Memorandum

To: Papio-Missouri River Natural Resources District Programs Projects and Operations Subcommittee

From: Paul W. Woodward, PE, Groundwater Management Engineer

Date: July 2, 2019

Re: Review and Recommendation of the Water Sustainability Fund Grant Application for Airborne Electromagnetic Surveys

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The District has been a partner of the Eastern Nebraska Water Resources Assessment (ENWRA) project for over 10 years. During this time, ENWRA projects have provided valuable insight into the complex geology found in Eastern Nebraska and our District. Airborne Electromagnetic Survey (AEM) flights completed in the spring of 2015 included several cross sections flown in western portions of our NRD, shown as red lines in Figure 1. In 2016, the District along with support from ENWRA and a Water Sustainability Fund (WSF) grant completed a detailed AEM survey in Sarpy County, shown as a grey shaded area in Figure 1. In 2018, the PMRNRD again participated with ENWRA in a large WSF funded AEM survey that collected a 3-mile framework grid in southern Washington County and northern and western Douglas County as well as block flight lines just west of Tekamah, all shown as blue lines in Figure 1.

A report for the 2018 flight in the PMRNRD was just completed and submitted by Aqua Geo Frameworks (AGF). One objective of the 2018 grid survey was to map the extents of glacial outwashes that exist in the southern portion of Washington County. What the three-mile grid showed was that not only do these sand and gravel outwashes run northwest to southeast, but that they run straight north to south and extend south of Arlington underneath the Elkhorn River valley. This potential connection to the hydraulically connected Platte/Elkhorn River alluvium is potentially significant. First, it would demonstrate a consistent hydrologic source of groundwater recharge from the alluvium into these glacial outwashes. The Village of Arlington' municipal wells are drilled into this outwash sand and gravel, so mapping this aquifer in more detail would help identify where the community's drinking water is coming from. Last, the deeper connected aquifer in the valley between the Platte and Elkhorn River may serve as ideal locations for future drought mitigation measures. For instance, a future streamflow augmentation project located between Fremont and Arlington was suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan. (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf).

Unfortunately, the 3-mile grid flight lines don't show enough detail about the aquifer extents or connections in order to develop an accurate geologic or hydrogeologic model. Follow-up work, after the report, was done by AGF to develop a proposed block flight plan of the southern Washington and western Douglas County area of interest. See the extent of the proposed flight plan in relation to the 2018 flight lines already collected in Figure 2. AGF has estimated a total cost for this AEM survey of $700,000.

The District is proposing to submit a Water Sustainability Fund application before the end of July for 60% of this AEM project cost. The application would request 60% from WSF or $420,000 and the remaining $280,000, or 40%, would come from the PMRNRD with payments over two fiscal years, FY 2020 and FY 2021. A draft of the application and associated maps and

attachments is enclosed for your review. If approved, the PMRNRD would need to hire a contractor directly and then request reimbursement from WSF.

Staff recommends that the subcommittee recommend to the Board of Directors that the General Manager be authorized to execute and submit a Water Sustainability Fund application for 60% of eligible project costs necessary to acquire the proposed AEM survey data for southern Washington County and western Douglas County, subject to changes deemed necessary by the General Manager and approval as to form by District Legal Counsel.

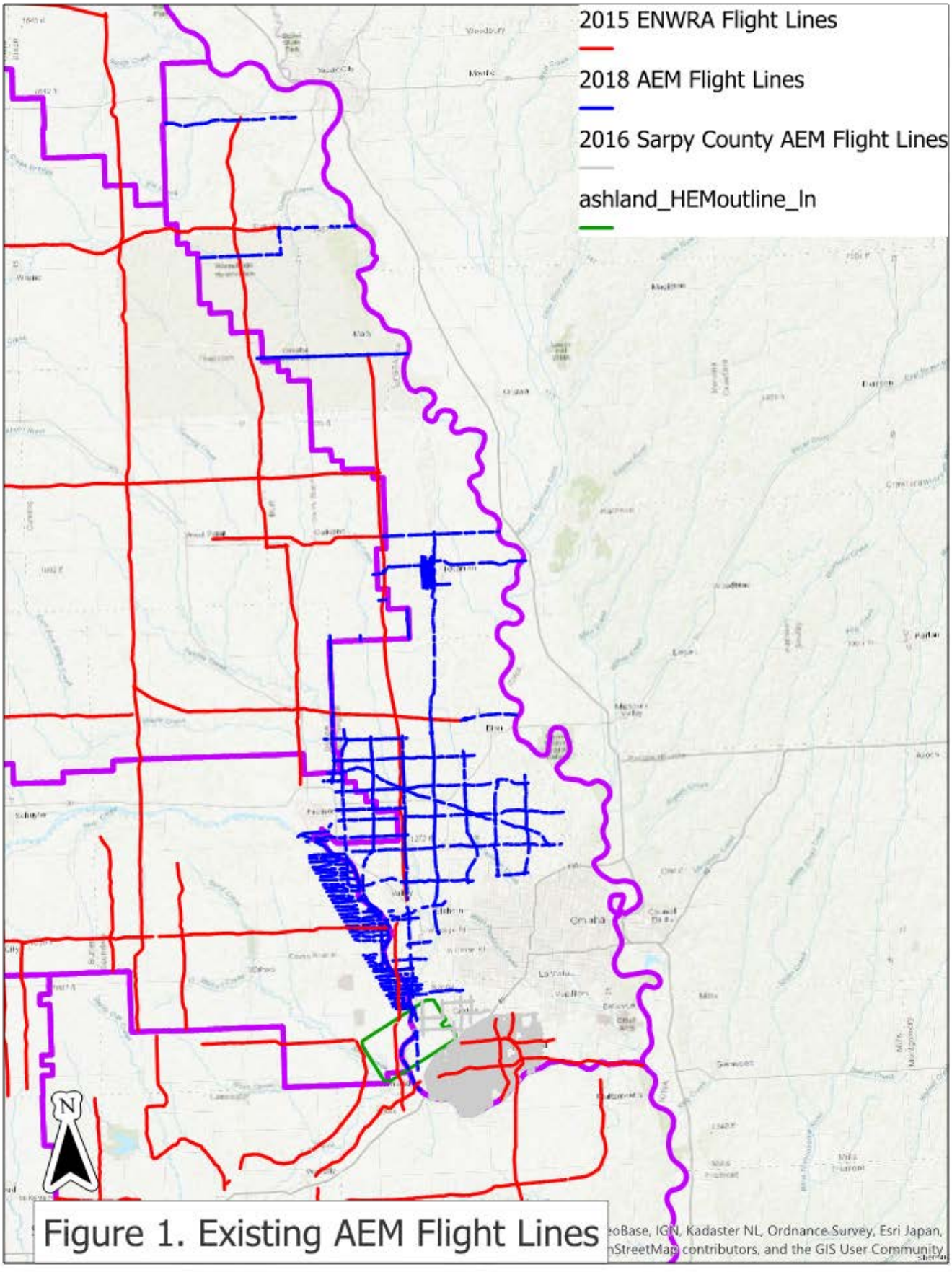


Figure 1. Existing AEM Flight Lines

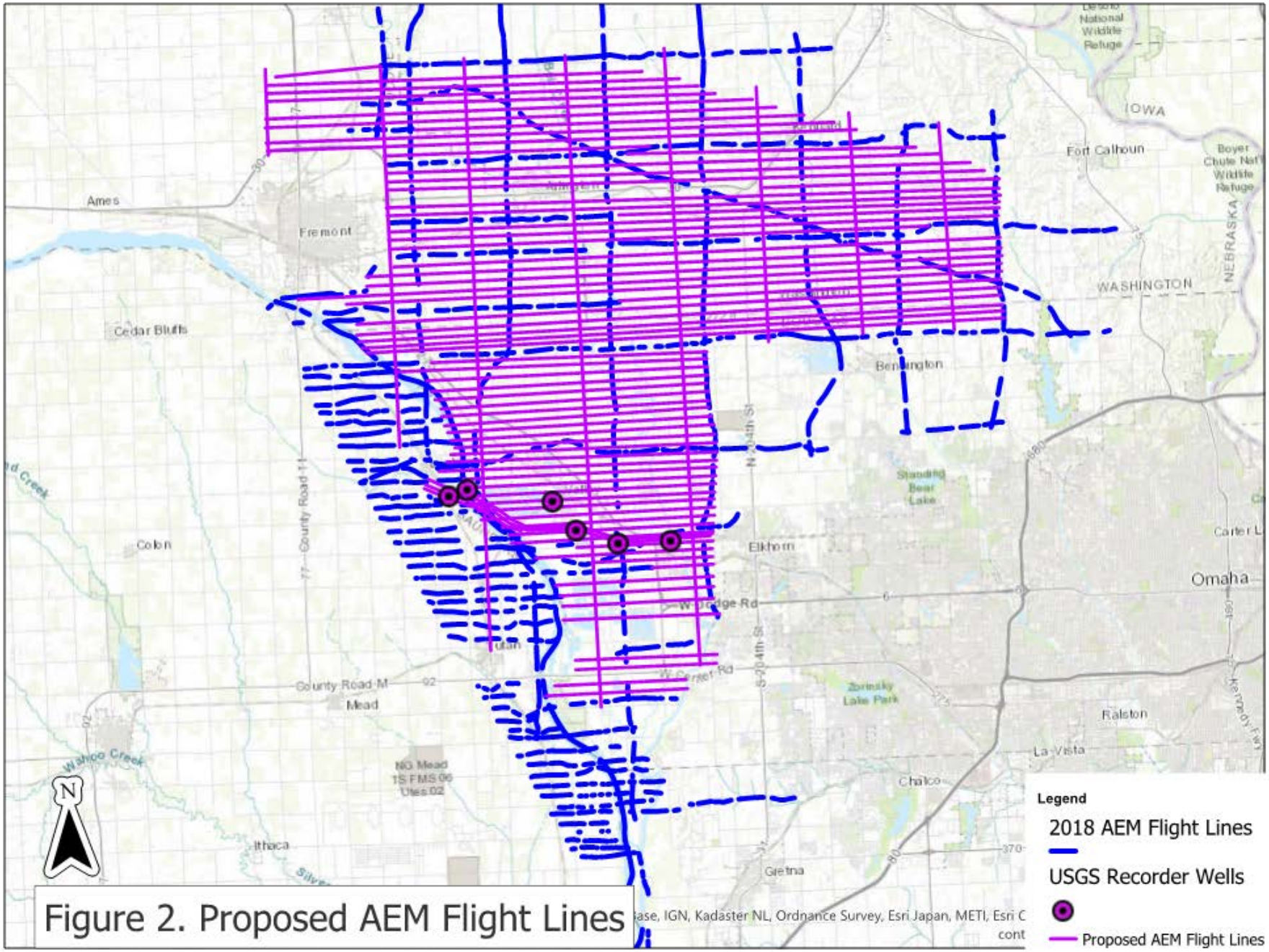


Figure 2. Proposed AEM Flight Lines

NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Detailed Airborne Electromagnetic (AEM) Survey of Platte/Elkhorn River Valley and Adjoining Glacial Outwashes

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

Sponsor Business Name: Papio-Missouri River NRD

Sponsor Contact's Name: Paul W. Woodward, PE, CFM

Sponsor Contact's Address: 8901 South 154th Street, Omaha, NE 68138

Sponsor Contact's Phone: 402-444-6222

Sponsor Contact's Email: pwoodward@papionrd.org

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

   Grant amount requested. $ 420,000

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

   If a loan is requested amount requested. $ NA

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

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. Click here to enter text.
- What is the population served by your project? Click here to enter text.
- Provide a demonstration of need. Click here to enter text.
- **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☐

Click here to enter text.

4. **Partnerships**

List each Partner / Co-sponsor, attach documentation of agreement:
No other Partners or Co-sponsors will provide funding or assistance.

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

NA

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.

The 2019 funding levies listed below for the PMRNRD will provide sufficient funds to provide the cash contribution necessary to complete this Project. Additionally, the PMRNRD has planned to budget matching funds for this Project in their annual fiscal year (FY) FY2020/2021 budget (finalized after July 1 each year).

Local Sponsors	Cents per $100 Assessed Valuation	FY 18-19 Property Tax Revenue	FY 18-19 Total Budget
Papio-Missouri R. NRD ($700,000 project)	3.76	$24,823,950	$72,185,027

Fiscal Year (July 1 – June 30)	Total Cost	PMRNRD Funding	WSF Funding
FY 19-20	$220,000	$88,000	$132,000
FY 20-21	$480,000	$192,000	$288,000
TOTAL	$700,000	$280,000	$420,000

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!

Using 2017 Water Sustainability Grant Funding, Application 5189, the Papio-Missouri River NRD, in cooperation with the Eastern Nebraska Water Resources Assessment (ENWRA) and Lower Platte South NRD, provided the 40% matching funding required to conduct an Airborne Electromagnetic (AEM) framework survey across portions of southern Washington County and western Douglas and Sarpy Counties, see Figure 1. The purpose of this framework survey was to identify the extent and depth of alluvial aquifer material between the Platte and Elkhorn River, and locate and determine the possible connection of glacial sand and gravel outwashes. This reconnaissance level survey included east to west and north to south flight lines approximately every 3 miles. Results from the AEM framework survey indicate that glacial outwashes located beneath the loess and till in southern Washington County

have a connection underneath the Platte and Elkhorn valley alluvium between Fremont and Arlington, NE. This potential connection to the hydraulically connected Platte/Elkhorn River alluvium is important for a number of reasons. First, the community water supply for Arlington, NE is pumped from wells in this glacial outwash sand aquifer. A highly transmissive connection to the alluvial aquifer would provide documentation about the reliability of Arlington's drinking water supply and give insight into potential contaminant pathways that may affect its water quality. Another reason for obtaining more detailed AEM survey is to greatly improve groundwater models that are currently being utilized to define what aquifers are hydrologically connected to surface waters, including the Platte and Elkhorn Rivers and their tributaries. Detailed mapping of this potential connection between glacial outwash aquifers and river alluvium will greatly enhance the accuracy of such models. More accurate models can be utilized in the future to explore the opportunity where these deeper connected aquifers might be used for augmentation pumping during periods of extreme or extended drought in the Platte or Elkhorn River watersheds. Such a future streamflow augmentation project was suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf). The use of such groundwater already available along the Lower Platte River, just upstream from the municipal well fields for Omaha and Lincoln, could help offset low river levels during drought which might otherwise necessitate additional mitigation upstream or a call on the Platte River to meet domestic water supply needs.

Other previous studies of the hydrologically connected alluvium between the Platte and Elkhorn River have shown that the Platte River from Fremont, NE downstream to the confluence generally loses streamflow into the aquifer, but that groundwater is gained by the Elkhorn River and its smaller tributaries along this same reach (https://pubs.er.usgs.gov/publication/sir20195048). The opportunity from a groundwater to streamflow augmentation standpoint would be to utilize this "lost" streamflow collected in the aquifer and supplement the river during low flow (drought) conditions. Even though this area is still part of the hydrologically connected area to the rivers, a preliminary analysis has also been completed which shows that the area between Fremont and Arlington is ideal for withdrawing groundwater over the 90-day summer timeframe (June – August) without negatively impacting streamflows during this same period. It has also been documented that the area between Fremont and Arlington already has a high groundwater table that at times may require dewatering. So, an augmentation well field may serve two purposes in this area, both during drought and periods of excess water.

The purpose of this NEW WSF Application is to fund a detailed AEM survey of these aquifers and their potential connection. The NEW AEM survey would include flight lines approximately every 400 meters and tie into flight lines already flown in Lower Platte North NRD. Given the close proximity of the AEM survey data, a 3-D geologic model will be constructed down to depths of 500 feet below land surface. Such 3-D data will allow highly accurate geologic data to be imported into hydrogeologic models which can better define the wellhead protection areas for Arlington and Fremont and be used to fully evaluate possible conjunctive management projects that may provide drought mitigation on the Lower Platte and Elkhorn Rivers.

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):

Tasks	Year 1$	Year 2$	Year 3$	Remaining	Total $ Amt.
Permits	$18,000				$18,000
Engineering		$96,000			$96,000
Construction		$87,000	$96,000		$183,000
Close-out				$8,000	$8,000
				TOTAL	$305,000

- 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.

Tasks	Year 1$	Year 2$	Total $ Amt.
AEM Data planning	$140,000		$140,000
AEM Survey		$280,000	$280,000
Geophysical Data Analysis		$80,000	$80,000
Hydrogeologic Framework Report		$200,000	$200,000
		TOTAL	$700,000

8. **IMP**

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

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; Click here to enter text.

1.A.2 Describe the plan of development (004.01 A); Click here to enter text.

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

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

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

1.A.6 Discuss each component of the final plan (004.01 E); Click here to enter text.

1.A.7 When applicable include the geologic investigation required for the project (004.01 E 1); Click here to enter text.

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

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). Click here to enter text.

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

1.B.1 Insert data necessary to establish technical feasibility (004.02); ENWRA started research activities in 2007 with three pilot study sites: Oakland, Ashland and Firth employing a variety of assessment tools including AEM - the first of its kind to be

used in Nebraska (please refer to http://enwra.org/ website for history of airborne applications and results). AEM has been proven over the past 12 years to be crucial in non-invasively acquiring large amounts of detailed hydrogeologic information in a relatively short amount of time and in a cost-effective manner for the area covered. Additionally, Nebraska has become one of the international leaders in coordinated use of AEM for groundwater management purposes with over 15,000 line miles flown in approximately 15 of Nebraska's 23 NRDs (please refer to 2007-2018 flights found at http://enwra.org/ and AEM related 2015 to 2016 WSF awards: #4132, 4133, 4134, 4140, 4141, 4142, 4143, 4144, 4164, and 5189). The map included as Figure 1 depicts ENWRA NRD's 2007 to 2018 flights (red lines) and Figure 2 shows the new 700 miles of planned AEM flights for this Project (blue lines).

1.B.2 Discuss the plan of development (004.02 A); The specific plan developed for this Project is based on previous Airborne Electromagnetic (AEM) geophysical surveys flown by the Eastern Nebraska Water Resources Assessment (ENWRA) group, 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. Please refer to the http://enwra.org/ website for a history of airborne applications in this glaciated region of Nebraska.

The PMRNRD wishes to develop a detailed high resolution hydrogeologic framework to better understand the local aquifers in the project area. Specifically, for the hydrologic connections between the aquifers and the Elkhorn and Platte rivers in Washington County near Fremont and Arlington, NE. Because of the highly transmissive nature of the sand and gravel deposits and high-water table locating the areas that are vulnerable in and around the community water supply near Arlington, NE is a priority. Figure 1 shows Profile L701001 from the 2018 AEM survey which lies just north of Arlington and is oriented east-west presenting the complexity of the subsurface of the area. The distribution of aquifer and coarse aquifer materials and their connectivity with the Elkhorn River is apparent in the profile.

If funded, the PMRNRD would retain a geophysical contractor in a manner similar to past AEM surveys for the following services (please refer to http://enwra.org/ website for history of airborne applications):

1) Review the flight line locations and adjust them as needed to minimize interference (from power lines and other infrastructure)
2) Choose the appropriate AEM method/equipment/subcontractors/schedule
3) Oversee the survey activities
4) Collect and quality check the airborne data
5) Process the data
6) Gather/georeference all existing data near the flight lines
7) Interpret the data in a final report taking into account the reconnaissance framework (2014-2015 ENWRA AEM flights) and previous results (2007-2018 flights) specific to each NRD (http://enwra.org/).

The resulting datasets will be used by the PMRNRD and ENWRA for insight on

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. Additionally, results will be provided to ENWRA, the Nebraska GeoCloud Project (Water Sustainability Fund [WSF] Award #4164), University of Nebraska Conservation and Survey Division (UNL-CSD), United States Geological Survey (USGS), Nebraska Department of Environmental Quality (NDEQ), Nebraska Department of Natural Resources (NeDNR) and the general public for collaboration and shared use of the best available comprehensive hydrogeologic framework data for the area. Please refer to Attachment 1 for a map of the approximate 700 miles of anticipated flights. The accomplishment of this Project will impact the management and sustainability of groundwater resources which provide municipal water for 37% of the state's 1.9 million population.

1.B.3 Describe field or research investigations utilized to substantiate the project conception (004.02 B); ENWRA started research activities in 2007 with three pilot study sites: Oakland, Ashland and Firth employing a variety of assessment tools including AEM - the first of its kind to be used in Nebraska (please refer to http://enwra.org/ website for history of airborne applications and results). AEM has been proven over the past 12 years to be crucial in non-invasively acquiring large amounts of detailed hydrogeologic information in a relatively short amount of time and in a cost-effective manner for the area covered. Additionally, Nebraska has become one of the international leaders in coordinated use of AEM for groundwater management purposes with over 15,000 line miles flown in approximately 15 of Nebraska's 23 NRDs (please refer to 2007-2018 flights found at http://enwra.org/ and AEM related 2015 to 2016 WSF awards: #4132, 4133, 4134, 4140, 4141, 4142, 4143, 4144, 4164, and 5189). The map included as Attachment 1 depicts ENWRA NRD's 2007 to 2018 flights (green lines) and approximately 700 miles of planned AEM flights for this Project (blue lines).

1.B.4 Describe any necessary water and/or land rights (004.02 C); No water or land rights are required to complete this Project. No trespass on private property or human health issues result from data collection. All data is collected under Federal Aviation Administration rules and procedures. Following evaluation of the Project results against existing UNL-CSD test holes and NRD well sampling networks, additional test holes and associated monitoring wells may be advanced in select locations for detailed geology/downhole geophysics and/or to address groundwater quantity and quality concerns. Planning, securing access and implementation of those activities will be conducted separately, subsequent to the Project approval by NRDs and ENWRA.

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). The PMRNRD anticipates using the results from this project to improve hydrogeologic modeling to determine the feasibility of potential drought mitigation measures that may include groundwater flow augmentation to the Lower Platte or Elkhorn River. Such flow augmentation may use groundwater already available along the Lower Platte River, just upstream from the municipal well fields of Fremont, Omaha and Lincoln, to help offset low river levels during drought which might otherwise necessitate additional mitigation upstream or a call on the Platte River to meet domestic water supply needs. Such a future streamflow augmentation project was suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf).
Additionally, this survey data will cover all or parts of 12 local communities' WHPAs, potentially leading to future adjustments to the boundaries, new public wells in better locations/depths, ability to better evaluate potential development of rural water systems, and/or target areas most susceptible to water quality impairments (for example, potential pathways from surface water to groundwater or confining units separating/protecting aquifers become apparent). The AEM results provided by the contractor include Google Earth layer deliverables with information dots every 250 feet along each flight line. The dots are linked to corresponding interpreted profile image files broken into approximate 5 to 10-mile sections with legal description track maps shown at the top. This publicly available dataset can influence future well siting for any well type for any beneficial use. As with past surveys, many private landowners have inquired to ENWRA regarding AEM results on their property and are provided specific printouts of the available information to understand the potential resource under their land (see example Attachment 6). Private landowners can use the new understandings to identify suitable areas to construct a domestic, stock, or irrigation well, especially in areas where water resources are highly variable and/or limited, saving time and money in test hole drilling and other development costs.
The data will also be used to help landowners and the PMRNRD to narrow down areas where irrigation development is appropriate and help avoid well interference issues. Using the data will also allow for selection of areas within the NRDs' for managed aquifer recharge to assist with increased groundwater supplies and associated surface water objectives.

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. Hydrogeologic mapping at the spatial scale and level of detail proposed herein is not possible in any other way. Geophysics is the best technology for this

purpose. The next best alternative to achieve the same amount of detail would be to drill boreholes every 100m for nearly 1,396 km, totaling nearly 13,960 boreholes. This would cost almost $139,000,000 @ an average cost of $10,000 per hole and take hundreds of years to accomplish. Clearly this option is not feasible.

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).

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).

AEM surveys totaling 1,396 line km, including flight planning, data acquisition, QA/QC and data processing, initial LCI geophysical inversions and final SCI inversions, and hydrogeologic interpretation with framework development report ($700,000)

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). There is no generally accepted method for calculation of primary tangible benefits; however, the project will increase water sustainability. The results of the hydrogeologic mapping will result in actionable information for the implementation of the previous mentioned activities in the introduction section of this application.

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).

Tasks	Year 1$	Year 2$	Total $ Amt.
AEM Data planning	$140,000		$140,000
AEM Survey	$80,000	$200,000	$280,000
Geophysical Data Analysis		$80,000	$80,000
Hydrogeologic Framework Report		$200,000	$200,000
			TOTAL $700,000

No annual benefit data is available.

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.) Hydrogeologic mapping at the spatial scale and level of detail proposed herein is not possible in any other way. Geophysics is the best technology for this purpose. The next best alternative to achieve the same amount of detail would be to drill boreholes every 100m for nearly 1,396 km, totaling nearly 13,960 boreholes. This would cost almost $139,000,000 @ an average cost of $10,000 per hole and take hundreds of years to accomplish. Clearly this option is not feasible.

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. Natural Resources Districts (NRDs) are granted the authority to impose property tax levies to generate revenue for operational needs. The 2019 funding levies listed below for the PMRNRD will provide sufficient funds to provide the cash contribution necessary to complete this Project. Additionally, the PMRNRD has planned to budget matching funds for this Project in their annual fiscal year (FY) FY2020/2021 budget (finalized after July 1 each year).

Local Sponsors	Cents per $100 Assessed Valuation	2019 Property Tax Revenue	2019 Total Budget
Papio-Missouri R. NRD ($700,000 project)	3.76	$24,823,950	$72,185,027

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace). The extended cost to operate and maintain the work achieved is covered in the annual dues paid to ENWRA by the associated NRDs (Attachment 7). UNL-CSD and the USGS have teamed with ENWRA to create the Nebraska GeoCloud to house all the AEM data statewide and provide long-term data visualization, management, and sharing capabilities (WSF award contract #4164). Because the Project is primarily data collection, there is no cost associated with equipment replacement, just annual Nebraska GeoCloud costs which are currently local match-funded under a 10-NRD interlocal agreement (eastern and western Nebraska NRDs). Additionally, anticipated annual costs of $25,000 or less per year to maintain the Nebraska GeoCloud are within ENWRA's (or other statewide entity as appropriate) long range plan budget for data management (Attachment 4).

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.). The AEM survey is conducted in and out of local airports without trespass on private land beneath the flight lines, and is conducted according to current FAA rules which minimize disturbance to property owners. The number of holes and observation wells required to define aquifer systems is decreased significantly by the AEM mapping process, thus lowering the degree of impact on the natural environment from drilling rigs and support vehicles. The areas of impact to the natural environment will be narrowed to those most beneficial for the public and the NRD rather than used as reconnaissance holes.

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds. NRDs are responsible for maintaining groundwater quality and quantity for municipal, domestic, and agricultural uses (Nebraska State Statute Chapter 2 Article 32 and Nebraska Groundwater Protection Act Chapter 46 Article 7). The NRD staff members have local knowledge of the area and groundwater resources. Paul W. Woodward is the Groundwater Management Engineer for the Papio-Missouri River NRD. He is a registered Professional Engineer, License No. E-12037, in the State of Nebraska.

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state. Interest in this project and AEM data is a response to numerous objectives and actions in various management plans. First, the PMRNRD's Integrated Management Plan (IMP) contains specific actions to continue to collect and analyze hydrogeologic data in support of NDNR's annual evaluation of hydrologically connected water resources. This geologic data serves as the backbone for making these evaluations and models as realistic and accurate as possible. Similar data collection objectives are called out in the Lower Platte River Basin Water Management Plan, dated October 2017. This plan provides an accounting of all new uses in the Lower Platte Basin and relies on utilizing the best available geologic data to determine hydrologically connected influences. The PMRNRD would also plan to use new AEM data to better understand and evaluate Wellhead Protection Areas for multiple municipalities. Two of these municipalities, MUD and Fremont, have current Wellhead Area Protection Plans that could be updated given the results of this AEM project.
Additionally, data from the proposed AEM survey will provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. These connected aquifer areas may serve as ideal locations for future conjunctive management and drought mitigation measures. For instance, a future streamflow augmentation project was suggested in this project area as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf). Finally, the PMRNRD's own Groundwater Management Plan describes the use of AEM data in our District to enhance geologic mapping and eventually create a

complete volumetric ground water inventory. There are still many un-mapped aquifer areas between the uplands and floodplains in the PMRNRD which may have valuable connection and influence the total groundwater availability in our NRD.

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. Click here to enter text.

10.B Attach proof of ownership for each easements, rights-of-way and fee title currently held. Click here to enter text.

10.C 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. Click here to enter text.

12. Identify the probable consequences (environmental and ecological) that may result if the project is or is not completed. The AEM survey is conducted in and out of local airports without trespass on private land beneath the flight lines, and is conducted according to current FAA rules which minimize disturbance to property owners. The number of holes and observation wells required to define aquifer systems is decreased significantly by the AEM mapping process, thus lowering the degree of impact on the natural environment from drilling rigs and support vehicles. The areas of impact to the natural environment will be narrowed to those most beneficial for the public and the NRD rather than used as reconnaissance holes.

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.

In the PMRNRD (www.papiond.org), the proposed Project area includes an estimated 1,400 active domestic wells (including registered and unregistered wells) serving approximately 4,200 people and 12 active WHPAs (Attachment 9) serving a combined

population of approximately 700,000 including MUD and Fremont. Potential threats to drinking water in this project area involve both water quantity and water quality issues. Specific to groundwater quantity, the Village of Arlington's municipal water supply, serving approx. 1,225 residents, comes from wells on the bluff above the Elkhorn River that are within an approximately 50 foot saturated sand and gravel unit 220 feet below ground. Although Arlington does not currently report any groundwater declines, the extent of this water bearing unit is unknown as is its source of groundwater recharge. The PMRNRD drilled and installed monitoring wells just northwest of Arlington's municipal wells in 2014. This geologic bore log and well construction correlate well with the City's well, but this is just one location. AEM data is the equivalent of drilling hundreds of test holes to map an aquifer. The proposed AEM survey will map the extent of this glacial outwash unit and will likely identify potential connections and sources of recharge. If AEM mapping is not completed, it is unlikely that wellhead protection areas will be able to be redefined and areas of recharge or possible contamination pathways could remain unknown.

One of the primary purposes of this AEM survey project is to identify and provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. In areas where these various geologic aquifer units are connected, it is thought that they share groundwater resources, providing a larger potential groundwater supply than the alluvial sands and gravels by themselves. A future streamflow augmentation project, suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf), may be able to draw from these combined aquifers, actual reducing depletions in the alluvial aquifer and subsequently the hydrologically connected rivers. This would help maintain the shared groundwater and streamflow resources during normal and wet periods. In addition, a future augmentation project could provide streamflow in the Lower Platte River during times of severe drought conditions. This supplemental streamflow could help maintain municipal and industrial supplies from the connected alluvial aquifer, including those for Fremont, MUD, and Lincoln. If sufficient geologic data is not acquired, it would be difficult to design and model a future streamflow augmentation project that can optimize these numerous benefits.

Water quality sampling since 1992 in the Project area has indicated that there are elevated levels of nitrate ranging from 5 to over 10 parts per million (ppm) at various locations in the alluvial systems associated with the Platte and Elkhorn River. The P-MRNRD Groundwater Management Plan (GMP) sets 5 ppm (half of the drinking water limit of 10 ppm) as a trigger level for further study and with the potential for actions to address the nitrate contamination. These elevated nitrate levels vary greatly both geographically and by depth. In fact, water quality sampling from shallow wells and deeper wells over the years has shown that denitrification near the high groundwater table between the Platte and Elkhorn River actually results in lower nitrate levels at shallow depths and higher nitrate levels in deeper portions of the alluvium. This is a reason why a detailed 3D representation of the alluvium would provide valuable insight when mapping nitrate concentrations and drilling future wells.

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.

   Interest in this project and AEM data is a response to numerous objectives and actions in various management plans. First, the PMRNRD's Integrated Management Plan (IMP) (https://dnr.nebraska.gov/water-planning/papio-missouri-river-nrd) contains specific actions to continue to collect and analyze hydrogeologic data in support of NDNR's annual evaluation of hydrologically connected water resources. This geologic data serves as the backbone for making these evaluations and models as realistic and accurate as possible. Similar data collection objectives are called out in the Lower Platte River Basin Water Management Plan, dated October 2017 (https://dnr.nebraska.gov/water-planning/lower-platte-basin-wide-plan). This plan provides an accounting of all new uses in the Lower Platte Basin and relies on utilizing the best available geologic data to determine hydrologically connected influences. The PMRNRD would also plan to use new AEM data to better understand and evaluate Wellhead Protection Areas for multiple municipalities. Two of these municipalities, MUD and Fremont, have current Wellhead Area Protection Plans that could be updated given the results of this project.
   Additionally, data from the proposed AEM survey will provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. These connected aquifer areas may serve as ideal locations for future conjunctive management and drought mitigation measures. For instance, a future streamflow augmentation project was suggested in this project area as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf). Finally, the PMRNRD's own Groundwater Management Plan (https://www.papionrd.org/water-quality-supply/groundwater/groundwater-management-plan/) describes the use of AEM data in our District to enhance geologic mapping and eventually create a complete volumetric ground water inventory. There are still many un-mapped aquifer areas between the uplands and floodplains in the PMRNRD which may have valuable connection and influence the total groundwater availability in our NRD.

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.

It is anticipated that results from this AEM survey may show previously unmapped glacial outwash sands and gravels that are hydrologically connected to the combined Platte and Elkhorn River alluvium. Since these glacial outwash areas may be deeper and have greater saturated thickness then just the alluvium itself, it is thought that these may be ideal areas for groundwater augmentation to the river system during periods of drought. Specifically, a future streamflow augmentation project was suggested in this project area as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf). Other previous studies of the hydrologically connected alluvium between the Platte and Elkhorn River have shown that the Platte River from Fremont, NE downstream to the confluence generally loses streamflow into the aquifer, but that groundwater is gained by the Elkhorn River and its smaller tributaries along this same reach (https://pubs.er.usgs.gov/publication/sir20195048). The opportunity from a groundwater to streamflow augmentation standpoint would be to utilize this "lost" streamflow collected in the aquifer and supplement the river during low flow (drought) conditions. Even though this area is still part of the hydrologically connected area to the rivers, a preliminary analysis has also been completed which shows that the area between Fremont and Arlington is ideal for withdrawing groundwater over the 90-day summer timeframe (June – August) without negatively impacting streamflows during this same period. The bottom line is that if drought condition impacts resulting in low flows in the Lower Platte River near the Lincoln, Omaha, and Fremont area wellfields can be solved closer to the source of the problem, less efficient conjunctive management projects will not be needed further upstream in the Platte, Loup and Elkhorn River basins.

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.

One of the primary purpose of this AEM survey project is to identify and provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. In areas where these various geologic aquifer units are connected,

it is thought that they share groundwater resources, providing a larger potential groundwater supply than the alluvial sands and gravels by themselves. A future streamflow augmentation project, suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf), may be able to draw from these combined aquifers, actual reducing depletions in the alluvial aquifer and subsequently the hydrologically connected rivers. This would help maintain the shared groundwater and streamflow resources during normal and wet periods. In addition, a future augmentation project could provide streamflow in the Lower Platte River during times of severe drought conditions. This supplemental streamflow could help maintain municipal and industrial supplies from the connected alluvial aquifer, including those for Fremont, MUD, and Lincoln. Increased streamflow during drought is also very important in maintaining instream flow requirements on the Lower Platte to provide minimal aquatic habitat for T&E species as well as all wildlife. Agricultural uses can actually benefit from a streamflow augmentation project between Fremont and Arlington as an abnormally high groundwater table in this area can actually result in occasional lower yields or crop losses. If sufficient geologic data is not acquired, it would be difficult to design and model a future streamflow augmentation project that can optimize these numerous benefits.

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.

   The primary purpose of this AEM survey project is to identify and provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. In areas where these various geologic aquifer units are connected, it is thought that they share groundwater resources, providing a larger potential groundwater supply than the alluvial sands and gravels by themselves. Using deeper and thicker saturated aquifers can increase the efficiency and long-term effectiveness of beneficial uses. A future streamflow augmentation project, suggested as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf), may be able to draw from these combined aquifers, actual reducing depletions in the alluvial aquifer and subsequently the hydrologically connected rivers. This would help maintain the shared groundwater and streamflow resources during normal and wet periods. In addition, a future augmentation project could provide streamflow in the Lower Platte River during times of severe drought conditions. This supplemental streamflow could help maintain municipal and industrial supplies from the connected alluvial aquifer, including those for Fremont, MUD,

and Lincoln. Increased streamflow during drought is also very important in maintaining instream flow requirements on the Lower Platte to provide minimal aquatic habitat for T&E species as well as all wildlife. Agricultural uses can actually benefit from a streamflow augmentation project between Fremont and Arlington as an abnormally high groundwater table in this area can actually result in occasional lower yields or crop losses. If sufficient geologic data is not acquired, it would be difficult to design and model a future streamflow augmentation project that can optimize these numerous benefits.

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.

Please refer to Section D of this application for scope overview, specific tasks, timeline, and costs (also described in Section B #3 bullet 3 table) associated with this Project. Please refer to http://enwra.org/ website tabs: “about”, “projects”, “media downloads”, and “AEM” (several tabs) for background on the technology and methods the NRDs have expended to get to the level of this Project request. There are no costs for construction, O/M, etc. for this Project. However, it’s important to note that, even though AEM surveys are not inexpensive, the technology provides the equivalent of a detailed geologic cross section for every aerial line flown. Such a result can be obtained in rough form within a few hours, and after data analysis, inversion, etc., the detailed result is produced (along with three-dimensional versions, derived characteristics, etc.) within several months. Traditional methods of collecting hydrogeologic information are through the drilling of test holes and logging of the geologic materials found. Individual test holes provide a single point of information about the area’s hydrogeology, and the materials between test holes are inferred. The aquifer materials and their properties may change dramatically in as little as a few tens of feet from the individual test hole. Individual points of information, like test holes, provide limited information about the broader aquifer characteristics. While limited, test holes have been the best available method for assessing aquifer characteristics until the recent employment of AEM. AEM essentially provides virtual test holes along a flight path, thereby collecting a nearly seamless cross-section of the aquifer materials. This type of seamless cross-section cannot be collected through any other known method. As a generic example, it would cost around $945,000 ($15 per foot of drilling, not accounting for geologist time) to produce a typical cross section along a 10-mile line using approximately 210 test holes spaced every 250 feet (drilled to typical depths of around 300 feet). Drilling 210 test holes would certainly require months if not years of intensive effort. The AEM proposed herein will provide virtual borehole soundings about every 20 feet with x, y, z axis data lumped every 250 feet to depths around 400 to 500 feet. The $945,000 required

for traditional test hole drilling and logging can be compared to a 10 mile AEM flight line at approximately $8,050 ($804.672/mile) as planned with this Project, or less than 1% of the cost of traditional methods. In addition, the raw data for such a 10 mile AEM flight line can be collected in a matter of hours, and the processing of that data can be accomplished in a few days. For the entire proposed Project area, it would likely take decades to complete the 4,076 miles of cross sections (see Section B, #3, bullet 3 table) through the use of test hole drilling and logging of geologic materials, compared to two years anticipated for the proposed AEM flights and reporting. Additionally, there is no UNL-CSD staff/equipment available to dedicate to completing this scale of work for the region. For example, if you use a $12 per foot rate (see Section B, #3, bullet 3 table footage/scope discussions) for two geologists' time (CSD commonly uses $6 per foot as an in-kind value for one geologist's time in grant applications) it would take about 2,000 years for two full time employees to complete the work (annual salaries of $75k, totaling about $302 Million). Further, the AEM electronic products and deliverables are conducive to incorporation into modern computing and modeling work and already include existing geologic data gathered along the flight lines as compared to manual test hole processing and conversion into electronic format for test holes. Given these points, it's apparent that collection of geologic and groundwater data through AEM will provide almost immediate payback as the data will be available in a few years and can be used for the foreseeable future, while collection of such data via traditional methods would take generations, if it would even be possible at all.

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.

   Federally endangered species such as the Pallid Sturgeon, Topeka Shiner, Salt Creek Tiger Beetle, and Western Prairie Fringed Orchid exist within the Lower Platte River watershed and are susceptible to their health and function. By better understanding the aquifer resources, the Lower Platte Basin 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 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 a instream flow priority date of November 30, 1993). A better understanding of how the geology in this area impacts the Platte and Elkhorn 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.
Lastly, information gained from these surveys can benefit Nebraska's drinking water program which has 1,375 public water systems, serving most of its 1.7 million residents (Nebraska Health and Human Services [DHHS] website accessed Dec 2015). 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 AEM data (Ongoing County Atlas work and Nebraska GeoCloud WSF award #4164) into their survey 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 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.

   Acquiring detailed 3D geologic data as a result of this AEM survey project will provide the level of data necessary to design future conjunctive management projects and site them without interfering with existing infrastructure and utilities. Additionally, the AEM survey is conducted in and out of local airports without trespass on private land beneath the flight lines, and is conducted according to current FAA rules which minimize disturbance to property owners. The number of holes and observation wells required to define aquifer systems is decreased significantly by the AEM mapping process, thus lowering the degree of impact on existing infrastructure.
   Furthermore, understanding the entire aquifer system and focusing on WHPAs is essential to prevent future drinking water supply contamination and ensure a reliable public water supply for the future development of this Project area (Attachments 1, 8, 9 and 10). Private and Public Water System well owners can face drinking water contamination, especially due to nitrates, a primary long term

widespread public health issue affecting the ENWRA NRDs (Attachment 11 example). If areas are identified by the AEM indicting increased risk, the Districts can implement focused education efforts for private landowners, communities, and crop producers in the area where crop nutrients and chemicals may impact the resource. More precisely defining the aquifer boundaries of WHPAs provides the basis for improved public security by ensuring communities have the knowledge necessary to protect water quality and quantity, which in turn protects public health and safety.
The knowledge gained by the work will enable the state and ENWRA NRDs to focus management efforts in specific areas where there is specific threat to groundwater quality or quantity. Cost savings to critical infrastructure resulting from the completion of this Project may be realized in the future. 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 dependent on the type of well being replaced.

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 Project would provide information that would improve the understanding of the extent and connectedness of groundwater resources, as well as the types of materials overlying the resource. That information can be utilized to improve or create programs or projects that directly improve water quality. Water quality sampling since 1992 in the Project area has indicated that there are elevated levels of nitrate ranging from 5 to over 10 parts per million (ppm) at various locations in the alluvial systems associated with the Platte and Elkhorn River. The P-MRNRD Groundwater Management Plan (GMP) sets 5 ppm (half of the drinking water limit of 10 ppm) as a trigger level for further study and with the potential for actions to address the nitrate contamination. These elevated nitrate levels vary greatly both geographically and by depth. In fact, water quality sampling from shallow wells and deeper wells over the years has shown that denitrification near the high groundwater table between the Platte and Elkhorn River actually results in lower nitrate levels at shallow depths and higher nitrate levels in deeper portions of the alluvium. This is a reason why a detailed 3D representation of the aquifer system and its various connections would provide valuable insight when mapping nitrate concentrations and drilling future wells. While the primary threat to groundwater quality in the Project area is nitrates, some communities and private wells have experienced concerns over detection

of additional, often naturally-occurring contaminants like arsenic. Portions of the area also have naturally occurring, elevated levels of iron, manganese, sulfates, and dissolved solids, which contribute to taste, odor staining, and other aesthetic water quality problems. Where drinking water supplies are impacted, and the owners of those wells are aware of the impacts, costly treatment systems are needed to remove these water quality problems. Creation of a 3D hydrogeologic model that delineates the extents, thickness, and interaction of the area aquifer systems allows NRDs and water users to make science based decisions regarding the protection of the water resources, and can assist well drillers in locating and designing wells to minimize these problems. The highly variable, and in some cases limited, extent of aquifer units in several of the Project mapping areas provides less "buffer" due to dilution effects. If groundwater does become contaminated, it is more difficult to find an alternative source in this area than in other more groundwater rich areas.

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.

Natural Resources Districts (NRDs) are granted the authority to impose property tax levies to generate revenue for operational needs. The 2019 funding levies listed below for the PMRNRD will provide sufficient funds to provide the cash contribution necessary to complete this Project. Additionally, the PMRNRD has planned to budget matching funds for this Project in their annual fiscal year (FY) FY 19-20 and FY 20-21 budgets (finalized after July 1 each year).

Local Sponsors	Cents per $100 Assessed Valuation	2019 Property Tax Revenue	2019 Total Budget
Papio-Missouri R. NRD ($700,000 project)	3.76	$24,823,950	$72,185,027

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 PMRNRD is the local jurisdiction with plans in place that support sustainable water use. Interest in this project and AEM data is a response to numerous objectives and actions in these various management plans. First, the PMRNRD's Integrated Management Plan (IMP) (https://dnr.nebraska.gov/water-planning/papio-missouri-river-nrd) contains specific actions to continue to collect and analyze hydrogeologic data in support of NDNR's annual evaluation of hydrologically connected water resources. This geologic data serves as the backbone for making these evaluations and models as realistic and accurate as possible.

Similar data collection objectives are called out in the Lower Platte River Basin Water Management Plan, dated October 2017 (https://dnr.nebraska.gov/water-planning/lower-platte-basin-wide-plan). This plan provides an accounting of all new uses in the Lower Platte Basin and relies on utilizing the best available geologic data to determine hydrologically connected influences. The PMRNRD would also plan to use new AEM data to better understand and evaluate Wellhead Protection Areas for multiple municipalities. Two of these municipalities, MUD and Fremont, have current Wellhead Area Protection Plans that could be updated given the results of this project.

Additionally, data from the proposed AEM survey will provide detailed 3D geologic representations of the combined Platte/Elkhorn River alluvium as well as any glacial outwash or Dakota formation sandstone connections. These connected aquifer areas may serve as ideal locations for future conjunctive management and drought mitigation measures. For instance, a future streamflow augmentation project was suggested in this project area as an alternative mitigation action in the Draft Lower Platte River Drought Contingency Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf). The objective for this streamflow augmentation project would be to add an additional 100 cfs to the Platte River system when its flows at Ashland drop below 500 cfs.

Finally, the PMRNRD's own Groundwater Management Plan (https://www.papionrd.org/water-quality-supply/groundwater/groundwater-management-plan/) describes the use of AEM data in our District to enhance geologic mapping and eventually create a complete volumetric ground water inventory. There are still many un-mapped aquifer areas between the uplands and floodplains in the PMRNRD which may have valuable connection and influence the total groundwater availability in our NRD. Stakeholders who are in support of this plan include MUD, Fremont, Lincoln and Arlington. Support letters which describe their interest and potential benefits are enclosed as Attachment X.

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.

In this case, AEM survey data of the geology and groundwater is a necessity as a basis for modeling and designing a streamflow augmentation or other conjunctive management project; just like topographic survey is necessary for designing a road or dam. As described in the Drought Mitigation Plan (https://www.lpsnrd.org/sites/default/files/20181130_lprdcp_draft.pdf), a severe drought affecting the Lower Platte River could become a statewide issue if any of the municipalities which depend upon water in the river would ever be forced to make a "priority" call and shut down upstream surface water uses. This may impact irrigation on as many as 250,000 irrigated acres upstream. NDNR has also issued a priority call 23 times 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 a instream flow priority date of November 30, 1993). Streamflow augmentation may be utilized to help meet instream flow rights during times of shortage. 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. Lastly, information gained from these surveys can benefit Nebraska's drinking water program which has 1,375 public water systems, serving most of its 1.9 million residents (Nebraska Health and Human Services [DHHS] website accessed Dec 2015). 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 AEM data (Ongoing County Atlas work and Nebraska GeoCloud WSF award #4164) into their survey 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."

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 PMRNRD is the sole local partner for this project and a break-down of the costs are shown in the table below. Funding for this project will be included in the PMRNRD's FY 19-20 and FY 20-21 fiscal years as shown below.

Fiscal Year (July 1 – June 30)	Total Cost	PMRNRD Funding	WSF Funding
FY 19-20	$220,000	$88,000	$132,000
FY 20-21	$480,000	$192,000	$288,000

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.

This AEM survey data will be used to enhance integrated management decisions and actions aimed at maximizing flow in local rivers and streams. Increasing or maintaining flow from groundwater in the rivers and streams of a watershed is vital to its health and ecological function, especially during times of low flow and drought. During drought, aquatic habitat and numerous wildlife species are negatively impacted by low flow in rivers and streams. The Platte and Elkhron 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. In particular, this AEM survey project will improve our understanding of the hydrologic interactions occurring between the Platte and Elkhorn River and their adjoining streams. These watershed improvements would occur in the Lower Platte and Lower Elkhorn River watersheds.

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.

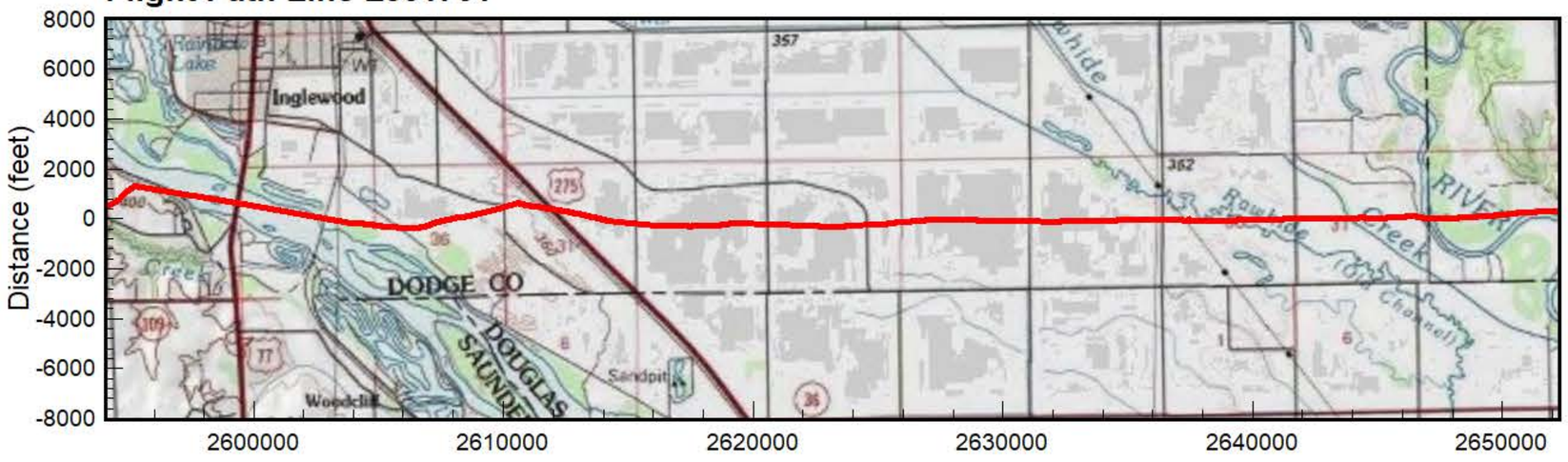
Referencing the September 2018 Annual Report (https://nebraskalegislature.gov/FloorDocs/105/PDF/Agencies/Natural_Resources__Department_of/4_20180913-095300.pdf), this proposed AEM survey project will aid the Lower Platte River Basin Coalition and NDNR in continuing to develop and calibrate the Lower Platte and Missouri Tributaries groundwater model as discussed on pg. 25. Using AEM data to improve regional and local groundwater models will serve as the foundation for continuing to evaluate conjunctive management projects in the Lower Platte River Basin.

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:

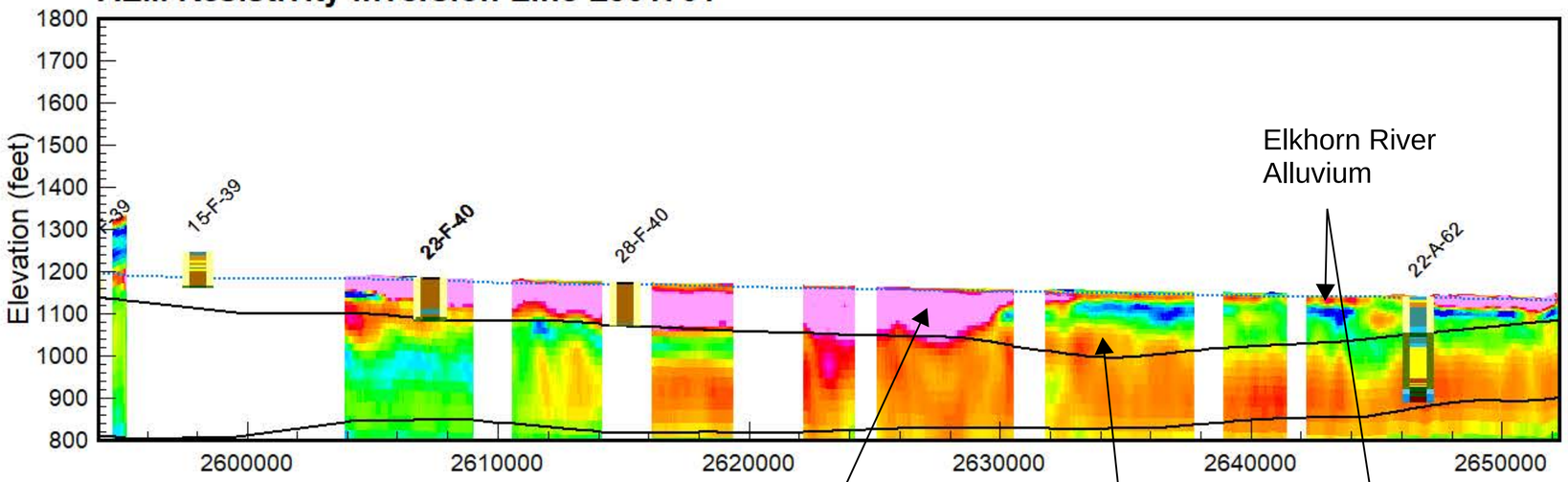
- Describe the federal mandate.
- Provide documentary evidence of the federal mandate.
- Describe how the project meets the requirements of the federal mandate.
- Describe the relationship between the federal mandate and how the project furthers the goals of water sustainability.

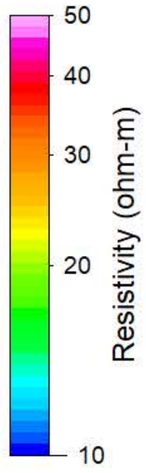
NA

Flight Path Line L501701

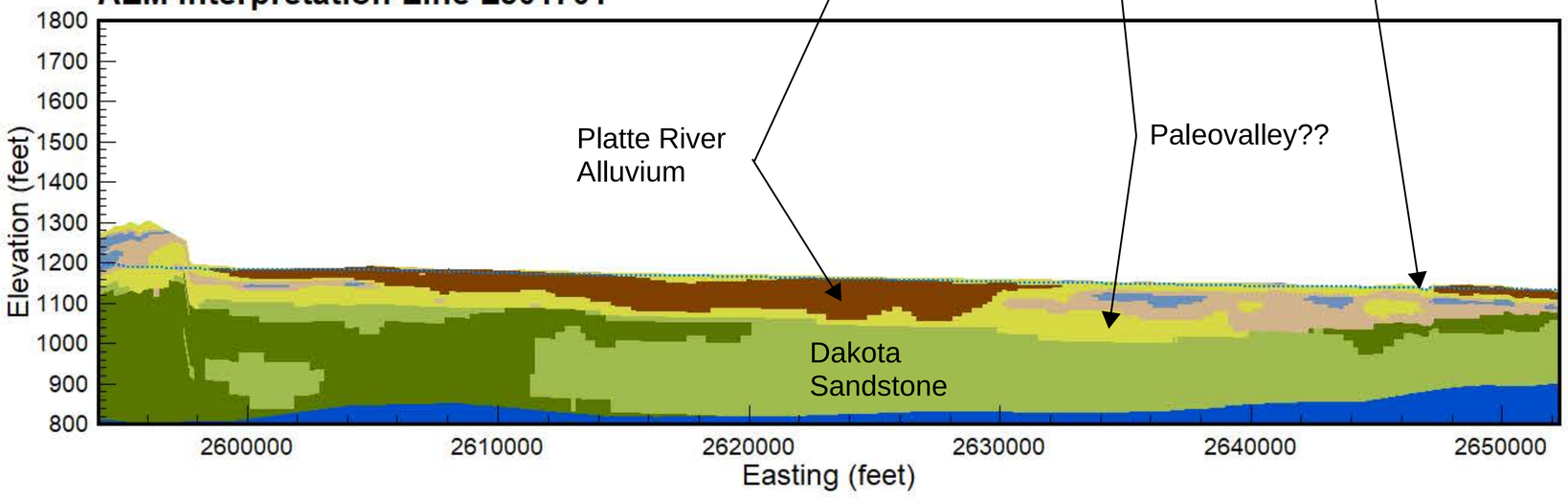


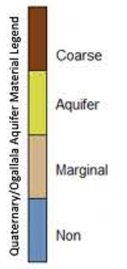
AEM Resistivity Inversion Line L501701





AEM Interpretation Line L501701





ENWRA Eastern Nebraska Water Resources Assessment

Papio-Missouri River Natural Resources District — Finding Solutions Today for a Secure Tomorrow.

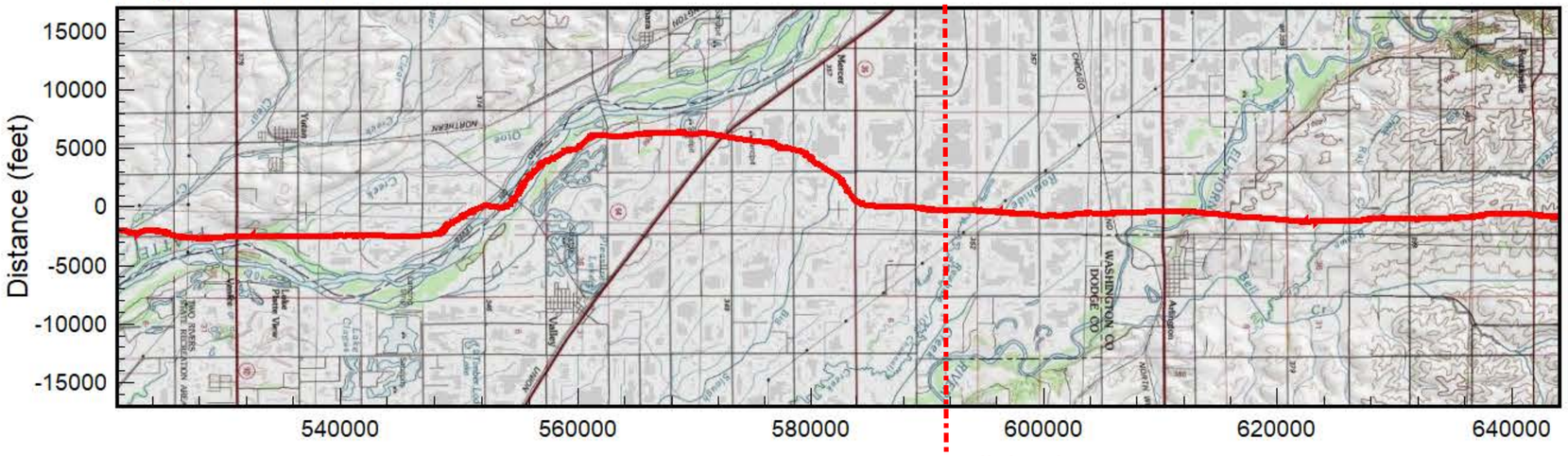
Results of the final inversion of Airborne Electromagnetic (AEM) data collected along flight lines within the Papio-Missouri River Natural Resources District (P-MRNRD) July 1-20, 2018. The red line on the Flight Path Map (US Geological Survey 100K Topo) indicates the location of the data collection.

The AEM inversions shown are Spatially-Constrained using the Aarhus Geo Software Workbench version 5.8.3 in the indicated electrical resistivity color scale. Boreholes displayed on the AEM inversion profile are within 1 mile of the flight line are from the Conservation Survey Division (CSD) public website downloaded on September 9, 2018. Lithology and stratigraphy are indicated by the legends. Gray-dashed lines when visible on the AEM inversions profile indicate the estimated depth of investigation (DOI). White gaps in the AEM inversion profile indicate gaps in data coverage due to electromagnetic coupling or areas that were not flown due to infrastructure. The solid-black line on the AEM Inversion profile indicates the interpreted stratigraphic contact of the Kc= Cretaceous Carlile FM, Kgg= Cretaceous Greenhorn and Graneros FM, Kd=Cretaceous Dakota Group and the IP= undifferentiated Pennsylvanian formations/groups. The 1995 CSD water table is represented by a dashed blue line. The AEM interpretation profiles shows Q=Quaternary materials classified into the four groups indicated by the legend. The undifferentiated Pennsylvanian is indicated as a blue fill below the Quaternary. The depth extent of the profile is optimized to illustrate the Quaternary materials.

Prepared for the P-MRNRD and the Eastern Nebraska Water Resources Association (ENWRA) by Aqua Geo Frameworks., LLC.

AGF Aqua Geo Frameworks

Flight Path Line L800201



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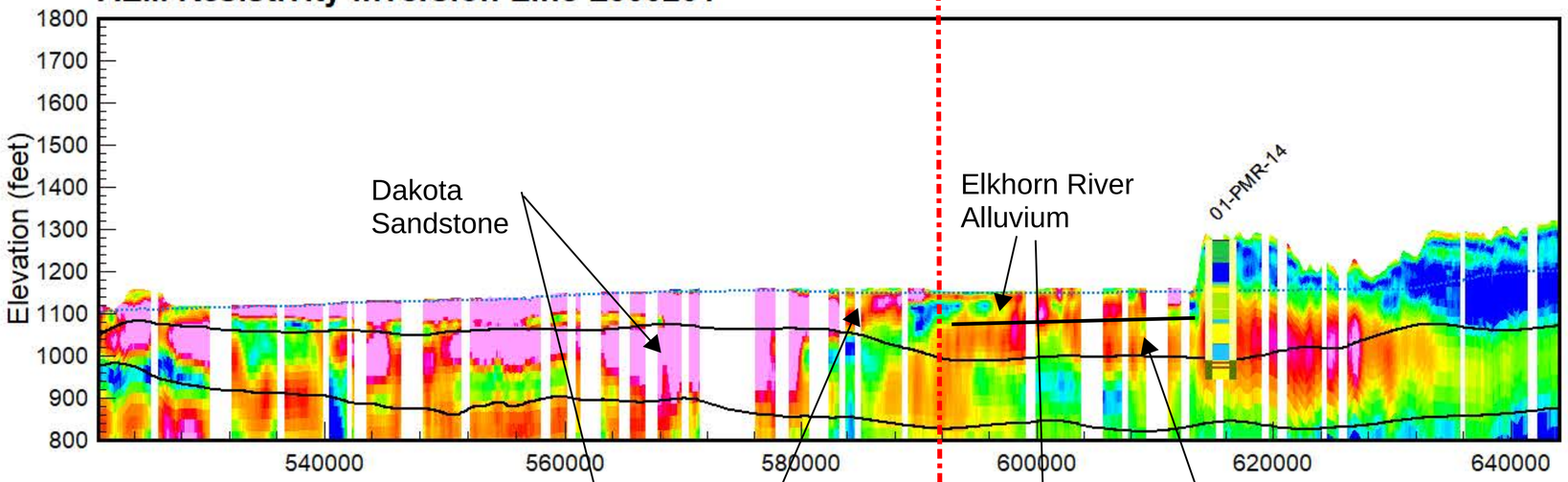
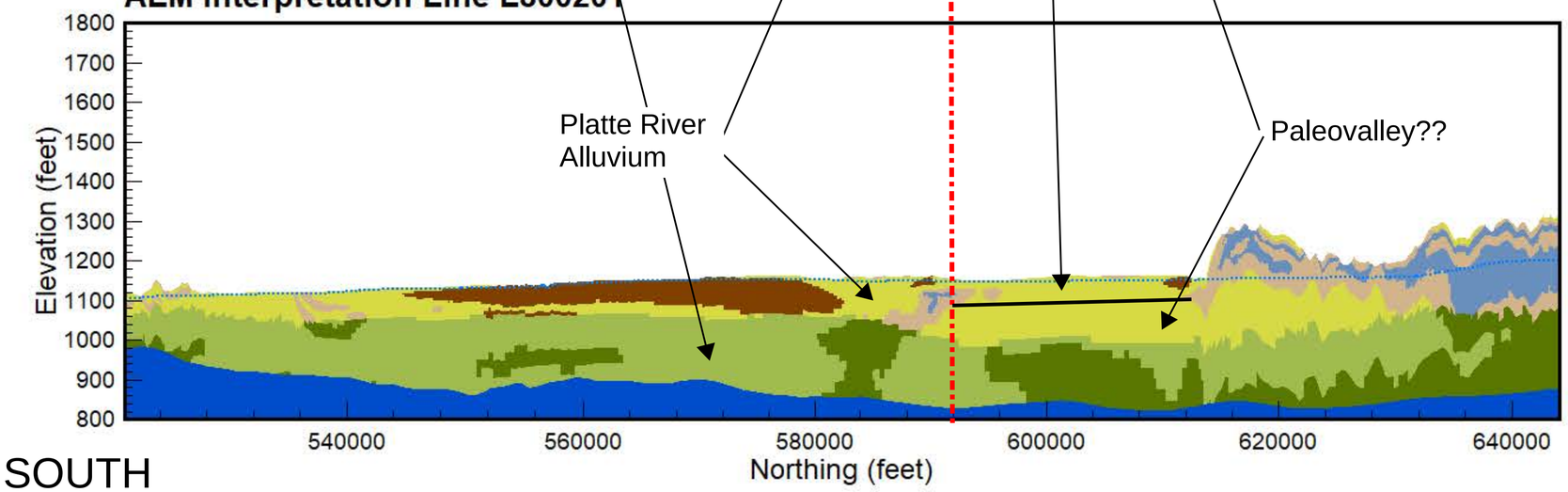
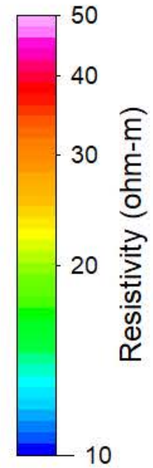


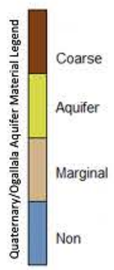
AEM Interpretation Line L800201

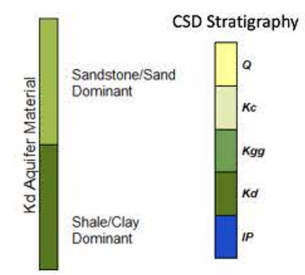


SOUTH

NORTH







Aqua Geo Frameworks

Results of the final inversion of Airborne Electromagnetic (AEM) data collected along flight lines within the Papio-Missouri River Natural Resources District (P-MRNRD) July 1-20, 2018. The red line on the Flight Path Map (US Geological Survey 100K Topo) indicates the location of the data collection.

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Prepared for the P-MRNRD and the Eastern Nebraska Water Resources Association (ENWRA) by Aqua Geo Frameworks., LLC.