	$44,322.8	$164,958.4
WSF reimbursements (60%)	**$12,229.2**	**$111,321**	**$57,403.2**	**$66,484.2**	**$247,437.6**

All funding sources have been confirmed. See Attachments 6 through 8. The fiscal year 17 activities will be initiated regardless of grant funding; however, the remainder of the project will not be conducted if grant match funding is not obtained.

5. Support/Opposition

Discuss both support and opposition to the project, including the group or interest each represents.

Early discussions of this project concept and design with funding partners indicated wide support and no known opposition. Letters of support have been included from 8 participating NRDs (Attachment 6) and the USGS Nebraska Water Science Center. Confirmation of funding from the ENWRA group is included in the long-range plan budget table (Attachment 8). Additionally, the results from the project will likely result in sustainable water management decisions within the State of Nebraska that would help maintain the quantity and quality of our water resources, which are relied upon by communities to support growth and economic development.

References Cited

Abraham, J.D., Cannia, J.C, Bedrosian, P.A., Johnson, M.R., Ball, L.B., and Sibray, S.S. 2011. Airborne Electromagnetic Mapping of the Base of the Aquifer in Areas of Western Nebraska: U.S. Geological Survey Scientific Investigations Report 2011-5219, accessed July 1, 2016 at *http://pubs.usgs.gov/sir/2011/5219/*.

Abraham, J.D., Carney, C.P., and Cannia, J.C., 2013, Data Report on Mapping the Hydrogeology of the Clarkson Area within the Lower Elkhorn Natural Resources District Using an Airborne Electromagnetic Survey. Project findings report prepared for the Lower Elkhorn Natural Resources District.

Cooperative Hydrology Study, 2016, Platte River Cooperative Hydrology Study: Lincoln, Nebraksa, accessed June 29, 2016, at *http://cohyst.dnr.ne.gov/*.

Divine, D.P. and Korus, J.T., 2012, Eastern Water Resources Assessment. Three-dimensional Hydrostratigraphy of the Sprague Nebraska Area: Results from Helicopter Electromagnetic (HEM) Mapping in the Eastern Nebraska Water Resources Assessment (ENWRA), accessed June 29, 2016 at *http://www.enwra.org/media/2012ENWRA_Sprague_final.pdf*.

Korus, J.T., Joeckel, R.M. and Divine, D.P. 2013a. Three-dimensional hydrostratigraphy of the Firth, Nebraska Area: Results from Helicopter Electromagnetic (HEM) mapping in the Eastern Nebraska Water Resources Assessment (ENWRA). Conservation and Survey Division, School of Natural Resources, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. Conservation Bulletin 3 (New Series), 100 p.

Korus, J.T., Joeckel, R.M., Divine, D.P., and Abraham, J.D., 2016, 3-D architecture and hydrostratigraphy of cross-cutting buried valleys using airborne electromagnetics, glaciated Central Lowlands, Nebraska, U.S.A. Sedimentology, *(accepted article in press)*